ISSN 2411-5096

JSMDC

Journal of Sharif Medical & Dental College

SHARIF
Medical & Dental College

01/ Vol.7
June
2021

JSMDC

Journal of Sharif Medical & Dental College

Volume 7 | Number 01 | June 2021

Approved by the *Pakistan Medical and Dental Council*
PMDC Index Pak No: IP/0076

Indexed in
PakMediNet

Editorial Correspondence should be addressed to
Editor JSMDC
Sharif Medical & Dental College
Sharif Medical City Road,
Off Raiwind Road, Jati Umra,
Lahore 54000, Pakistan.

Tel
(+92-42) 111-123-786

Fax
(+92-42)37860122

E-mail
editors@jsmdc.pk

Website
www.jsmdc.pk

Published by
ALIGARH Publishers
Ghalib Market, Gulberg III,
Lahore 54660
Ph:042-35771801-5
www.aligarh.com.pk

Annual Subscription Fee:
PKR.1500/-

Editorial

Hospital Funding: Case-mix or Global Budgeting System

Muhammad Adnan Khan

The rapid shift towards universal health coverage depends on the efficient utilization and improved recruitment of resources.[1] During the past decades, equitable access to the most cost-effective healthcare services is one of the major challenges faced by policy-makers, providers, and patients. The current evidence suggests that the wrong utilization of payment methods may lead to the misuse of limited resources.[2] The aim of this study is to compare the funding of hospital using global budgets and case-mix funding in terms of their method, pros, and cons, and also to enumerate the implementation and monitoring challenges of the two systems.

PAYMENT METHODS

There are two basic approaches to payment systems which are retrospective and prospective.[3] In the retrospective payment system, the provider's own cost is partially or fully reimbursed ex-post while opposite to this the payment budgets or rates of providers are determined ex-ante in the prospective system.[4] The prospective method includes the case-mix system, capitation payment, and global budget while the fee-for-service and payment per itemized bill are included in retrospective systems.[3]

CASE-MIX SYSTEM

The purpose of introducing diagnosis-related groups (DRGs) is to measure what hospitals actually do to define hospital products.[5] Case-mix system is used to classify people into classes that are homogeneous in the respect of resources used with meaningful clinical descriptions of these individuals as it is a reflection of the total risk of all individual patients within a hospital.[3,6] It has been implemented worldwide in more than 40 countries including Asia.[7] The two basic components of this system are disease classification which includes coding for diagnosis and procedures and cost analysis which comprises top-down costing, clinical pathways, and activity-based costing.[8]

Sharif Medical & Dental College, Sharif Medical City. Sharif Medical City Road, Off Raiwind Road, Jati Umra, Lahore 54000, Pakistan.

Correspondence: Dr. Muhammad Adnan Khan
Chief Executive Sharif Medical City
Executive Director SMRC
E-mail:adnan.khan@outlook.com

Received: May 12, 2021; Accepted: May 19, 2021

IMPLEMENTATION AND MONITORING

The two main issues in implementation and adaptation are costing methods and patient classification.[9] In this system, the accuracy of the coding is crucial, a wrong code will relate to an incorrect assignment of the DRGs code which may have an adverse impact on hospital income in countries, thus the accuracy coding is ensured through coding audits.[8,10] It involves difficult technical choices to maintain and design this system as there is a need to monitor the wrong effects of the endowment system and take account of changes in health technology.[10] The substantive responsibility of direct expenses in most low and middle-income countries and the lack of correct data on the share of financing of each mechanism render the task of assessing the overall progressivity of Asian health care systems more difficult than in Europe.[11]

ADVANTAGES

This system provides incentives for hospitals by which it improves efficiency as it treats more people and limits the service per patient.[5] It proves economically beneficial for both the patient and a hospital's budget setup, as it reduces the average stay duration of patients in hospitals and eliminates as much the need for the hospital to provide many items of service.[12]

DISADVANTAGES

There are also several drawbacks which are the intensive need for technical skills in designing case-mix system, disease coding quality is also affected and the information about the costing data is also limited.[13] Upcoding, cherry-picking, dumping, frequent readmissions, and overtreatment are the other potential unintended consequences of DRG-based hospital payment. Cherry-picking occurs if certain patients are systematically more costly than others within one group leading incentives for hospitals to select more profitable cases which are less costly and to avoid or transfer unprofitable ones (dumping).[5]

GLOBAL BUDGETING SYSTEM

In a global budgeting system, a hospital-acquired lump sums to cover all particular services throughout a specified period as it allows managers real flexibility when they are strictly enforced.[14] It is used by some types of outpatient care facilities as well as by government or insurers to pay hospitals.[15]

IMPLEMENTATION AND MONITORING

An operational framework requires for implementing the global budgeting system which includes how payers will participate and how an effective structure for administration and governance will be established.[16] In addition, it also needs information about the patient population, the type of services included in the system along with monitoring of its performance.[17] It can result in high overall spending by transfer of services from hospitals to non-hospitals providers in their area as payer would be paying both for care that has shifted and fixed budget of target hospital.[17] So the two important considerations are important for obtaining micro-efficiency include responsibility and decentralization of management capacity.[18] Effective monitoring of payment patterns and trends depends on per capita spending, service volume, and high-quality data on service prices. The health insurance purchasing cooperatives (HIPCs) and health plans need data on costs, volume, and service pricing at the local level as it is crucial for internal use. There is also the need for information on the quality of care, practice patterns, and patient outcomes to assist HIPCs in identifying the most cost-effective practices where such standards do not yet exist and in monitoring health plans compliance with accepted practice standards.[19]

ADVANTAGES

The major benefit of the global budgeting system is that it gives cheaper and easier administration, assurance of funding, and better management of services.[18] It can promote the addition of incentives and the improvement of changes to service delivery patterns to reward efficiency, suitable clinical practice, and quality. It can manage and control the cumulative overall spending on a particular service by the healthcare institution and program.[18] By limiting the total expenditure global budgets contain costs but run the risk of hospitals not producing enough services to meet patient needs.[5]

DISADVANTAGES

Global budgeting system may have unintended consequences if the effects are too strong. For example, it is intended to reduce the cost of treatment and length of stay but the quality of care may reduce due to excessive reduction in length of stay.[5] It results in the waiting when the target volume is exceeded and creates a situation in which either the hospital will reject to do additional work or as to give extra cash and the lack of incentives to get better efficiency is one of the major restrictions which can be faced by using this model.[20]

REFERENCES

1. Mathauer I, Wittenbecher F. Hospital payment systems based on diagnosis-related groups: experiences in low- and middle-income countries. Bull World Health Organ. 2013; 91(10):746-56A. doi:10.2471/BLT.12.115931.

2. Babashahy S, Baghbanian A, Manavi S, Sari AA, Olyaee Manesh A, Ronasiyan R. Towards reforming health provider payment methods: Evidence from Iran. Heal Scope. 2016; 6(1): e33575. doi:10.5812/jhealthscope.33575.

3. Syed-Abdul S, Hsu MH, Iqbal U, Scholl J, Huang CW, Nguyen PA, et al. Utilizing health information technology to support universal healthcare delivery: experience of a national healthcare system. Telemed J E Health. 2015; 21(9):742-7. doi:10.1089/tmj.2014.0189.

4. Jegers M, Kesteloot K, De Graeve D, Gilles W. A typology for provider payment systems in health care. Health Policy. 2002; 60(3):255-73. doi:10.1016/s0168-8510(01)00216-0.

5. Busse R, Geissler A, Aaviksoo A, Cots F, Hakkinen U, Kobel C, et al. Diagnosis related groups in Europe: moving towards transparency, efficiency, and quality in hospitals? BMJ. 2013; 346:f3197. doi:10.1136/bmj.f3197. .

6. Ammar W, Khalife J, El-Jardali F, Romanos J, Harb H, Hamadeh G, et al. Hospital accreditation, reimbursement and case mix: links and insights for contractual systems. BMC Health Serv Res. 2013; 13:505. doi:10.1186/1472-6963-13-505.

7. Amrizal MN, Rohaizat Y, Zafar A, Saperi S, Aljunid SM. Case-mix costing in Universiti Kebangsaan Malaysia Hospital a top-down approach: cost analysis for cardiology cases. MJPHM. 2005; 5(Suppl 2):33-44. Available from: https://www.researchgate.net/publication/269097779_Case Mix_Costing_in_Universiti_ Kebangsaan_Malaysia_ Hospital_A_Topdown_Approach_Cost_Analysis_for_Cardiology_Cases.

8. Zafirah SA, Nur AM, Puteh SEW, Aljunid SM. Potential loss of revenue due to errors in clinical coding during the implementation of the Malaysia diagnosis related group (MY-DRG®) Casemix system in a teaching hospital in Malaysia. BMC Health Serv Res. 2018; 18(1):38. doi:10.1186/s 12913-018-2843-1.

9. Or Z. Implementation of DRG payment in France: issues and recent developments. Health Policy. 2014; 117(2):146-50. doi:10.1016/j.healthpol. 2014.05.006.

10. Elissen AMJ, Verhoeven GS, de Korte MH, van den Bulck AOE, Metzelthin SF, van der Weij LC, et al. Development of a casemix classification to predict costs of home care in the Netherlands: a study protocol. BMJ Open. 2020; 10(2):e035683. doi:10.1136/bmjopen-2019-035683.

11. Roger France FH. Case mix use in 25 countries: a migration success but international comparisons failure. Int J Med Inform. 2003; 70(2-3):215-9. doi:10.1016/s1386-5056(03)00044-3.

12. Hopfe M, Stucki G, Marshall R, Twomey CD, Ustun TB, Prodinger B. Capturing patients' needs in casemix: a systematic literature review on the value of adding functioning information in reimbursement systems. BMC Health Serv Res. 2016;16:40. doi:10.1186/s12913-016-1277 x.

13. Steinbusch PJ, Oostenbrink JB, Zuurbier JJ, Schaepkens FJ. The risk of upcoding in casemix systems: a comparative study.

Health Policy. 2007; 81(2-3):289-99. doi:10.1016/j.healthpol. 2006.06.002.

14. Beil H, Haber SG, Giuriceo K, Amico P, Morrison M, Beadles C, et al. Maryland's global hospital budgets: impacts on medicare cost and utilization for the first 3 years. Med Care. 2019; 57(6):417-24. doi: 10.1097/MLR. 0000000000001118.

15. Yuan B, He L, Meng Q, Jia L. Payment methods for outpatient care facilities. Cochrane Database Syst Rev. 2017; 3(3):CD011153. doi:10.1002/14651 858.CD011153.pub2.

16. Rajkumar R, Patel A, Murphy K, Colmers JM, Blum JD, Conway PH, et al. Maryland's all-payer approach to delivery-system reform. N Engl J Med. 2014; 370(6):493-5. doi:10.1056/ NEJMp 1314868.

17. Murray R. Toward hospital global budgeting: State considerations. Issue Briefs. 2018.1-18. Available from: https://www.shvs.org/resource/toward-hospital-global-budgeting-state-considerations.

18. Lorch SA. National quality measures in Perinatal Medicine. Clin Perinatol. 2017; 44(3):485-509. doi:10.1016/j.clp. 2017.05.001.

19. Roberts ET, McWilliams JM, Hatfield LA, Gerovich S, Chernew ME, Gilstrap LG, et al. Changes in health care use associated with the introduction of hospital global budgets in Maryland. JAMA Intern Med. 2018; 178(2):260-8. doi:10.1001/ jamainternmed. 2017. 7455.

20. Gaspar K, Portrait F, van der Hijden E, Koolman X. Global budget versus cost ceiling: a natural experiment in hospital payment reform in the Netherlands. Eur J Health Econ. 2020; 21(1):105-14. doi:10.1007/s10198-019-01114-6.

Original Article

Platelet-Rich Plasma in the Treatment of Plantar Fasciitis versus Corticosteroids

Farooq Azam Khan

ABSTRACT

Objective: To determine the effect of platelet-rich plasma (PRP) injections versus corticosteroid injections in plantar fasciitis.

Methodology: It was a non-randomized controlled trial done in the Orthopaedic Department of the Sharif Medical City Hospital, Lahore after approval by the institutional ethical committee from February to April 2021. Seventy patients of plantar fasciitis for greater than 6 months who failed to respond to the conservative treatment were included in the study by non-probability convenient sampling technique. The patients were divided into two groups: 35 patients in the standard (Corticosteroid) treatment group and 35 patients in the intervention (Platelet-rich plasma) group. After taking informed written consent, the standard treatment group received the intra-articular corticosteroid injection whereas the intervention group received the intra-articular PRP injection. The patients were assessed for plantar fascia thickness, visual analog scale (VAS), and the American Orthopaedic Foot and Ankle Society (AOFAS) score before treatment, and at 6 weeks, 3 months, and 6 months after treatment.

Results: The plantar fascia thickness decreased from 4.77 to 3.68 mm in the PRP group and from 4.66 to 3.96 mm in the corticosteroid group. The pre-treatment VAS score improved from 8.02±0.857 to 1.37±0.49 at 6 months in the PRP group and from 7.8±0.719 to 2.8±0.759 at 6 months in the corticosteroid group. The pre-treatment AOFAS score was 57.45±4.972 in the PRP group and it increased to 89.82±4.01 at 6 months. In the corticosteroid group, the AOFAS score improved from 57.85±6.329 at baseline to 77.02±4.307 at 6 months. When the pre-treatment VAS score, AOFAS score & plantar fascia thickness were compared with the scores at 6 weeks, 3 months, and 6 months in each group, there was a significant difference in the score and thickness (p-value=0.001).

Conclusion: Both the corticosteroid and PRP treatment modalities lead to improved VAS score, AOFAS score, and plantar fascia thickness but the improvement was statistically significant in the PRP group as compared to the corticosteroid group.

Keywords: *Plantar fasciitis. Platelet-rich plasma. Corticosteroid.*

INTRODUCTION

Plantar fasciitis (PF) is the most common foot problem constituting 11-15% of the foot symptoms in adults.[1] It is characterized by chronic inflammation and the degenerative process of the plantar aponeuroses. About 2 million people are affected by plantar fasciitis in the United States annually and 10% of the individuals develop the disease during their life.[2] It is a self-limiting condition but rehabilitation takes a long time. Chronic pain leads to a significant healthcare burden for patients and affects their quality of life.[3]

The plantar fascia is a thick tendinous sheet on the bottom of the foot and is composed of collagen and elastic fibers. It arises from the medial side of the calcaneus bone. It has a central thick portion and peripheral thin portions.[1] It maintains and stabilizes the medial arch of the foot and absorbs shock.[4] It manifests as heel pain typically occurring in the morning and tenderness on the medial side of the heel.[1] There is a gradual decrease in pain with physical activity. The pain worsens with the dorsiflexion of the toes because it pulls the plantar fascia.[4]

It frequently affects 40 to 60 years old individuals.[5] The predisposing factors of plantar fasciitis are prolonged standing, obesity, female gender, increasing age, high arched foot, leg length discrepancy, uncomfortable shoes, excessive foot pronation, and foot deformities such as pes planus/pes cavus, and a shortened Achilles tendon.[6] The underlying cause of plantar fasciitis is the repeated trauma that causes tears in the plantar fascia, periostitis, and chronic inflammation. In chronic disease, degeneration of the fascia occurs.[7]

The treatment modalities of plantar fasciitis are nonsteroidal anti-inflammatory drugs (NSAIDs), physiotherapy, ice packs, night splints, and corticosteroid injections. Eighty percent of the cases are cured with conservative treatment whereas, in 10% of the patients, the disease fails to respond to conservative treatment and progresses to the chronic stage.[8] Steroid injections are used as the treatment option in patients not responding to conservative management. Multiple steroid injections are required for effective and long-term pain relief but they can cause rupture of fascia and atrophy of the fat pad.[9] Fascial rupture interferes with the foot windlass mechanism and promotes inflammation in the neighboring tissue. Atrophy of the plantar fat pad reduces the subcalcaneal cushioning, making it more susceptible to trauma and pain.[10]

Sharif Medical & Dental College, Sharif Medical City. Sharif Medical City Road, Off Raiwind Road, Jati Umra, Lahore 54000, Pakistan.

Correspondence: Dr. Farooq Azam Khan
Associate Professor Department of Orthopedics
Sharif Medical & Dental College, Lahore
E-mail: dr.farooq224@hotmail.com

Received: May 20, 2021; Accepted: June 24, 2021

The treatment modality that activates the healing process rather than inhibiting inflammation is now considered the most efficacious option. Platelet-rich plasma (PRP) is recognized for inducing tissue healing and cell growth. It contains a high concentration of platelets and growth factors which will increase the regeneration capacity of the local tendons and muscles in plantar fasciitis.[4] Ultrasound is a famous, inexpensive, and radiation-free radiological technique for the diagnosis of many musculoskeletal conditions. In addition, it also helps in assessing the prognosis after the PRP injection. Platelet-rich plasma is a safe and effective alternative as compared to steroids.[11]

Plantar fasciitis is a very common degenerative disease which affects the hindfoot. Its successful treatment is a great challenge for clinicians. Despite the availability of several treatment modalities, the chronic pain associated with the disease is a major cause of morbidity and affects the quality of life of the patients. Platelet-rich plasma (PRP) has been introduced as a popular, safe, effective, and revolutionary intervention for the treatment of various musculoskeletal diseases including plantar fasciitis. This study was planned to determine the effectiveness of PRP injections in patients with plantar fasciitis who fail to respond to the conservative treatment and compare it with steroid injections. It will help us to use PRP injections in the future for the treatment of plantar fasciitis.

METHODOLOGY

It was a non-randomized controlled trial done in the Orthopaedic Department of the Sharif Medical City Hospital, Lahore. After approval by the institutional ethical committee (Letter No. SMDC/SMRC/153-20, 20-01-2021), the study was conducted from February to April 2021. Seventy patients with plantar fasciitis for greater than 6 months who failed to respond to the conservative treatment were included in the study by non-probability convenient sampling technique. The patients with a history of surgery, recent steroid injection within 6 months and plantar fascia rupture on ultrasound, severe anemia, thrombocytopenia, bleeding disorder, impalpable pedal pulse, and neuropathy were excluded from the study. The patients were divided into two groups: 35 patients in the standard treatment group and 35 patients in the intervention group. After taking informed written consent, the standard treatment group received the intra-articular corticosteroid injection whereas the intervention group received the intra-articular PRP injection. Using the aseptic technique, the standard treatment group was given a corticosteroid injection containing 80 mg methylprednisolone with 1 ml of lignocaine into the medial calcaneal tubercle. Under aseptic conditions, 20 ml venous blood of the patient was taken and mixed with 3 ml of citrate phosphate dextrose solution. Equal amounts of the sample were put into 4 vacutainers and then centrifuged for 7 minutes at 3500 revolutions per minute (rpm). The supernatant layer containing the buffy coat was discarded. The sample obtained was put into 2 vacutainers and then centrifuged for 5 minutes at 3000 rpm. The buffy coat was separated making PRP. The PRP was injected into the medial calcaneal tubercle of the intervention group. The follow-up duration was 6 weeks, 3 months, and 6 months. The patients were prescribed NSAIDs, ice packs, and physiotherapy. Patients were assessed before treatment and at each follow-up for plantar fascia thickness determined by ultrasonography, visual analog scale (VAS), and the American Orthopaedic Foot and Ankle Society (AOFAS) score. The visual analog scale quantifies the intensity of pain. It has a score from 0 to 10 (Figure 1).

The American Orthopaedic Foot and Ankle Society

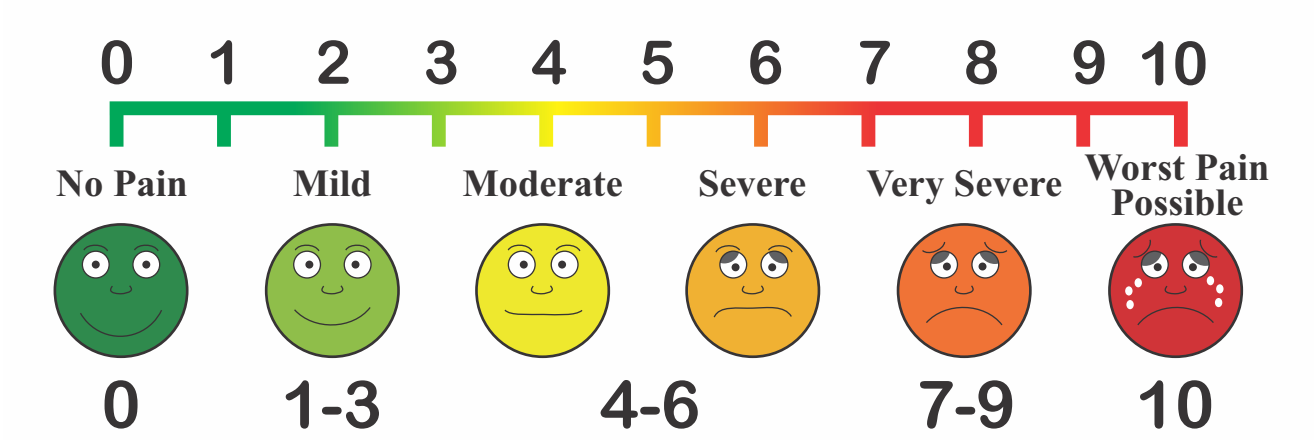

Figure 1: Visual Analog Scale

(AOFAS) score determines the outcome in patients with hindfoot diseases or injuries. It has 3 subscales of pain, function, and alignment. The pain has the highest score of 40. Function and alignment have the highest score of 40 and 10, respectively. The maximum score is 100 showing no symptoms or malfunctioning.[12]

STATISTICAL ANALYSIS

The data was analyzed using the Statistical Package for the Social Sciences (SPSS) version 25. The quantitative variables such as age, plantar fascia thickness, VAS score, and AOFAS score were expressed using mean and standard deviation. The qualitative variables such as gender were represented by frequency and percentage. Paired t-test was applied to compare the plantar fascia thickness, VAS, and AOFAS score at baseline, 6 weeks, 3 months, and 6 months. The plantar fascia thickness, VAS, and AOFAS scores in the two groups were compared by independent t-test. The significant p-value was taken as ≤ 0.05.

RESULTS

Patients had a mean age of 44.97±4.712 years in the PRP group and 45.08±4.761 years in the corticosteroid group. In the PRP group, 19(54.3%) patients were females and 16(45.7%) patients were males. Twenty two (62.9%) patients were females and 13(37.1%) patients were males in the corticosteroid group. The difference in the age, BMI, and duration of disease between the two groups was insignificant. The demographic features of the two treatment groups are shown in Table 1.

When the pre-treatment VAS score was compared with the score at 6 weeks, 3 months, and 6 months in each group, there was a significant difference in the score with the p-value of 0.001. Similarly, there was a significant difference between the pre-treatment AOFAS score & plantar fascia thickness and the score & plantar fascia thickness at 6 weeks, 3 months, and 6 months in each group (p-value=0.001) (Table 2).

The difference in the pre-treatment VAS score was statistically insignificant between the PRP and the

Table 1: Comparison of Demographic Features and Outcomes between the Intervention and Standard Treatment Group Using Independent t-test

Parameters	PRP Group	Corticosteroid Treatment Group	p-value
Age (Years)	44.97±4.712	45.08±4.761	0.920
BMI (kg/m^2)	32±4.036	31.57± 3.301	0.628
Duration of Disease (Months)	23.25±9.159	20.314 ±7.218	0.140
Pre-treatment VAS Score	8.02±0.857	7.8±0.719	0.231
VAS Score at 6 weeks	5.82±0.663	6.05±0.639	0.147
VAS Score at 3 months	4.02±0.513	4.77±0.546	0.001*
VAS Score at 6 months	1.37±0.49	2.8±0.759	0.001*
Pre-treatment AOFAS Score	57.45±4.972	57.85±6.329	0.770
VAS Score at 6 weeks	68.57±4.852	64.22±5.461	0.001*
VAS Score at 3 months	78.25±4.06	70.31±5.251	0.001*
VAS Score at 6 months	89.82±4.01	77.02±4.307	0.001*
Pre-treatment Plantar Fascia Thickness (mm)	4.77±0.189	4.66±0.181	0.015
Plantar Fascia Thickness (mm) at 6 weeks	4.35±0.231	4.40±0.166	0.377
Plantar Fascia Thickness (mm) at 3 months	3.98±0.262	4.14±0.124	0.002*
Plantar Fascia Thickness (mm) at 6 months	3.68±0.341	3.96±0.100	0.001*

**Significant p-value*

Table 2: Comparison of Pre-treatment and After Treatment Outcomes in Each Group Using Paired t-test

Outcome	Mean±SD	Difference	p-value
PRP Group			
Pre-treatment VAS Score	8.02±0.857	2.20±0.472	0.0019*
VAS Score at 6 weeks	5.82±0.663		
Pre-treatment VAS Score	8.02±0.857	4±0.641	0.001*
VAS Score at 3 months	4.02±0.513		
Pre-treatment VAS Score	8.02±0.857	6.65±0.905	0.001*
VAS Score at 6 months	1.37±0.49		
Pre-treatment AOFAS Score	57.45±4.972	-11.11±2.586	0.001*
AOFAS Score at 6 weeks	68.57±4.852		
Pre-treatment AOFAS Score	57.45±4.972	-20.8±2.826	0.001*
AOFAS Score at 3 months	78.25±4.06		
Pre-treatment AOFAS Score	57.45±4.972	-32.37±4.066	0.001*
AOFAS Score at 6 months	89.82±4.01		
Pre-treatment Plantar Fascia Thickness (mm)	4.77±0.189	0.417±0.188	0.001*
Plantar Fascia Thickness (mm) at 6 weeks	4.35±0.231		
Pre-treatment Plantar Fascia Thickness (mm)	4.77±0.189	0.788±0.258	0.001*
Plantar Fascia Thickness (mm) at 3 months	3.98±0.262		
Pre-treatment Plantar Fascia Thickness (mm)	4.77±0.189	1.08±0.335	0.001*
Plantar Fascia Thickness (mm) at 6 months	3.68±0.341		
Corticosteroid Treatment Group			
Pre-treatment VAS Score	7.8±0.719	1.74±0.443	0.001*
VAS Score at 6 weeks	6.05±0.639		
Pre-treatment VAS Score	7.8±0.719	3.02±0.617	0.001*
VAS Score at 3 months	4.77±0.546		
Pre-treatment VAS Score	7.8±0.719	5±0.970	0.001*
VAS Score at 6 months	2.8±0.759		
Pre-treatment AOFAS Score	57.85±6.329	-6.37±1.516	0.001*
AOFAS Score at 6 weeks	64.22±5.461		
Pre-treatment AOFAS Score	57.85±6.329	-12.45±2.512	0.001*
AOFAS Score at 3 months	70.31±5.251		
Pre-treatment AOFAS Score	57.85±6.329	-19.17±3.442	0.001*
AOFAS Score at 6 months	77.02±4.307		
Pre-treatment Plantar Fascia Thickness (mm)	4.66±0.181	0.262±0.103	0.001*
Plantar Fascia Thickness (mm) at 6 weeks	4.40±0.166		
Pre-treatment Plantar Fascia Thickness (mm)	4.66±0.181	0.514±0.153	0.001*
Plantar Fascia Thickness (mm) at 3 months	4.14±0.124		
Pre-treatment Plantar Fascia Thickness (mm)	4.66±0.181	0.702±0.159	0.001*
Plantar Fascia Thickness (mm) at 6 months	3.96±0.100		

**Significant p-value*

corticosteroid group (p-value=0.231). The VAS score was also statistically insignificant between the two groups at 6 weeks (p-value=0.147). There was a significant reduction in the VAS score in the PRP group than the corticosteroid group at 3 months and 6 months (p-value=0.001). The pre-treatment AOFAS score was statistically insignificant between the two groups with a p-value of 0.77. But the score improved greatly with the PRP injection than the corticosteroid injection. The results were statistically significant at 6 weeks, 3 months, and 6 months. The pre-treatment plantar fascia thickness was statistically different between the two treatment groups (p-value=0.015). The mean difference in the plantar fascia thickness was insignificant between the two groups at 6 weeks (p-value=0.377) but was significant at 3 months and 6 months with the p-value of 0.002 and 0.001, respectively (Table 1).

DISCUSSION

Plantar fasciitis is a frequent cause of heel pain encountered in Orthopedics.[13] There is a lack of awareness about the various treatment options of plantar fasciitis among the patients.[14] Corticosteroids are a very popular treatment modality for plantar fasciitis. But PRP injections have also shown promising results in plantar fasciitis patients. Platelet-rich plasma contains growth factors that promote the healing and regeneration of plantar fascia.[15]

In our study, the mean age of the patients was 44.97±4.712 years in the PRP group and 45.08±4.761 years in the corticosteroid group. Similarly in a study by Baz et al., patients had a mean age of 46.5 years.[1] The mean age was 40 years in the PRP group and 42 years in the control group.[5] In contrast, another study reported the mean age as 30.72±7.42 years and 33.92±8.61 years in the PRP and corticosteroid groups, respectively.[8] In our study, most of the study subjects were females; 19(54.3%) in the PRP group and 22(62.9%) in the corticosteroid group. In another study, the male:female ratio was 8:17 in the PRP group and 12:13 in the corticosteroid group, showing female predominance similar to our study.[8] In contrast, a study showed that 54.5% of the patients were males and 45.45% of patients were females.[1]

The average duration of the disease was 23 months in the PRP group and 20 months in the control group in our study. Deghady et al. reported the disease duration of 9 months and 12 months in the PRP and control group, respectively.[5] The follow-up duration was 6 months in our study. Similarly, the follow-up period was 6 months in another study.[12] Whereas the follow-up durations of 4 months and 3 months have been documented in other studies.[1,8]

Our results showed that the plantar fascia thickness decreased from 4.77 to 3.68 mm in the PRP group and 4.66 to 3.96 mm in the corticosteroid group. Another study reported that the thickness of the plantar fascia reduced from 4.9 to 4 mm in the PRP group and 4.8 to 4.3 mm in the control group.[5] A study conducted in Egypt found decreased plantar fascia thickness from 6.04 to 4.93 mm after PRP injection.[1]

In our study, the pre-treatment VAS score was 8.02±0.857 and it improved to 5.82±0.663 at 6 weeks, 4.02±0.513 at 3 months, and 1.37±0.49 at 6 months in the PRP group. In the corticosteroid group, the pre-treatment VAS score improved from 7.8±0.719 to 6.05±0.639 at 6 weeks, 4.77±0.546 at 3 months, and 2.8±0.759 at 6 months. In a study by Mahindra et al., the VAS score improved from 7.44±1.04 at baseline to 3.76±1.53 at 3 weeks and 2.52±1.71 in the PRP group, and from 7.72±1.17 at baseline to 2.84±1.46 at 3 weeks and 3.64±1.62 at 3 months in the corticosteroid group.[8] There was an improvement in the VAS score from 9 to 4 in the PRP group and 9 to 7 in the control group in a study by Deghady et al.[5] Shetty et al. reported that the VAS score improved from 7.16 to 3.92 at 6 weeks and 2.92 at 6 months in the corticosteroid group. In contrast, in the PRP group, the VAS score improved from 7.74 to 4.48 at 6 weeks and 1.6 at 6 months.[12] In another study, the visual analog scale (VAS) score improved from 8.14 to 2.59 at follow-up after PRP injection.[1]

In our study, the pre-treatment AOFAS score was 57.45±4.972 in the PRP group and it increased to 68.57±4.852 at 6 weeks, 78.25±4.06 at 3 months, and 89.82±4.01 at 6 months. In the corticosteroid group, the AOFAS score improved from 57.85±6.329 at baseline to 64.22±5.461 at 6 weeks, 70.31±5.251 at 3 months, and 77.02±4.307 at 6 months. Another study reported that the AOFAS score increased from 51.56±11.10 at baseline to 83.92±12.12 at 3 weeks and 88.24±8.76 at 3 months in the PRP group and from 55.72±11.79 at baseline to 86.6±6.77 at 3 weeks and 81.32±6.39 at 3 months.[10] A study conducted by Shetty et al., showed that the AOFAS score increased from 67.08 to 86.88 at 6 weeks and 88.32 at 6 months in the corticosteroid group. In the PRP group, the AOFAS score increased from 67.08 to 89.32 at 6 weeks and 93.04 in the 6 months.[12]

Our results show that there was a statistically significant improvement in the outcomes in the PRP group than in the corticosteroid group. A study reported that the improvement in the VAS and AOFAS score was statistically significant in the PRP group as compared to the corticosteroid group.[12] In a study by Mahindra et al., the difference in the VAS and AOFAS score was insignificant at 3 weeks. But there was a statistically significant improvement in the AOFAS score at 3 months in the PRP group but not in the VAS score.[8]

A study conducted in India showed that PRP injection is a more effective treatment modality for patients with chronic plantar fasciitis as compared to corticosteroid injection.[16]

A systematic review concluded that PRP injection had no better curative response as compared to corticosteroid injection in a well-designed double-blind clinical trial.[17]

In another study, the effectiveness of PRP and corticosteroid injections were compared in patients with chronic plantar fasciitis. They reported that the PRP injection is a safe, long-lasting, and efficient treatment option as compared to the corticosteroid injections.[18]

CONCLUSION

Both the corticosteroid and PRP treatment modalities lead to improved VAS score, AOFAS score, and plantar fascia thickness but the improvement was statistically significant in the PRP group as compared to the corticosteroid group.

RECOMMENDATIONS

- Platelet-rich plasma injections should be used routinely in treating patients with plantar fasciitis non responsive to conservative management.

LIMITATIONS

- Future research should be conducted on a larger number of patients with plantar fasciitis from multiple institutions.
- A double-blinded, randomized controlled trial should be conducted to further validate the results of this study.

REFERENCES

1. Baz AA, Gad AM, Waly MR. Ultrasound-guided injection of platelet-rich plasma in cases of chronicplantar fasciitis. Egypt J Radiol Nucl Med. 2017; 48(1):125-32. doi:10.1016/j.ejrnm.2016.12.004.

2. Shafaat HK, Aziz T, Butt AW, Iqbal S, Aziz U, Aziz T. Comparison of platelet-rich plasma with local steroid injection in the management of chronic plantar fasciitis. Pak Armed Forces Med J. 2020; 70(2):442-6. Available from: https://www.pa fmj.org/index.phpPAFMJ/article/view/4208.

3. Ling Y, Wang S. Effects of platelet-rich plasma in the treatment of plantar fasciitis: a meta-analysis of randomized controlled trials. Medicine (Baltimore). 2018; 97(37):e12110. doi:10.1097/ MD.0000000000012110.

4. Chiew SK, Ramasamy TS, Amini F. Effectiveness and relevant factors of platelet-rich plasma treatment in managing plantar fasciitis: a systematic review. J Res Med Sci. 2016; 21:38. doi:10.4103/1735-1995.183988.

5. Deghady AAM, Hamid MMA, Helal AMH, El-Sherif SM, Latief HAA. Platelet-rich plasma in treatment of plantar fasciitis: randomized double-blinded placebo controlled study. J Clin Pathol. 2019; 2(1):1. doi:10.24983/scitemed.jacp.2019.00097.

6. Wrobel JS, Fleischer AE, Matzkin-Bridger J, Fascione J, Crews RT, Bruning N, et al. Physical examination variables predict response to conservative treatment of nonchronic plantar fasciitis: secondary analysis of a randomized, placebo-controlled footwear study. PM R. 2016; 8(5):436-44. doi:10.1016/j.pmrj.2015.09.011.

7. Gautham P, Nuhmani S, Kachanathu SJ. Plantar fasciitis-an update. Bangladesh J Med Sci. 2014; 14(1):3-8. doi:10.3329/bjms.v14i1.17052.

8. Mahindra P, Yamin M, Selhi HS, Singla S, Soni A. Chronic plantar fasciitis: effect of platelet-rich plasma, corticosteroid, and placebo. Orthopedics. 2016; 39(2):e285-9.doi:10.3928/01477447-201 60222-01.

9. Yang WY, Han YH, Cao XW, Pan JK, Zeng LF, Lin JT, et al. Platelet-rich plasma as a treatment for plantar fasciitis: a meta-analysis of randomized controlled trials. Medicine (Baltimore). 2017; 96(44):e8475. doi:10.1097/MD.0000000000008475.

10. Sherpy NA, Hammad MA, Hagrass HA, Samir H, Abu-ElMaaty SE, Mortada MA. Local injection of autologous platelet-rich plasma compared to corticosteroid treatment of chronic plantar fasciitis patients: a clinical and ultrasonographic follow-up study. Egypt Rheumatol. 2016; 38(3):247-52. doi:10.1016/j.ejr.2015.09.008.

11. Sami M, Nassr MH, Hamdy M, Khalil A. Preliminary study reveals the efficiency of platelet-rich plasma injection over physiotherapy for chronic plantar fasciitis treatment. Int J Clin Rheumatol. 2019; 14(3):120-6. Available from: https://www.openaccessjournals.com/articles/preliminary-study-reveals-the-efficiency-of-platelet-rich-plasma-injection-over-physiotherapy-for-chronic-plantar-fascii.pdf.

12. Shetty N, Shetty V, Shetty S. A comparative prospective study of platelet-rich plasma vs. corticosteroid injection in plantar fasciitis not responding to 6 weeks of conservative treatment. Int J Foot Ankle. 2018; 2(2):008. doi:10.23937/IJFA-2017/1710008.

13. Van Lieshout EMM, De Boer AS, Meuffels DE, Hoed PTD, Van der Vlies CH, Tuinebreijer WE, et al. American Orthopaedic Foot and Ankle Society (AOFAS) ankle-hindfoot score: a study protocol for the translation and validation of the Dutch language version. BMJ Open. 2017; 7(2):e012884. doi:10.1136/ bmjopen-2016-012884.

14. Menon NA, Jain J. Plantar fasciitis: a review. Indian J Pain. 2018; 32(1): 24-9. doi:10.4103/ijpn. ijpn_3_18.

15. Luffy L, Grosel J, Thomas R, So E. Plantar fasciitis: a review of treatments. JAAPA. 2018; 31 (1):20-4. doi:10.1097/01.JAA.0000527695. 76041.99.

16. Soraganvi P, Nagakiran KV, Raghavendra-Raju RP, Anilkumar D, Wooly S, Basti BD, et al. Is platelet-rich plasma injection more effective than steroid injection in the treatment of chronic plantar fasciitis in achieving long-term relief? Malays Orthop J. 2019; 13(3):8-14. doi:10.5704/MOJ.1911.002.

17. Yu T, Xia J, Li B, Zhou H, Yang Y, Yu G. Outcomes of platelet-rich plasma for plantar fasciopathy: a best-evidence synthesis. J Orthop Surg Res. 2020; 15(1):432. doi:10.1186/s13018-020-01783-7.

18. Jimenez-Perez AE, Gonzalez-Arabio D, Diaz AS, Maderuelo JA, Ramos-Pascua LR. Clinical and imaging effects of corticosteroids and platelet-rich plasma for the treatment of chronic plantar fasciitis: a comparative non randomized prospective study. Foot Ankle Surg. 2019; 25(3):354-60. doi:10.1016/j.fas.2018.01.005.

Original Article

Association of Median Diastema with Maxillary Labial Frenal Attachment in School-Going Children

Hida Tajasar, Faiza Malik, Rabia Tabassum, Mubashir Rasheed,
Hira Asghar, Muhammad Moazzam

ABSTRACT

Objective: To determine the frequency of the type of maxillary labial frenal attachment and its association with median diastema in school-going children of Raiwind, Lahore.

Methodology: After taking ethical approval from Sharif Medical & Dental College, this cross-sectional study was carried out in 8 different schools of Raiwind, Lahore, during a period of 3 months, from January to March 2020. A total of 815 school-going children of both genders, aged 10 to 16 years, were included in this study, after prior permission from the school principals and written informed consent from the parents of these children. Intraoral examination was performed on these children to check the type of maxillary labial frenal attachment (mucosal, gingival, papillary, papillary penetrating), median diastema (presence or absence), and type of dentition (mixed or permanent).

Results: A total of 815 children participated in this study with a mean age of 12.5±1.1 years, out of which 56.2% were males and 43.8% were females. Gingival type of maxillary labial frenum was most common while the papillary penetrating was the least common. Median diastema was present in about 32.8% of the children with no statistically significant difference in genders. Diastema was present in 100% of the students having the papillary penetrating type of labial frenal attachment. It was least common in mucosal type (22.8%) of frenal attachment. Regarding the type of dentition, 57.9% had mixed dentition and 42.1% had permanent dentition. An association between median diastema and type of frenal attachment was determined using the Chi-gender test and the results were significant ($p \leq 0.05$). There was a statistically significant difference of frenal attachment types among gender and dentition as well.

Conclusion: This study found maxillary labial frenal attachment types in children in the following descending order: gingival, mucosal, papillary, and papillary penetrating. The percentage of median diastema was highest in papillary penetrating type and lowest in mucosal type of labial frenum. The association between median diastema and the type of labial frenal attachment was statistically significant.

Keywords: *Maxillary labial frenal attachment. Median diastema. Frenectomy.*

INTRODUCTION

The frenal attachment is one of the most interesting yet misunderstood anatomic structures in the oral cavity and is subject to variation in size, location, and morphology throughout its development.[1] A vertical band of muscle fibers of orbicularis oris and oral mucosa, comprise the labial frenum, which limits the movement of the lips by attaching them to the alveolar mucosa and periosteum of maxillary and mandibular arches.[2] The labial frenum primarily functions for the provision of stability to the lips, both at rest and during oral functions such as mastication, smiling, speech, and swallowing.[3]

The labial frenum arises as a part of the oral cavity within the first few weeks of fetal life, along with the developing lips and cheeks. A prominence starts to appear in the middle part of the inner zone of the upper lip which changes into a tuberculum as growth and development progresses. As soon as the tuberculum is developed, one more prominence appears on the anterior part of the palate which develops into palatine papilla. The prominences of the tuberculum and the palatine papilla are connected by a continuous fold of tissue called the tectolabial frenum. It simulates an abnormal frenum of post-natal life. It extends as a continuous band of tissue from the inner aspect of the upper lip, over and across the alveolar ridge, to be inserted in the palatine papilla. The labial and palatal portions are divided by the growing alveolar process that causes a severance of the continuous fold of the tissue in any normal individual. The palatine papilla is developed from the palatal part whereas the superior labial frenum develops from the labial tissue that extends from the upper lip to the crest of the alveolar ridge.[3]

At various stages of growth and development, the levels of the frenal attachment are different.[1] The different types of frenal attachments were classified by Placek et al., depending on the anatomical location of the frenum in mucogingival junction, attached gingiva, interdental papilla, and papilla extending to the palate.[4] The papillary and papillary penetrating types are likely to be pathological if they persist beyond the mixed dentition phase.[5]

The spaces between two or more consecutive teeth can occur anywhere in the mandibular and maxillary arches and are called diastema.[6] The etiological factors of the median diastema or a gap between maxillary central incisors are the presence of supernumerary teeth (mesiodens), a disproportion between the size of the

Sharif Medical & Dental College, Sharif Medical City. Sharif Medical City Road, Off Raiwind Road, Jati Umra, Lahore 54000, Pakistan.

Correspondence: Dr. Faiza Malik
Assistant Professor Department of Orthodontics
Sharif Medical & Dental College, Lahore
E-mail: dr.faizahash@gmail.com

Received: May 11, 2021; Accepted: June 1, 2021

teeth and arch perimeter, abnormal labial frenum, hypodontia, and periodontal disease.[6] It is a common aesthetic problem in mixed and early permanent dentition with a reported frequency of 1.6-25.4%.[7]

Among the various causes of median diastema, the role of the frenum is of vital interest. The pull of the inordinately large and wide frenal attachment is much greater than usual in some individuals. This variation may require orthodontic treatment for reasons beyond mere cosmetics. It produces a constant force on the attached gingiva with the ultimate consequence of periodontal pocket and localized gingival recession.[6]

This study was aimed to determine the distribution of the type of maxillary labial frenal attachment and its association with median diastema in school-going children of Raiwind Lahore. During orthodontic treatment, understanding the association of frenal attachment and median diastema is of immense importance as the frenal tissue can inhibit the closure of a diastema. A seemingly perfect orthodontic correction of diastema may be unstable leading to post-orthodontic relapse. In cases of high frenal attachment, the adjunctive surgical removal of the labial frenum becomes quite necessary by employing Miller's technique, V-Y plasty, Z plasty, conventional frenectomy, or electrocautery.[8] This study will contribute to the local database and will highlight the importance of this association in orthodontic diagnosis and treatment planning. It will also support the grounds for spreading public awareness regarding median diastema, its etiology, effect on the rest of the dentition, role in aesthetics, and diverse treatment options available for treating this problem.

METHODOLOGY

This cross-sectional study involved 815 children studying in 8 different schools of Raiwind, Lahore. Firstly, ethical approval (Letter No.SMDC/SMRC /106-19, 07-11-2019) for the study was obtained from Sharif Medical & Dental College, Lahore and the study duration was from January to March 2020. Thereafter, permission was taken from the schools' principals for intraoral examination of the children fulfilling the selection criteria. Informed consent was also taken from their parents prior to the examination date. The inclusion criteria were children of both genders aged 10 to 16 years, having fully erupted both maxillary central incisors. The exclusion criteria were children having foreign ethnicity, children with hypodontia, microdontia, macrodontia, supernumerary tooth, periodontitis, cleft lip and/or palate, or any other orofacial deformity. Children undergoing orthodontic treatment or with a previous history of orthodontic treatment, dental trauma, restored anterior teeth, dental prosthesis, or any dental extraction were also excluded.

Data was collected by the primary researcher. To avoid visual fatigue, the number of children examined per day was kept to a maximum of 30, which corresponded to the number of children in one class. All intraoral examinations were performed by the direct visual method. Each child was examined while seated in an upright position under natural daylight using disposable wooden blades to retract the upper lip and examine median diastema and frenal attachment. The child's head was then extended to view the palatine papilla on the palatal surface to check for any palatal attachment of the frenal fibers. Type of maxillary labial frenal attachment, presence or absence of median diastema, type of dentition, whether mixed or permanent, were recorded in a pre-designed proforma along with the demographic data.

The type of frenal attachment was based on classification by Placek et al. (Figure 1).

- Mucosal: when the frenal fibers are attached up to the mucogingival junction.
- Gingival: when the frenal fibers are inserted within the attached gingiva.
- Papillary: when the frenal fibers are extending into interdental papilla.
- Papilla penetrating: when the frenal fibers cross the alveolar process and extend up to palatine papilla.[4]

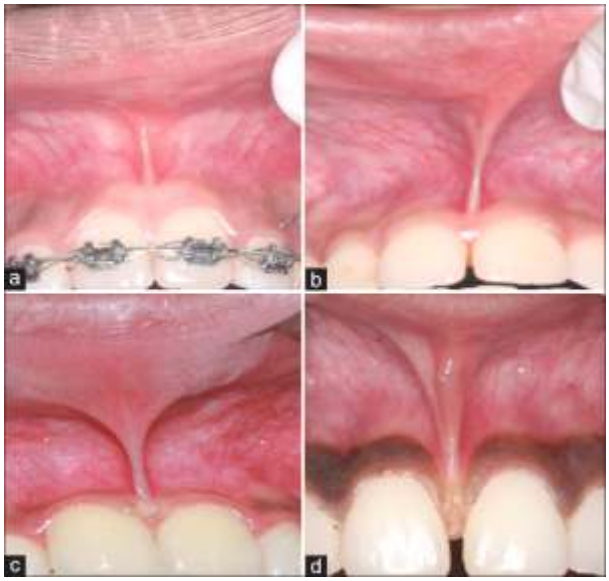

Figure 1: Types of Maxillary Labial Frenal Attachment

(a) Mucosal type **(b)** Gingival type
(c) Papillary type **(d)** Papillary penetrating
Median diastema is seen in b & d

STATISTICAL ANALYSIS

Data was analyzed by Statistical Package for the Social Sciences (SPSS) version 25. Quantitative variables

like age were represented as mean and standard deviation. Categorical variables like gender, labial frenal attachment type, and median diastema (presence or absence) were represented as frequency or percentage. The Chi-square test was used to determine the association between median diastema and labial frenal attachment. A p-value of ≤0.05 was considered significant.

RESULTS

A total of 815 children participated in this study with a mean age of 12.5±1.1 years, out of which 56.2% were males and 43.8% were females. Among the types of frenal attachment, the gingival type (61.3%) was the most common while papillary penetrating (4.3%), the least common (Figure 2).

Median diastema was present in about 32.8% of children, out of which 153(57.3%) were males and 114(42.7%) were females. There was no significant difference in diastema among both genders (p-value=0.707). An association between median diastema and the type of frenal attachment was determined using the Chi-square test. Figure 3 shows percentage of median diastema in various frenal attachment types. A p-value of 0.001 showed a statistically significant association between the two variables.

Among the gingival type of frenal attachment (which is most common), 58.8% were males and 41.2% were females. The distribution of various types of frenal attachment according to gender is displayed in Table 1. There was an insignificant difference in frenal attachment types among genders (p-value=0.001).

Regarding the type of dentition, 57.9% had mixed dentition and 42.1% had permanent dentition. In mixed dentition, median diastema was present in 51.7% of children, and in permanent dentition, it was found in 48.3% of children. An association between median diastema and dentition was determined using the Chi-square test and a p-value of 0.007 was significant.

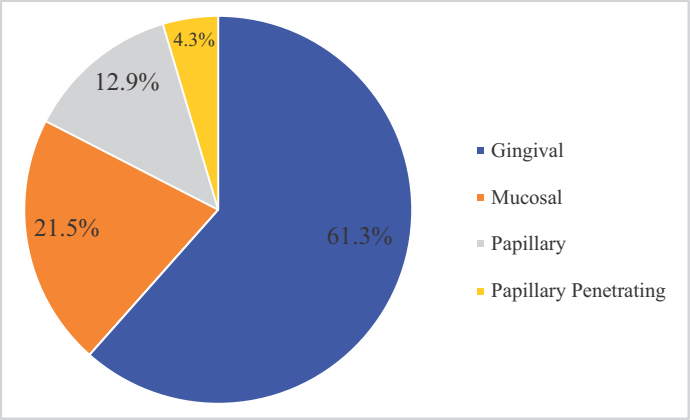

Figure 2: Percentage of Maxillary Labial Frenum Attachment Type

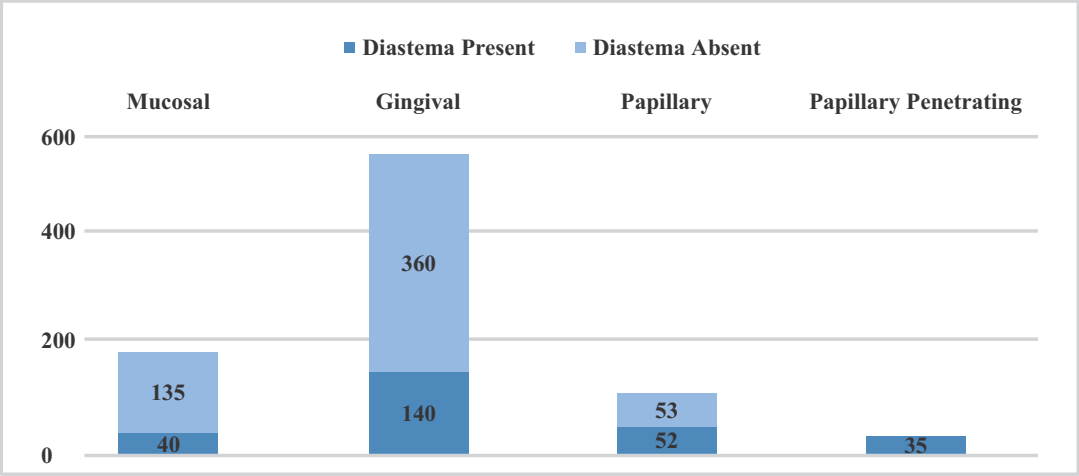

Figure 3: Percentage of Median Diastema in Various Frenal Attachment Types

Table 1: Gender Distribution of Maxillary Labial Frenal Attachment Type

Type of Frenal Attachment	Male	Female	Total	p-value
	Frequency (Percentage)	Frequency (Percentage)	Frequency (Percentage)	
Mucosal	104(59.4%)	71(40.6%)	175(100%)	0.001*
Gingival	294(58.8%)	206(41.2%)	500(100%)	
Papillary	40(38.1%)	65(61.9%)	105(100%)	
Papillary Penetrating	20(57.1%)	15(42.9%)	35(100%)	
Total	458(56.2%)	357(43.8%)	815(100%)	

**Significant p-value*

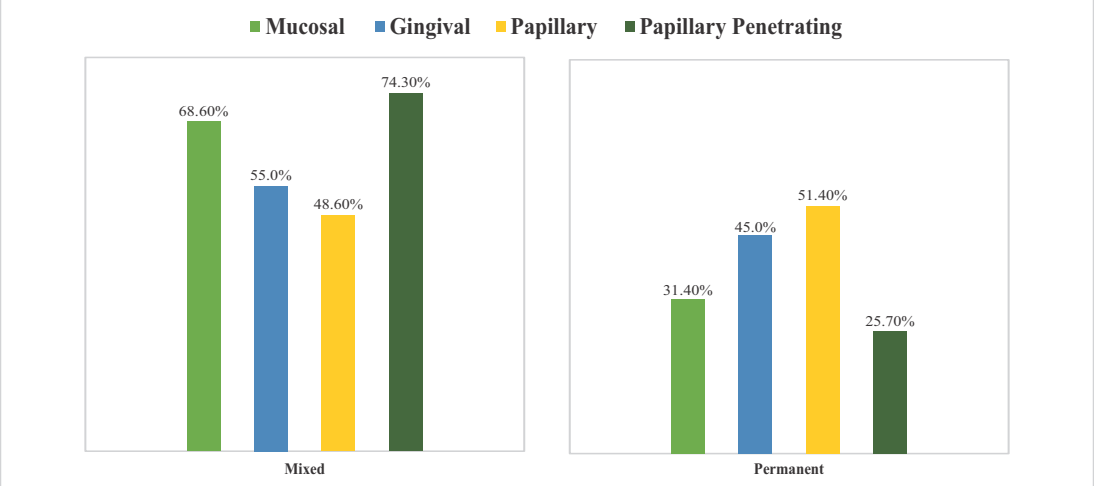

Figure 4: Distribution of Maxillary Labial Frenal Attachment Types among Mixed and Permanent Dentition

Figure 4 shows the distribution of frenal attachment types among both the dentitions and there was a statistically significant association between them (p-value=0.001).

DISCUSSION

The characterization of maxillary labial frenum and interdental spaces of maxillary central incisors is important because they may impose some modifications in dental treatment procedures.[9] The current cross-sectional study conducted on 815 school-going children of Raiwind Lahore, Pakistan, found that the most frequent type of maxillary labial frenum was gingival (61.3%). Similar results were found in other studies.[10,11] However, according to Jindal et al., and Nadar, mucosal type was the most common.[3,12]

The present study showed papillary (12.9%) and papillary penetrating (4.3%) are the least common types of frenal attachment, comparable to the studies conducted in Iraq and Jordan.[1,13] However, Thahir et al. found papillary penetrating in 16.1% of subjects and papillary type in 3.1% of subjects from Prague.[4] Similarly, Jindal et al. found papillary penetrating in 3.2% of the sample population and papillary type in 2.4% of the sample population in India.[3] The difference in these results from the current study are probably representative of the population diversity.

The gender-based analysis in this study showed a statistically significant difference regarding the types of labial frenum (p=0.001), whereas, in other studies no significant gender difference was found.[5,10]

The present study found median diastema in 32.8% of school-going children, whereas a study conducted by Deepa in Chennai reported 75.5% children with diastema.[14] According to Jonathan et al., 41.75% of the population of Sri Ganganagar city had median diastema.[2] In this study, it was considerably higher in males (57.3%) than females (42.7%), similar to the

studies conducted in Jammu Kashmir and India.[15,16] The higher prevalence in males can probably be attributed to their late dental development than females.

The present study showed a significant association between the type of frenal attachment and median diastema (p=0.001). Diastema was present in 100% of children having the papillary penetrating type of labial frenum.

Deepa reported that there was an increased presence of median diastema in children with the gingival type and the papillary type of frenum attachment.[14] Another study reported median diastema to be associated with the papillary (33.3%) and the papillary penetrating type (62.5%) similar to the present study.[3] A study including Caucasian subjects in Poland also showed similar results.[17]

In this study, an association between the types of maxillary labial frenum and dentition was also studied. The most frequent type of frenal attachment in mixed dentition was papillary penetrating (74.3%) whereas, in permanent dentition it was papillary (51.4%). This is in contrast to another study in which the most frequently occurring frenal attachment type in mixed dentition was gingival (52.2%), in permanent dentition was mucosal (85.7%) and in primary dentition was also mucosal (41.1%).[5]

In the current study an association of dentition with median diastema was also determined and it was found to be significant (p=0.007). The percentage of median diastema was higher in mixed dentition children (51.7%) than in permanent dentition (48.3%). This result could be attributed to the fact that mesial drifting of permanent teeth during growth and development can reduce or close the median diastema.[18] This could explain the reduced frequency of median diastema in older children with permanent dentition.

Median diastema in mixed dentition can be transitional which requires no orthodontic treatment. However, regular follow-up is essential in these children. Median diastema can be genetic, physiological, or due to dental factors like hypodontia, macroglossia, ankylosed central incisors, dentoalveolar discrepancy, and delayed or ectopic canine eruption. Midline alveolar bone cleft could also be considered as a contributory factor of median diastema.[19] The difficulty for an orthodontist lies in decision making, whether to close, open, or redistribute the space in the arch. Orthodontic space closure by reciprocal anchorage, reducing incisor proclination, or composite build-ups may eliminate the need for prosthetic rehabilitation of median diastema but there can be an esthetic and/or functional problem in case of missing maxillary lateral incisors.[20] Treatment of median diastema depends on many factors such as the age of the patient, dentofacial profile, amount of overjet, lip support, tooth morphology, and root angulation. If all or most of these factors are unfavorable, space opening and prosthetic replacement are probably the top choice.[19]

Papillary and papillary penetrating types of labial frenal attachment, which persist even after vertical alveolar growth during the transition from mixed to permanent dentition, require surgical treatment, with simultaneous fixed orthodontic treatment to close the median diastema.[14] Even after treatment, timely and appropriate counseling about maintaining proper oral hygiene is certainly recommended. A great amount of emphasis should be placed on the proper examination of the maxillary labial frenum during routine dental check-ups, as it is relevant to smile aesthetics and also one of the leading causes of median diastema. This further makes it important to properly classify the frenum and its morphological variations before commencing orthodontic treatment so that a successful outcome in the long-term is achieved through proper diagnosis and treatment planning.[21]

CONCLUSION

The current study found maxillary labial frenal attachment types in children in the following descending order: gingival, mucosal, papillary, and papillary penetrating. Median diastema was present in all children with the papillary penetrating type of attachment. Furthermore, the frequency of median diastema decreased from papillary to mucosal type. The association between median diastema and the type of labial frenal attachment was statistically significant. The occurrence of median diastema was more common in males and mixed dentition, however, the association was significant for the type of dentition, but not gender.

LIMITATIONS & RECOMMENDATIONS

The limitation of this study is a small sample size from only one Tehsil of Lahore, Pakistan. Similar studies should be conducted in other districts of the country as well, covering a broader region for more purified results pertaining to the frenal type and its association with median diastema. The influence of other etiological factors on median diastema was not determined, as only labial frenal attachment type was assessed. Future studies may determine the exact single etiological factor of median diastema with a more refined sampling method. Furthermore, dental extractions, tooth size discrepancy, periodontal problems, and size variation of pre-maxilla should also be taken into consideration as a probable reason for diastema.

REFERENCES

1. Hammouri E, Alsmadi H, Rihani F, Alrawashdeh T. Morphology and positional characteristics of maxillary labial frenum in Jordanian children. J Royal Med Serv. 2017; 24(2): 35-40. doi:10. 12816/0039640.

2. Jonathan PT, Thakur H, Galhotra A, Galhotra V, Gupta N. Maxillary labial frenum morphology and midline diastema among 3 to 12-year-old schoolgoing children in Sri Ganganagar city: a cross-sectional study. J Indian Soc Pedod Prev Dent. 2018; 36(3):234-9. doi:10.4103/JISPPD.JISPPD_51_18.

3. Jindal V, Kaur R, Goel A, Mahajan A, Mahajan N, Mahajan A. Variations in the frenal morphology in the diverse population: a clinical study. J Indian Soc Periodontol. 2016; 20(3):320-3. doi:10. 4103/0972-124X.182598.

4. Thahir H, Djais AI, Wendy S, Achmad MH, Akbar FH. Management of maxillary labial frenum with comparison of conventional and incision below the clamp techniques: a case report. J Dentomaxillofac Sci. 2018; 3:61-6. doi: 10.15562/jdmfs.v3i1.634.

5. Christabel SL, Gurunathan D. Prevalence of type of frenal attachment and morphology of frenum in children, Chennai, Tamil Nadu. World J Dent. 2015; 6(4):203-7. doi:10.5005/jp-journals-10015-1343.

6. Faiz N, Maiti S, Nasim I, Jessy P. High frenal attachment-as a risk factor of midline diastema. Int J Res Pharm Sci. 2020; 379-84. doi:10.26452/ ijrps. v11iSPL3.2948.

7. Rajani ER, Biswas PP, Emmatty R. Prevalence of variations in morphology and attachment of maxillary labial frenum in various skeletal patterns - a cross-sectional study. J Indian Soc Periodontol. 2018; 22(3):257-62. doi:10.4103/jisp.jisp_294_17.

8. Bhosale N, Khadtare Y, Waghmare P, Chaudhari A, Lele P, Gavali N. Frenectomy by Millers technique: a case report. IP Int J Periodontol Implantol. 2020; 5(4):177-80. doi:10.18231./j.ijpi.2020.039.

9. Khursheed DA, Zorab SS, Zardawi FM, Ali AJ, Talabani RM. Prevalence of labial frenum attachment and its relation to diastema and black hole in Kurdish young population. IOSR J Dent Med Science. 2015; 14(9):97-100. doi:10.9790/ 0853-149197100.

10. Rathod S, Bawankar PV, Chikhale P, Bidwaikar A. Evaluation of variations in morphology and attachment of frenum in diverse population - a cross-sectional study. Clin Epidemiology Glob Health. 2020; 8(4):1094-7. doi:10.1016/j.cegh.2020.03.026.

11. Divater V, Bali P, Nawab A, Hiremath N, Jain J, Kalaivanan D. Frenal attachment and its association with oral hygiene status among adolescents in Dakshina Kannada population: a cross-sectional study. J Family Med Prim Care. 2019; 8(11):3664-7. doi:10.4103/jfmpc.jfmpc _611_19.

12. Nadar S. Maxillary labial frenum attachment in children of different age groups. Int J Curr Res. 2017; 9(5):50367-9. Available from: https://www.journalcra.com/sites/default/files/issue-pdf/20873.pdf.

13. Alwan AH. Prevalence of types of labial frenum attachment and frenectomy with conventional scalpel technique in a sample of Iraqi population. Int Medical J. 2020; 25(4). Available from:https://www. researchgate.net/publication/345437869.

14. Deepa. Attachment of maxillary frenum and occurrence of midline diastema in children. J Pharm Sci & Res. 2016; 8(6):536-9. Available from: http://www.jpsr.pharmainfo.in/Documents/ Volumes/vol8Issue06/jpsr08061637.pdf.

15. Gupta R, Jandial S, Mahajan N, Kotwal B, Kaur S, Gupta N. The prevalence and etiology of maxillary midline diastema in Jammu population. Int J Prevent Public Health Sci. 2017; 3:41-3. doi:0.17354/ ijpphs/2016/72.

16. Pereira WD, Jessy P, Surendar S.Prevalence of developmental maxillary midline diastema in children - a retrospective study. Eur J Mol Clin Med. 2020; 7(1):1579-86. Available from: https://ejmcm.com/pdf_2597_91f52629296260e860427635162bf5df.html.

17. Sekowska A, Chałas R. Diastema size and type of upper lip midline frenulum attachment. Folia Morphol (Warsz). 2017; 76(3):501-5. doi:10.5603/FM. a2016.0079.

18. Manohar J, Dinesh SPS. Midline diastema patients less than 25 years of age opting for orthodontic correction. Ann Trop Med & Public Health. 2020; 23(S22):SP232302. doi:10.36295/ ASRO.2020.2323302.

19. Hasan HS, Al Azzawi AM, Kolemen A. Pattern of distribution and etiologies of midline diastema among Kurdistan-region population. J Clin Exp Dent. 2020; 12(10):e938-43. doi:10.4317/jced.57122.

20. Viazis AD, Viazis E, Pagonis TC. The biology of orthodontic treatment time; days versus years. J Dent Health Oral Disord Ther. 2017; 8(1):432-5. doi:10.15406/jdhodt. 2017.08.00268.

21. Niazi M, Manzoor N, Sajjad S, Qazi H. Morphological and attachment variations of median maxillary labial frenum. Pak Oral J. 2017; 9(1):19-23. Available from: https://poj.org.pk/index.php/poj/ article/view/153.

Original Article

An Anatomical Study of Proximal End of Femur in Human Cadavers from a Single Center in Pakistan

Nadia Ahmad, Ammara Ghafoor, Waqas Iqbal, Mamoona Shaukat, Ayesha Khalid, Izza Ahmad

ABSTRACT

Objective: To measure the anatomical parameters of the proximal end of femur among local population from a single center of Pakistan.

Methodology: A cross-sectional study was conducted on sixty non paired human cadaveric femorii at the Department of Anatomy, Sharif Medical & Dental College, Lahore from September to December 2020. Exclusion criteria were considered as fractured or damaged bones. The total length of the femur in cm, the diameter of femur head in mm, length of femur neck in mm, the diameter of femur neck in mm, the thickness of femur neck in mm, and neck-shaft angle in degrees were observed and measured for each femur.

Results: Total number of femorii studied was sixty out of which 31 were right-sided and 29 were left-sided. The mean length of the right femorii was 44.78±1.29 cm whereas the left femorii mean length was 44.62±2.01 cm. The total mean length of 60 femorii was 44.7±1.66 cm. The neck-shaft angle of the right femorii was 122.29±4.93°, whereas of left femorii was 124.07±4.26°. The total mean neck-shaft angle of 60 femorii was 123.15±4.66°. However, Analysis of Variance (ANOVA) showed statistically no significant difference between the various anatomical parameters of right and left femorii.

Conclusion: There was no statistically significant difference recorded between anatomical parameters length, diameter of femur, length, thickness & diameter of femoral neck, and neck-shaft angle of the right and left femorii.

Keywords: *Neck-shaft angle. Femur. Femur length. Femur neck length.*

INTRODUCTION

Anatomists and orthopedic surgeons have studied the femur bone and its relation to various clinical conditions by measuring its different anatomical parameters which differ in various ethnic and regional groups.[1] In humans, femur commonly known as the thigh bone, is the longest and the sturdiest bone which measures around 45 cm, about one fourth of the length of an average built adult. The femur is studied in three parts, the upper, lower, and middle parts. The upper end is expanded forming a head, neck, greater and lesser trochanters with intervening inter-trochanteric line and inter-trochanteric crest. The expanded lower end forms the medial and lateral condyles with the middle cylindrical part forming the shaft or diaphysis. The length of the neck is about 5 cm connecting the head and shaft and making an angle of about 125° with the shaft.[2] Angle between the long axis of the shaft of the femur and the long axis of the femur neck is known as a neck-shaft angle. It is also known as the angle of the neck of the femur, angle of inclination, and cervico-diaphyseal angle. The normal angle of the neck of the femur varies between 120° and 140°. The condition in which this angle is less than 120° is known as coxa vara and the condition in which this angle is more than 140° is known as coxa valga. The neck-shaft angle facilitates the hip joint movements and enables the lower limb to swing clear of the pelvis.[3]

The anatomical understanding of the femoral neck-shaft angle is helpful in treating pathologies of this area. This angle is measured from the proximal end of the shaft of the femur and neck length can be predicted and hence prosthesis can be prepared for restoration. This knowledge is very valuable in planning any interventional procedure on the hip joint like arthroplasty, osteotomy or fracture fixation. Also, this information can be useful in implant manufacturing in our community as an incorrect implant can lead to abnormal weight transfer from the upper part of the body to the lower limb causing tension and stress in the affected parts. This may lead to long-term serious mobility issues in the affected individual.[4] In this study we observed the anatomy of the proximal end of the femur in relation to its various parameters from cadaveric bones. Our aim of the study was to find out various anatomical parameters including length, diameter, length, thickness & diameter of femoral neck, and neck-shaft angle of the right and left femorii in our community.

Sharif Medical & Dental College, Sharif Medical City. Sharif Medical City Road, Off Raiwind Road, Jati Umra, Lahore 54000, Pakistan.

Correspondence: Dr. Nadia Ahmad
Associate Professor Department of Anatomy
Sharif Medical & Dental College, Lahore
E-mail: diaejaz_74@hotmail.com

Received: May 24, 2021; Accepted: June 20, 2021

METHODOLOGY

The present cross-sectional study was conducted on sixty (n=60) unpaired dry femorii of unknown age and sex; thirty one were right-sided and twenty nine were left-sided femorii. After the approval by the institutional ethical committee (Letter No. SMDC/SMRC/121-20, 23-06-2020) the bones were collected

from the Anatomy Department of Sharif Medical & Dental College, Lahore from September to December 2020.

Fractured and damaged bones were excluded from the study. In the current study, six anatomical parameters were measured by using the osteometric board (Figure 1), vernier caliper (Figure 2), and a goniometer (Figure 3). The parameters which were recorded were; total length of the femur in cm, the diameter of femur head in mm, length of femur neck in mm, the diameter of femur neck in mm, the thickness of femur neck in mm, and neck-shaft angle in degrees (Figure 4).

Figure 1: Osteometric Board

Figure 2: Vernier Calipers

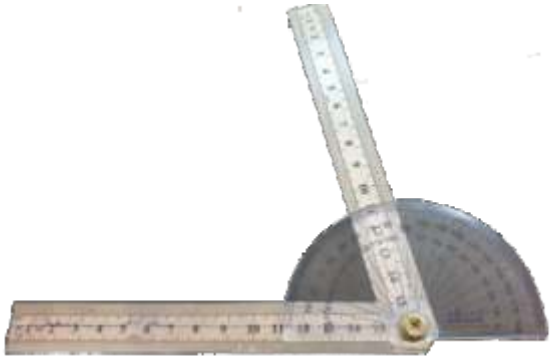

Figure 3: Goniometer

The femur was placed on the osteometric board by rotating its shaft internally. The total length of the femur was measured from the uppermost point of the caput of the femur to the most distal part of the medial condyle on the osteometric board. The distance between the proximal and distal end of the femoral head in the cranio-caudal axis was recorded as femur head diameter.[1] The distance between the inferior part of the

Figure 4: Measurements of Parameters of the Proximal End of Femur

a. Diameter of femur head
b. The thickness of femur neck
c. Diameter of femur neck
d. Length of femur neck
e. The total length of the femur
f. The neck-shaft angle of the femur

base of the femoral head and the lower end of the inter-trochanteric line was measured as femoral neck length. The distance between the proximal and distal end of the neck of the femur in cranio-caudal direction was measured as femoral neck diameter. The thickness of the femur neck was measured in the antero-posterior axis. The neck-shaft angle was measured with the help of a goniometer. It was measured by taking the long axis of the shaft and the long axis of the neck of the femur. The line joining the center of the head of the femur and the upper end of the midpoint of the narrowest part of the neck was taken as the long axis of the neck.[5]

STATISTICAL ANALYSIS

All observations and results gathered were thoroughly analyzed as per standard statistical methods. Data analysis was done using Statistical Package for the Social Sciences (SPSS) version 23. Mean and standard deviation was calculated for quantitative variables and one-way ANOVA was applied to observe differences within and between various parameters of right and left femorii. A p-value of ≤ 0.05 was considered statistically significant.

RESULTS

The total number of femorii studied was sixty out of which 31 were right-sided and 29 were left-sided. The mean length of the right femorii was 44.78±1.29 cm whereas the left mean length was 44.62±2.01 cm. The total mean length of 60 femorii was 44.7±1.66 cm. The neck-shaft angle of the right femorii was 122.29±4.93° whereas of left femorii was 124.07±4.26°. The total mean neck-shaft angle of 60 femorii was 123.15±4.66°. The recorded anatomical parameters, the total length of the femur in cm, the diameter of femur head in mm, length of femur neck in mm, the diameter of femur neck in mm, the thickness of femur neck in mm, and neck-shaft angle in degrees are presented in Table 1.

DISCUSSION

Over 80,000 artificial hip joint replacement procedures are performed annually all over the world.[5] Due to the geographical differences in the built of human beings, the prosthesis should preferably be designed to remove pathology and restore normal anatomy for a particular population.[6] One study showed that a mismatch between femoral bone and stem may result in micromotion which can be a major cause for thigh pain, osteolysis, and aseptic loosening.[7] Oversized implants may cause the femur to fracture and undersized implants may fail to bind with the bone.[4]

In the current study, the mean length of the right femorii was 44.78±1.29 cm whereas the left mean was 44.62±2.01 cm. The total mean length of 60 femorii was 44.7±1.66 cm. In a similar study done by Khan et al., the mean length of femorii was comparable to our results which were 44.62±2.63 cm, the length of right femorii was 44.66±2.66 cm and of left femorii was 44.58±2.61 cm.[8] Another study carried out by Verma et al., showed similar results in which the mean femorii length was 42.82±2.87 cm, the length of right femorii was 42.94±2.77 cm and of left femorii was 42.70±3.01 cm.[5]

The neck-shaft angle of the femur has been a very important gauge to measure the inclination between shaft and neck of the femur helping in the diagnosis of many pathologies of the proximal end of the femur and hence its curative treatments.[9] The normal angle between the shaft and neck of the femur varies between 120-140° degrees. Any neck-shaft angle of the femur less than 120° is defined as coxa vara and angles more than 140° are defined as coxa valga. The specific knowledge of this geometry is not only useful in preoperative planning of procedures on the proximal end of the femur such as arthroplasty or fixation of fracture but is also useful in designing suitable prosthesis for a particular population thus minimizing the postoperative complications leading to tension in the soft tissues, painful gait and joint stress especially on the knee joint.[10] In our study the neck-shaft angle of the right femorii was 122.29±4.93° whereas of left femorii was 124.07±4.26°. The total mean neck-shaft angle of 60 femorii was 123.15±4.66°. These results are similar to a study conducted by Amith et al.[11] In another

Table 1: Mean Values of Different Parameters of Femur in Right, Left, and Both Femorii

Parameters (Femorii)	Right-Sided (n=31) Mean±SD	Left-sided (n=29) Mean±SD	Total (n=60) Mean±SD	ANOVA Between Right & Left p-value
Length of Femur (cm)	44.78±1.29	44.62±2.01	44.70±1.664	0.910
Diameter of Femur Head (mm)	42.19±3.240	42.97±2.958	42.57±3.105	0.581
Length of Femur Neck (mm)	48.97±4.764	48.93±7.066	48.95±5.936	0.745
Thickness of Femoral Neck (mm)	24.94±2.744	25.38±2.583	25.15±2.654	0.402
Diameter of Femur Neck (mm)	34.23±3.138	35.31±3.587	34.75±3.378	0.405
Neck-shaft Angle of Femur (degree)	122.29±4.927	124.07±4.259	123.15±4.664	0.098

study done by Gullapalli et al., the neck-shaft angle was comparable to our results which were 121° of both sides, mean angle of right femorii was 119±17.15° and that of left femorii was 123±10.8°.[12] Our results were also in agreement with another study conducted by Ravichandran et al. In their study the neck-shaft angle was 126.55°.[13] Other similar studies by Fischer et al., and Dimitriou et al., reported a neck-shaft angle of 127°.[14,15]

The present study was conducted primarily to find out various anatomical parameters of the proximal end of the femur in our part of the world. This study will help clinicians, especially orthopedic surgeon to treat and correct various anomalies and pathologies of the neck-shaft area of the femur.

CONCLUSION

There was no statistically significant difference recorded between anatomical parameters length, diameter of femur, length, thickness & diameter of femoral neck, and neck-shaft angle of the right and left femorii.

LIMITATIONS

This study has some limitations as it was conducted in a single center with an unpaired and relatively smaller number of bones of unknown age and sex. So, it is suggested that in the future this study should be conducted in multiple centers of Pakistan. The proximal parameters of the femur should also be studied separately in males and females of different age groups.

REFERENCES

1. Dwivedi AK, Airan N, Bhatnagar R. Estimation of length of Femur from its proximal segment in Maharashtrian population. Int J Anat Radiol Surg. 2019; 8(1):AO01-5. doi:10.7860/IJARS/2019/ 37766:2448.

2. Gujar SM, Vikani S, Parmar J, Bondre KV. A correlation between neck-shaft angle to femoral neck length. Int J Biomed Adv Res. 2013; 4(5):295-8. doi:10.7439/ ijbar.v4i5.354.

3. Georgescu I, Gavriliu S, Nepaliuc I, Munteanu L, Tiripa I, Ghița R, et al. Burnei's technique of femoral neck variation and valgisation by using the intramedullary rod in Osteogenesis imperfecta. J Med Life. 2014; 7(4):493-8. Available from: https://medandlife.org/wp-content/uploads/JMedLife-07-493.pdf.

4. Sinha RR, Kumar B, Kumar S, Ratnesh R, Akhtar MJ, Fatima N. Study of neck-shaft angle of femur in population of Bihar. Int J Res Med Sci. 2017; 5(11):4819-21. doi:10.18203/2320-6012.ijrms 20174926.

5. Verma M, Joshi S, Tuli A, Raheja S, Jain P, Shirivastava P. Morphometry of proximal femur in Indian population. J Clin Diagn Res. 2017; 11(2):AC01-4. doi:10.7860/JCDR/2017/ 23955.9210.

6. Pathrot D, Ul Haq R, Aggarwal AN, Nagar M, Bhatt S. Assessment of the geometry of proximal femur for short cephalomedullary nail placement: an observational study in dry femora and living subjects. Indian J Orthop. 2016; 50(3):269-76. doi:10.4103/0019-5413. 181785.

7. Siwach R. Anthropometric study of proximal Femur geometry and its clinical application. Ann Natl Acad Med Sci (India). 2018; 54(4): 203-15. doi:10.1055/s-0040-1712831.

8. Khan SM, Saheb SH. Study on neck-shaft angle and Femoral length of South Indian Femur. Int J Anat Res. 2014; 2(4): 633-5. doi:10.16965/ ijar.2014.512.

9. Srisaarn T, Salang K, Klawson B, Vipulakorn K, Chalayon O, Eamsobhana P. Surgical correction of coxa vara: evaluation of neck-shaft angle, Hilgenreiner-epiphyseal angle for indication of recurrence. J Clin Orthop Trauma. 2019; 10(3):593-8. doi:10.1016/j.jcot. 2018.06.009.

10. Zia Ziabari SM, Joni SS, Faghani M, Pakdel Moghaddam A. Comparative study of the neck shaft angle in femoral neck and intertrochanteric fractures in north part of Iran. Int J Burns Trauma. 2020;10(5):225-30. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/ PMC7675205/pdf/ijbt0010-0225.pdf.

11. Amith R, Beena N, Vinay KV. Morphometry of femoral neck-shaft angle in dry femora of South India by computer assisted image analysis method. Int J Anat Res. 2017; 5(2.1):3753-8. doi:10.16965/ijar.2017.167.

12. Gullapalli A, Inuganti AK. Morphometric study of femoral neck-shaft angle and its clinical significance. Int J Anat Res. 2017; 5(3.2):4261-4. doi:10.16965/ ijar.2017.301.

13. Ravichandran D, Muthukumaravel N, Jaikumar R, Das H, Rajendran M. Proximal femoral geometry in Indians and its clinical applications. J Anat Soc India. 2011; 60(1):6-12. doi:101016/S0003-2778(11)80003-1.

14. Fischer CS, Kuhn JP, Volzke H, Ittermann T, Gumbel D, Kasch R, et al. The neck-shaft angle: an update on reference values and associated factors. Acta Orthop. 2020; 91(1): 53-7. doi:10.1080/1745 3674.2019.1690873.

15. Dimitriou D, Tsai TY, Yue B, Rubash HE, Kwon YM, Li G. Side-to-side variation in normal femoral morphology: 3D CT analysis of 122 femurs. Orthop Traumatol Surg Res. 2016; 102(1):91-7. doi:10.1016/j.otsr. 2015.11.004.

Original Article

Comparison of the Clinical Efficacy of Bacteria-Based Probiotics to Fungi-Based Probiotics

Muhammad Awais, Sadia Alam, Nadia Wali, Rizwan Mehmood, Usman Nasir, Aliya Waheed

ABSTRACT

Objective: To compare the clinical efficacy of bacteria-based probiotics with fungi-based probiotics for the treatment of acute watery diarrhea in children between 5 months to 5 years of age.

Methodology: A cross-sectional descriptive study was conducted on 150 cases of acute diarrhea admitted in the Paediatrics Department, Akhtar Saeed Trust Hospital, Lahore from May to June 2020. Patients were included by convenient sampling technique and further divided into groups A & B. Group A included 75 patients treated with bacteria-based probiotic i.e. *Lactobacillus acidophilus* and group B comprised 75 patients treated with fungi-based probiotic, *Saccharomyces boulardii.* Twelve billion lyophilized heat-killed *Lactobacillus acidophilus* was given twice a day to group A patients and 250 mg of *Saccharomyces boulardii* was given twice a day to patients included in group B. The children in each group (A and B) were observed on the 3rd day of treatment to see the efficacy. If diarrhea was resolved on day 3 of starting a probiotic, then that particular probiotic was considered as clinical efficient. The efficacy of probiotics used in both groups was compared.

Results: The age range of the children included in the study was 5 months to 5 years. In group A, 31(41.33%) and in group B, 27(36%) were in age group 1-2 years. In group A, 24(32%) and 31(41.33%) in group B were between 3-4 years, while 20(26.67%) in group A and 17(22.6%) in group B were 5 years of age. The mean age was 3.22±2.53 years in group A and 3.76±2.89 years in group B. As for as gender was concerned, 39(52%) in group A and 44(58.67%) in group B were males while 36(48%) in group A and 31(41.33%) in group B were females. Comparison of clinical efficacy in both groups revealed that 43(57.33%) in group A and 21(28%) in group B were effectively treated while the remaining 32(42.67%) in group A and 54(72%) in group B did not show efficacy. A statistically significant difference (p-value=0.0001) was found in the comparison of the efficacy of both groups.

Conclusion: Clinical efficacy of bacteria-based probiotics is higher than fungi-based probiotics in the treatment of acute watery diarrhea.

Keywords: *Acute watery diarrhea. Bacteria-based probiotics. Fungi-based probiotics. Efficacy.*

INTRODUCTION

Diarrhea is reported to be one of the leading causes of death in developing countries. Every child, on average, suffers from 5-6 episodes of diarrhea per year in Pakistan. The prevalence of diarrhea in Pakistan has been found to be 7.8%.[1] Diarrhea is defined as the passage of loose, watery stools from the bowel three or more times a day, indicating a change in the consistency of stool. Diarrhea can lead to serious complications like severe malnutrition, and morbidity. The main causes of deaths due to diarrhea in developing countries are dehydration and water & electrolyte imbalances.[2] Diarrhea is one of the major known cause of prolonged hospital stay for children under five years.[3]

The term "Probiotics" is a Greek word that means "For Life". Probiotics are living microbial organisms such as bacteria or yeast which are known to be resistant to digestion. Usually, they remain alive in the colon and are beneficial to the host when ingested in the recommended dose.[4] Microbial intestinal flora is known to have a protective role probably due to their inherent metabolic activities which play a beneficial role for the host. Probiotics have shown to considerably decrease the gastrointestinal diseases such as childhood diarrhea antibiotic associated diarrhea, traveller's diarrhea, *Helicobacter pylori* infections, etc.[5]

The use of probiotics is recommended in the treatment of diarrhea in children.[6] The possible mechanisms by which probiotics work include antimicrobial products formation, competing with pathogens for nutrients required for their growth, and modifying toxins or toxin receptors. Also, they are known to modulate nonspecific and specific immune reactions in the body.[3] *Lactobacillus acidophilus,* a probiotic bacterium is effective in reducing the span of acute watery diarrhea.[7] *Saccharomyces boulardii,* a probiotic yeast, has also been documented in the treatment of various types of diarrhea.[5] Probiotics play an important role in microbiological and immunological effects in patients with watery diarrhea.[6] Probiotics differ in their ability to resist gastric acid and bile acids, colonize the intestinal tract, and influence cytokines secreted by intestinal epithelial cells. Thus, not all probiotics are alike. As a result, benefits observed clinically with one species or with a combination of species are not necessarily generalized to another. *Saccharomyces boulardii* and *Lactobacilli* have been reported to show different clinical efficacy in treating acute watery

Sharif Medical & Dental College, Sharif Medical City. Sharif Medical City Road, Off Raiwind Road, Jati Umra, Lahore 54000, Pakistan.

Correspondence: Dr. Sadia Alam
Assistant Professor Department of Pathology
Akhtar Saeed Medical & Dental College, Lahore
E-mail: laibasadia97@gmail.com

Received: May 24, 2021; Accepted: June 30, 2021

diarrhea.[8]

The rationale of the current study was to determine which type of probiotics either *Saccharomyces boulardii* or *Lactobacillus acidophilus* is more efficacious than the other. So, by using probiotic therapy complications of diarrhea can be prevented.

METHODOLOGY

It was a cross-sectional descriptive study conducted on 150 children with acute watery diarrhea admitted to the Paediatrics Department of Akhtar Saeed Trust Hospital, Lahore. After taking approval from the institutional ethical committee (Letter No. 1040917/ASTH, 15-04-2020), the study was conducted from May to June 2020. A total of 150 children of both genders between 5 months to 5 years of age who presented with acute watery diarrhea (more than or equal to 3 loose consistency stools in last 24 hours not more than 14 days) accompanied with severe dehydration (lethargic, drinking poorly, eyes markedly sunken, skin pinch >2 seconds) were included in the study.[9] These patients were treated with *Lactobacillus acidophilus* or *Saccharomyces boulardii.* Informed consent was taken from the parents/attendants of the children. Patients were included by convenient sampling technique and further divided into groups A & B. Group A included 75 patients treated with *Lactobacillus acidophilus* and group B comprised 75 patients treated with *Saccharomyces boulardii.* Children who had a history of antibiotic associated diarrhea and were already taking antibiotics/ antidiarrheal or probiotics in the previous weeks, immunodeficient children, children with severe abdominal distension and risk of bowel perforation, and those with a history of gastrointestinal tract surgery were excluded from the study.

Twelve billion lyophilized heat-killed *Lactobacillus acidophilus* was given twice a day to group A patients and 250 mg of *Saccharomyces boulardii* was given twice a day to patients included in group B. The children in each group (A and B) were observed on the 3rd day of treatment to see the efficacy. If diarrhea was resolved on day 3 of starting a probiotic, then that particular probiotic was considered as clinical efficient. Rehydration and Zinc supplements were given to every patient as recommended by World Health Organization.

STATISTICAL ANALYSIS

Analysis of data was done by Statistical Package for the Social Sciences (SPSS) version 25. Comparison of efficacy of probiotics in both the groups was analysed by using Chi-square test. A p-value ≤ 0.05 was considered to be statistically significant.

RESULTS

A total of 150 patients qualifying the inclusion were enrolled to compare the clinical efficacy of bacteria-based probiotics with fungi-based probiotics in treating watery diarrhea in children between 5 months to 5 years of age. The mean age in group A was 3.22±2.53 years while the mean age in group B was 3.76±2.89 years. Age distribution of patients included in group A & B is shown in Table 1. Our study showed that diarrhea is common under the age of 4 years and there is a decreasing trend of the proportion of older children affected by diarrhea. Frequency & severity of acute diarrhea was equal in both genders i.e. 52% in group A and 58.67% in group B affected by diarrhea were males, while 48% in group A and 41.33% in group B affected by diarrhea were females. Both bacterial and fungal probiotics showed significant clinical efficacy in diarrhea treatment. Comparison of efficacy in both groups showed that diarrhea was resolved in 57.33% in

Table 1: Study Variables of Group A & B

Study Variables		Group A	Group B
		Frequency (Percentage)	Frequency (Percentage)
Age (Years)	1-2	31(41.33%)	27(36%)
	3-4	24(32%)	31(41.33%)
	5	20(26.67%)	17(22.67%)
Gender	Male	39(52%)	44(58.67%)
	Female	36(48%)	31(41.33%)
Efficacy	Yes	43(57.33%)	21(28%)
	No	32(42.67%)	54(72%)

Table 2: Stratification for Efficacy in Both Groups According to Age & Gender

Study Variables		Group A (n=43)	Group B (n=21)
		Frequency (Percentage)	Frequency (Percentage)
Age (Years)	1-2	14(32.56%)	9(42.86%)
	3-4	17(39.53%)	7(33.33%)
	5	12(27.91%)	5(23.81%)
Gender	Male	26(60.47%)	14(66.67%)
	Female	17(39.53%)	7(33.33%)

group A and 28% in group B while the rest of 42.67% in group A and 72% in group B did not show efficacy. A statistically significant difference (p-value=0.0001) was found in the comparison of the efficacy of both groups. Stratification of age and gender in both groups is shown in Table 2.

DISCUSSION

Worldwide, diarrhea is the second most important cause of death in less than five years paediatric age group. Early management of diarrhea in children is essential, as it may lead to significant morbidity and mortality.[10]

Our study showed that diarrhea is common under the age of 4 years and there is a decreasing trend of the proportion of older children affected by diarrhea. This indicates that infants and younger children are more susceptible to organisms causing acute diarrhea. A study conducted by Shati et al., showed that diarrhea is more prevalent in children under 2 years of age.[11] In a recent study by Sanyaolu et al., it was illustrated that diarrhea was predominant among children less than 5 years of age.[9] The findings are similar to the present study results in terms of the age group affected by acute watery diarrhea.

Frequency & severity of acute diarrhea was equal in both genders i.e. 52% in group A and 58.67% in group B affected by diarrhea were males, while 48% in group A and 41.33% in group B affected by diarrhea were females. These findings are similar to a recent study which also supports our findings that there is no difference in severity or frequency of diarrhea in both genders.[10] A study by Mahmud et al., found that dehydrating diarrhea was more prevalent in girls when they presented to the hospital as compared to the boys, which contradicts the current study findings.[12]

Probiotics have therapeutical potential in treating dysbiosis involved in treating gastrointestinal disorders.[13] Our results showed that both bacterial and fungal probiotics showed significant clinical efficacy in diarrhea treatment. *Lactobacillus* was effective in treating 57.33% of all diarrhea cases. Another study revealed that it is beneficial in the treatment of diarrhea in children.[14] In the fungal probiotic group *Saccharomyces* showed clinical efficacy of 42.67%. A study conducted on beneficial effects on *Saccharomyces boulardii* also showed that it's a safe and effective remedy in treating acute diarrhea.[15]

Our results showed that clinical efficacy of bacterial-based probiotics given in group A is higher than fungal-based probiotics given in group B (p-value=0.0001). Comparable results were found in another study by Erdogan et al., showing that the clinical efficacy of bacterial probiotics is significantly higher than fungal probiotics coinciding with the present study results.[16]

CONCLUSION

Clinical efficacy of bacteria-based probiotics is higher than fungi-based probiotics in the treatment of acute watery diarrhea.

LIMITATIONS & RECOMMENDATIONS

Lactobacillus acidophilus is found more efficacious than *Saccharomyces boulardii* for resolving acute watery diarrhea. So, use of bacteria-based probiotics can decrease disease morbidity and mortality.

This study did not compare the adverse effects of the probiotics and hospital stay of the patients. Further studies are suggested to be carried out so that any adverse effects may be addressed.

REFERENCES

1. Ali R. The use of probiotic with ORS and ors only in children with acute diarrhea. J Coll Physicians Surg Pak. 2019; 29(12):1179-82. doi:10.29271/jcpsp.2019.12.1179.

2. Sharif A, Kheirkhah D, Esfandabadi PS, Masoudi SB, Ajorpaz NM, Sharif MR.Comparison of regular and probiotic yogurts in treatment of acute watery diarrhea in children. J Prob Health. 2017; 5:1. doi:1 0.4172/2329-8901.1000164.

3. Das JK, Bhutta ZA. Global challenges in acute diarrhea. Curr Opin Gastroenterol. 2016; 32(1):18-23. doi:10.1097/MOG. 0000000000000236.

4. Kim SK, Guevarra RB, Kim YT, Kwon J, Kim H, Cho JH, et al. Role of probiotics in human gut microbiome-associated diseases. J Microbiol Bio technol. 2019; 29(9):1335-40. doi:10.4014/jmb. 1906.06064.

5. Abedini M, Hejri GM, Delpisheh A, Rasouli MA, Afkhamzadeh A. Effect of probiotic treatment on acute diarrhea in childhood. J Food Hyg Saf. 2015; 1(2):78-82. Available from: https://www.researchgate.net/publication/311970595.

6. Van Best N, Trepels-Kottek S, Savelkoul P, Orlikowsky T, Hornef MW, Penders J. Influence of probiotic supplementation on the developing microbiota in human preterm neonates. Gut Microbes. 2020; 12(1):1-16. doi:10.1080/ 19490976.2020.1826747.

7. Di Cerbo A, Palmieri B, Aponte M, Morales-Medina JC, Iannitti T. Mechanisms and therapeutic effectiveness of lactobacilli. J Clin Pathol. 2016; 69(3):187-203. doi:10.1136/jclinpath-2015-202976.

8. Czerucka D, Rampal P. Diversity of *saccharomyces boulardii* CNCM I-745 mechanisms of action against intestinal infections. World J Gastroenterol. 2019; 25(18):2188-203. doi:10.3748/wjg.v25.i18.2188.

9. Sanyaolu A, Okorie C, Marinkovic A, Jaferi U, Prakash S, Jan A, et al. Global epidemiology and management of acute diarrhea in children from developing countries. Ann Pediatr Child Health. 2020; 8(8):1205. Available from: http://www.jscimedcentral.com/Pediatrics/pediatrics-8-1205.pdf.

10. Jarman AF, Long SE, Robertson SE, Nasrin S, Alam NH, McGregor AJ, et al. Sex and gender differences in acute pediatric diarrhea: a secondary analysis of the Dhaka study. J Epidemiol Glob Health. 2018; 8(1-2):42-7. doi:10.2991/j.jegh.2018.08.102.

11. Shati AA, Khalil SN, Asiri KA, Alshehri AA, Deajim YA, Al-Amer MS, et al. Occurrence of diarrhoea and feeding practices among children below two years of age in Southwestern Saudi Arabia. Int J Environ Res Public Health. 2020; 17(3):722. doi:10.3390/ijerph17030722.

12. Mahmud I, Das S, Khan SH, Faruque ASG, Ahmed T. Gender disparity in care-seeking behaviours and treatment outcomes for dehydrating diarrhoea among under-5 children admitted to a diarrhoeal disease hospital in Bangladesh: an analysis of hospital-based surveillance data. BMJ Open. 2020; 10(9): e038730. doi:10.1136/bmjopen-2020-038730.

13. Wilkins T, Sequoia J. Probiotics for gastrointestinal conditions: a summary of the evidence. Am Fam Physician. 2017;96(3):170-8. Available from:https://www.aafp.org/afp/2017/0801/afp20170801p170.pdf.

14. Malagon-Rojas JN, Mantziari A, Salminen S, Szajewska H. Postbiotics for preventing and treating common infectious diseases in children: a systematic review. Nutrients. 2020; 12(2):389. doi:10.3390/nu12020389.

15. Stier H, Bischoff SC. *Saccharomyces boulardii* CNCM I-745 beeinflusst das darmassoziierte immunsystem [*saccharomyces boulardii* CNCM I-745 influences the gut-associated immune system]. MMW Fortschr Med. 2017; 159(Suppl 5):1-6. doi:10.1007/s15006-017-9802-3.

16. Erdogan O, Tanyeri B, Torun E, Gonullu E, Arslan H, Erenberk H, et al. The comparison of the efficacy of two different probiotics in rotavirus gastroenteritis in children. J Trop Med. 2012; 2012:787240. doi:10.1155/2012/787240.

Original Article

Hip Abductor Strength following Total Hip Arthroplasty: A Prospective Study of Lateral Approach in 38 Patients

Farhan Majeed, Khawar Tufail, Ahmad Shams Nasir, Mohammad Arif, Zahid Shafique

ABSTRACT

Objective: To assess the hip abductor strength and Trendelenburg test after total hip arthroplasty through a lateral approach.

Methodology: It was a prospective cohort study conducted at the Department of Orthopedic Surgery, Services Hospital, Lahore over a duration of 10 months from March to December 2020. Thirty-Eight patients with unilateral hip osteoarthritis undergoing total hip arthroplasty via lateral approach were selected by convenient sampling. Pre-operative assessment of patients was done and the patients were re-assessed post-operatively after 1, 4, and 24 weeks for muscle strength using the Medical Research Council (MRC) Scale and Trendelenburg test. Paired t-test was used to assess the difference between mean abductor muscle strength after 1 and 24 weeks for statistical, significance considering a p-value ≤0.05 as a significant value.

Results: Out of the 38 patients selected, 2 were lost during the follow-up. Pre-operatively 24 patients tested positive and 14 tested negative for the Trendelenburg test on the involved side. The average muscle strength on the involved side pre-operatively was 3.67±0.43. There was a marked difference in the Trendelenburg test and muscle power pre-operatively on the normal side. One week post-operatively, 15 patients tested positive for the Trendelenburg test in contrast to 24 pre-operatively, 7 tested positive at 4 weeks and 3 tested positive at 24 weeks subsequently. Muscle power improved to 4.21±0.41 one week post-operatively in contrast to 3.67±0.43 pre-operatively, 4.53±0.51 at 4 weeks, and 4.95±0.23 at 24 weeks. This trend was seen in both males and females.

Conclusion: There is a marked improvement in hip abductor strength following total hip arthroplasty using lateral approach provided timely rehabilitation is applied along with good patient compliance. The MRC method has proven to be a simpler yet effective method.

Keywords: *Abductor strength. Lateral approach. Osteoarthritis. Total hip arthroplasty. Trendelenburg test.*

INTRODUCTION

Total hip arthroplasty is the preferred modality of treatment in advanced osteoarthritis of the hip or when all other modalities are deemed ineffective. It is most commonly performed via the lateral or posterior approach each having its merits and demerits. The lateral Hardinge approach requires the dissection of the abductor muscle mass which can result in weakened abductor muscle strength and abductor insufficiency post-operatively.[1] Abductor insufficiency may be caused due to either injury to the superior gluteal nerve or failure to securely attach the muscle mass following dissection.[2] This can have a significant functional outcome on the patient's post-operative activities of daily living. Some may require more time and rehabilitation for the recovery of the hip abductor strength to normal.[3]

The most common pathologies affecting the hip joint are avascular necrosis of the head of the femur, fracture of the neck of the femur and osteoarthritis. These pathologies can also render the abductor musculature of the hip joint weak on the affected side.[4] Patients with osteoarthritis of the hip joint, on the other hand, may already have reduced abductor weakness as a result of a reduction in mass, disuse, and pain in the hip joint, as a result of which the joint is prone to further mechanical instability, decreased shock absorption, and worsening the disease.[5]

Abductor muscles of the hip also play a leading role during the normal gait of the patient. During the stance phase of the gait cycle, the ipsilateral hip abductors have to contract eccentrically to stabilize the pelvis and to avoid excessive shock impact on the contralateral hip joint.[6] Weak abductors can result in a Trendelenburg gait where there is a drop or adduction of the opposite hip during walking. The primary muscles involved are the gluteus medius and gluteus maximus. Trendelenburg test was first described by Friedrich Trendelenburg in 1895 as a test for abductor muscle function.[7]

The Medical Research Council of Great Britain system is a method of manual muscle testing that has been in use since the early 1940's. It is simple to use and interpret using numbers between 0 and 5. This method of quantifying the strength of muscles has been used in several studies.[8]

Despite the increase in the number of total hip arthroplasties, much void in the literature needs to be filled in regard to how hip abductor strength is related to its function and which exercises yield the best functional outcome. Literature available in our country regarding the abductor strength post-operatively in patients of total hip arthroplasty is lacking. So, the aim

Sharif Medical & Dental College, Sharif Medical City. Sharif Medical City Road, Off Raiwind Road, Jati Umra, Lahore 54000, Pakistan.

Correspondence: Dr. Farhan Majeed
Senior Registrar Department of Orthopedics
Services Hospital, Lahore
E-mail: farhanmajeed_85@hotmail.com

Received: Jan 22, 2021; Accepted: June 28, 2021

of the current study was to investigate the hip abductor strength in patients undergoing total hip arthroplasty via lateral approach.

METHODOLOGY

It was a prospective cohort study conducted at the Department of Orthopedic Surgery, Services Hospital, Lahore after approval by the institutional ethical committee (Letter No. IRB/2020/468/SIMS, 04-01-2020) over a duration of 10 months from March to December 2020. Twenty female and eighteen male patients with unilateral primary or secondary osteoarthritis undergoing total hip arthroplasty were included in this study after written informed consent. Patients with bilateral hip osteoarthritis, previous surgery on the hip, previous hip fracture, hip dysplasia, diagnosis of congenital dislocation of the hip, Paget's disease, or rheumatoid were excluded from this study. Abductor strength of the patients was measured using the Medical Research Council Scale and Trendelenburg test pre-operatively & post-operatively. The surgery was performed by the two surgeons both using the lateral approach to minimize the bias of the technique. This approach involves splitting of the gluteus minimus and medius muscles following which these are retracted anteriorly and in continuity with the anterior portion of the vastus lateralis muscle.

Standard physical therapy regime was started on the first post-operative day and continued daily until discharge at about 1 week after the surgery. Exercises carried out before the discharge by the physiotherapist included an active range of motion of hip, knee, and ankle, and functional activities. Patients were advised partial weight bearing with an assisted walking device for 6 months and weight bearing as tolerated following that. Upon discharge, the patients were given instructions regarding home exercises and were called for follow-up at 2 weekly intervals. The patients were assessed after 1, 4, and 24 weeks of surgery.

In our study we had one physiotherapist who performed Trendelenburg test to standardize our results. The patients were asked to perform one leg stance for 20 seconds. If the patient was unable to hold the one leg stance for 20 seconds, the test was deemed positive and negative if the patient held onto a single leg stance for more than 20 seconds. Measurement of abductor strength and Trendelenburg test was performed by the same physiotherapist with the patient in an erect position. This assessment was done at 1, 4, and 24 weeks post-operatively.

The Medical Research Council muscle strength scoring system consists of 5 scores (Table 1). This was measured pre-operatively and then post-operatively after 1, 4, and 24 weeks at follow-up.

STATISTICAL ANALYSIS

Data was analyzed using Statistical Package for the Social Sciences (SPSS) version 26.0. Paired t-test was used to assess the difference between mean abductor muscle strength pre-operatively & post-operatively after 1, 4, and 24 weeks. The results were considered statistically significant with a p-value ≤ 0.05.

RESULTS

Out of the 38 patients selected, 20 were females and 18 were males. The mean age of patients was 71.96±8.60 years, with a mean height of 1.69±0.14 m and a mean weight of 77.05±13.56 kg. The youngest patient was 54 years of age and the oldest was 88. Two patients were lost to the follow-up. Thus 36 patients were assessed up to the end of the study period. Patient demographics are tabulated in Table 2.

Pre-operatively, 24 patients tested positive and 14 tested negative for the Trendelenburg test on the involved side. The average muscle strength on the involved side pre-operatively was 3.67±0.43. There was a marked difference in the Trendelenburg test and muscle power pre-operatively on the normal side. One

Table 1: Medical Research Council Muscle Strength Scoring System

Score	Description
0	No contraction visible or palpable
1	Flicker of contraction visible or palpable, although no limb movement
2	Active movement with gravity eliminated with full range of motion
3	Active movement against gravity with full range of motion
4	Active movement against moderate resistance with a full range of motion
5	Normal power

Table 2: Descriptive Information of Patients

		Age (Years)	Height (m)	Weight (kg)
Gender	**Females (n=20)**	66.80±7.78	1.65±0.07	78.40±11.45
	Males (n=18)	77.11±8.60	1.73±0.08	75.56±10.75
Mean±SD	**38**	71.96±8.60	1.69±0.14	77.05±13.56

Table 3: Trendelenburg Test and MRC Score of Study Subjects

Study Variables	Pre-operative	1-week Post-operative	4-week Post-operative	24-week Post-operative	Paired t-test statistics for Trendelenburg test & MRC score at 1 week and 24 weeks
Trendelenburg Test					
Positive	24	15	7	2	t=4.13 p-value=0.00
Negative	14	23	31	36	
MRC Score					
Mean±SD	3.67±0.43	4.21±0.41	4.53±0.51	4.95±0.23	t=-10.18 p-value=0.00
Minimum	3.00	4.00	4.00	4.00	
Maximum	4.00	5.00	5.00	5.00	

week post-operatively, 15 patients tested positive for the Trendelenburg test in contrast to 24 pre-operatively, 7 tested positive at 4 weeks and 3 tested positive at 24 weeks subsequently. Muscle power improved to 4.21±0.41 one week post-operatively in contrast to 3.67±0.43 pre-operatively, 4.53±0.51 at 4 weeks, and 4.95±0.23 at 24 weeks. This trend was seen in both males and females (Table 3).

DISCUSSION

Total hip arthroplasty is most commonly performed via the lateral Hardinge approach.[9] This was also the approach used for this study as it is commonly performed in our unit. There were 20 female and 18 male patients and the mean age of the patients was 71.96±8.60 years. Other studies also reported that osteoarthritis occurs more commonly in females, and in patients aged above 60 years.[10]

Pre-operatively, we assessed the abductor muscle strength and Trendelenburg test of both the affected and the unaffected side. The abductor muscle strength on the unaffected side was 5 out of 5 according to the MRC grading.This was mainly due to our selection of patients with unilateral hip osteoarthritis. This trend was seen in patients of all age groups. The affected side, however, revealed the mean abductor strength of 3.67±0.43 out of 5 pre-operatively. This was a result of pain in the affected hip due to osteoarthritis. Post-operatively the abductor strength was seen to be 4.21±0.41 out of 5 at the first week following the physiotherapy. This jumped to 4.53±0.51 out of 5 at 4 weeks and finally to 4.95±0.23 out of 5 at 24 weeks post-operatively. This was seen because the source of pain in the affected hip joint had been removed and the patients were better able to cope with abductor strengthening exercises as a result of which this improvement in abductor strength was observed post-operatively.

A systematic review and meta-analysis were conducted to evaluate abductor muscle strength deficit in patients having total hip arthroplasty. According to this review, the strength of abductor muscle is reduced as compared to the unaffected contralateral side but it is improved post-operatively after hip arthroplasty.[11]

The results revealed 2 patients testing positive on the unaffected side and 36 testing negative. This was an unusual finding since both of these patients had abductor strength of 5 out of 5 on the unaffected side. This discrepancy may be explained by poor understanding of the patients of the test pre-operatively since the investigator was the same pre and post-operatively. The affected side pre-operatively showed the test to be positive in 24 patients and negative in 14. This was in correlation to the fact that 27 patients had abductor muscle strength of less than 5 pre-operatively. Post-operatively, as the abductor strength improved, the patients testing negative for the Trendelenburg also increased. At one week post-operatively 15 patients tested positive and 23 negative in contrast to 24 testing positive and 14 negative pre-operatively. Those patients testing positive went from 7 at 4 weeks and 3 at 24 weeks post-operatively whereas those testing negative went from 31 at 4 weeks and 35 at 24 weeks post-operatively. We found patients with total hip arthroplasty had improved abductor muscle strength following physiotherapy by 24 weeks post-operatively. None of the patients was limited by pain during muscle strengthening exercises. In another study, 88 patients who underwent total hip arthroplasty through lateral approach were included in the study. They assessed abductor strength and Trendelenburg test post-operatively and found improved Trendelenburg test result after surgery (p-value <0.001).[12]

In this study, we used the MRC method of grading the abductor muscle power. This system of grading does, however, have its limitations which can lead to bias in the result. Large joint motor muscles such as deltoid around the shoulder joint and hip abductors may recover enough strength against resistance but may not be able to provide the full range of motion against gravity. This can lead to confusion between grades three and four. Recent studies used devices such as Kin-Com isokinetic dynamometer to evaluate muscle strength and it reduces the limitations faced when using the MRC system. Measurement with such devices is not without limitations, in the performance and accuracy of measurement of muscle strength.[13]

Another prospective study measured the abductor muscle strength of patients after total hip arthroplasty by using 1 Repetition Maximum (1RM) test. The study showed marked improvement in the abductor muscle strength following total hip replacement using the lateral approach. Although abductor strength post-operatively using the direct anterior or posterior approach was higher than the abductor strength using a direct lateral approach, the abductor strength using direct lateral approach reached 100% at 6 weeks and 112% at 3 months of the pre-operative value.[14] These finding are consistent with the results of our study. Another study conducted by Tantithawornwat et al., reported that abductor muscle strength increased after total hip arthroplasty. It has no significant correlation with preoperative limb lengthen discrepancy. Total hip arthroplasty is an effective modality to decrease pain & improve functional outcomes of the patients.[15]

CONCLUSION

Hip abductor strength improves markedly, following total hip arthroplasty using lateral approach provided timely rehabilitation is applied along with good patient compliance. Although multiple methods of measuring hip abductor muscle strength following total hip arthroplasty using lateral approach are available, the MRC method has proven to be a simpler yet effective method.

LIMITATIONS & RECOMMENDATIONS

The MRC system of grading does however have its limitations which can lead to bias in the result. Large joint motor muscles such as deltoid around the shoulder joint and hip abductors may recover enough strength against resistance but may not be able to provide the full range of motion against gravity. This can lead to confusion between grades three and four. Another limitation of the study is the need to standardize the pathologies leading to a decrease in hip abductor strength pre-operatively, as this can help us understand how already weakened abductor musculature of the hip due to underlying pathology can respond functionally following traumatizing lateral approach to the hip.

A larger sample size needs to be evaluated to further understand the functional outcome of abductors and to validate the efficacy of the MRC grading of muscle strength over newer devices used for measuring abductor strength.

REFERENCES

1. Tay K, Tang A, Fary C, Patten S, Steele R, de Steiger R. The effect of surgical approach on early complications of total hip arthoplasty. Arthroplasty. 2019; 1:5. doi:10.1186/s42836-019-0008-2.

2. Elbuluk AM, Coxe FR, Schimizzi GV, Ranawat AS, Bostrom MP, Sierra RJ, et al. Abductor deficiency-induced recurrent instability after total hip arthroplasty. JBJS Rev. 2020; 8(1):e0164. doi:10.2106/JBJS.RVW.18.00164.

3. Wang T, Shao L, Xu W, Chen H, Huang W. Comparison of morphological changes of gluteus medius and abductor strength for total hip arthroplasty via posterior and modified direct lateral approaches. Int Orthop. 2019; 43(11):2467-75. doi:10.1007/s00264-019-04331-z.

4. Fukushi JI, Kawano I, Motomura G, Hamai S, Kawaguchi KI, Nakashima Y. Does hip center location affect the recovery of abductor moment after total hip arthroplasty? Orthop Traumatol Surg Res. 2018; 104(8):1149-53. doi:10.1016/j.otsr.2018.06.022.

5. Loureiro A, Constantinou M, Diamond LE, Beck B, Barrett R. Individuals with mild-to-moderate hip osteoarthritis have lower limb muscle strength and volume deficits. BMC Musculoskelet Disord. 2018; 19(1):303. doi:10.1186/s12891-018-2230-4.

6. Gerhardt DMJM, Mors TGT, Hannink G, Van Susante JLC. Resurfacing hip arthroplasty better preserves a normal gait pattern at increasing walking speeds compared to total hip arthroplasty. Acta Orthop. 2019; 90(3):231-6. doi:10.1080/17453674.2019.1594096.

7. Gandbhir VN, Lam JC, Rayi A. Trendelenburg Gait. [Updated 2021 Feb 11]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2021. Available from: https://www.ncbi.nlm.nih.gov/books/NBK541094.

8. O'Neill S, Jaszczak SLT, Steffensen AKS, Debrabant B. Using 4+ to grade near-normal muscle strength does not improve agreement. Chiropr Man Therap. 2017; 25:28. doi:10.1186/s12998-017-0159-6.

9. Malviya A, Abdul N, Khanduja V. Outcomes following total hip arthroplasty: a review of the registry data. Indian J Orthop. 2017; 51(4):405-13. doi:10.4103/ortho.IJOrtho_177_17.

10. Komiyama K, Fukushi JI, Motomura G, Hamai S, Ikemura S, Fujii M, et al. Does high hip centre affect dislocation after total hip arthroplasty for developmental dysplasia of the hip? Int Orthop. 2019; 43(9):2057-63. doi:10.1007/s00264-018-4154-x.

11. Ismailidis P, Kvarda P, Vach W, Cadosch D, Appenzeller-Herzog C, Mundermann A. Abductor muscle strength deficit in patients after total hip arthroplasty: a systematic review and meta-analysis. J Arthroplasty. 2021; S0883-5403(21)00292-8. doi:10.1016/j.arth.2021.03.042.

12. Manafi Rasi A, Zandi R, Qoreishi M, Habibollahzadeh A. Magnetic resonance imaging assessment of hip abductor after total hip arthroplasty using a direct lateral approach. Arch Bone Jt Surg. 2020; 8(1):83-8. doi:10.22038/abjs.2019.38549.2020.

13. Cerda Vega E, Jerez-Mayorga D, Machado Payer R, Campos Jara C, Guzman-Guzman I, Reyes Ponce A, et al. Validity and reliability of evaluating hip abductor strength using different normalization methods in a functional electromechanical device. PLoS One. 2018; 13(8):e0202248. doi:10.1371/journal.pone.0202248.

14. Winther SB, Husby VS, Foss OA, Wik TS, Svenningsen S, Engdal M, et al. Muscular strength after total hip arthroplasty: a prospective comparison of 3 surgical approaches. Acta Orthop. 2016; 87(1):22-8. doi:10.3109/17453674. 2015. 1068032.

15. Tantithawornwat S, Narkbunnam R. Recovery of hip abductor muscle strength after total hip arthroplasty in patients with leg length discrepancy. J Med Assoc Thai. 2016; 99(11): 1226-32.Available from: https://thaiscience.info/Journals/Article/JMAT/10986484.pdf.

Original Article

Diagnostic Accuracy of Ultrasonography in Diagnosing Acute Pancreatitis, Taking Computed Tomography as Gold Standard

Rafia Irum, Maliha Yousaf

ABSTRACT

Objective: To determine the diagnostic accuracy of ultrasonography (USG) in diagnosing acute pancreatitis taking computed tomography as gold standard.

Methodology: It was a cross-sectional study conducted from September 2020 to February 2021 at the Department of Radiology, Sharif Medical & Dental College, Lahore. A total of 156 patients of both genders between 15-55 years and with a duration of disease <2 weeks were included in the study. Patients presented with symptoms of acute pancreatitis like sudden onset abdominal pain, fever (>101F), tachycardia (heart rate >120/min), and serum amylase > 400U/L were taken as positive symptoms and included in this study. Patients with history of abdominal trauma, hypersensitivity history to iodinated contrast agent, chronic kidney failure, claustrophobic patients, and patients unable to undergo Computed Tomography (CT) scanning were excluded from the study. After taking informed consent, ultrasonography (USG) of hepatic-biliary system was performed by the consultant radiologist and was looked for presence or absence of acute pancreatitis as per-operational definition. All patients underwent CT scan and reports were interpreted by the radiologist. Ultrasonographic findings were compared with CT scan findings.

Results: Ultrasonography supported the diagnosis of acute pancreatitis in 71(45.51%) patients. Computed tomography findings confirmed acute pancreatitis in 81(41.67%) cases. In USG positive patients, 59 were true positive and 12 were false positive. Among 85 USG negative patients, 06 were false negative whereas 79 were true negative (p=0.0001). Overall sensitivity, specificity, positive & negative predictive value and diagnostic accuracy of ultrasonography in diagnosing acute pancreatitis taking computed tomography as gold standard was 90.77%, 86.81%, 83.10%, 92.94% and 88.46%, respectively.

Conclusion: Ultrasonography is a highly sensitive and accurate non-invasive method in diagnosing acute pancreatitis.

Keywords: *Acute pancreatitis. Ultrasonography. Sensitivity. Specificity.*

INTRODUCTION

Acute pancreatitis (AP) is a sudden inflammation of the pancreas that can involve adjacent or farther-apart tissues and organs. It is caused by triggering of its own enzymes that causes digestion of the gland. Acute pancreatitis is a common presentation in the emergency department (ED), generally of mild and severe forms. Admission judgments by ED clinicians are done according to the severity of pancreatitis.[1,2]

Acute pancreatitis can be divided into mild acute pancreatitis (MAP) and severe acute pancreatitis (SAP). It is an inflammatory disorder of the pancreas that has been clinically defined as a common form of acute abdominal pain.[3] Mild acute pancreatitis has a good prognosis & few problems with low mortality. But, it is noted that severe acute pancreatitis that is followed by serious complications has a high mortality rate.[4,5] Early diagnosis of necrotizing pancreatitis is significant because it helps to select the proper therapy of this severe condition & improves clinical outcome, management, symptom, and prognosis.[6]

Sharif Medical & Dental College, Sharif Medical City. Sharif Medical City Road, Off Raiwind Road, Jati Umra, Lahore 54000, Pakistan.

Correspondence: Dr. Rafia Irum
Assistant Professor Department of Radiology
Sharif Medical & Dental College, Lahore
E-mail: dr.rafiaasim@gmail.com

Received: May 2, 2021; Accepted: June 27, 2021

Since the early 1980s, various clinical or radiological scoring systems have been developed to predict the incidence and outcome of acute pancreatitis. Validation & comparison of the different scoring systems are complicated by confusing and incompatible use of terminology and definitions of severity, complications, and outcome of the disease.[7]

Predicting the development of disease has remained a major challenge in managing of acute pancreatitis. The Bedside Index for Severity in Acute Pancreatitis (BISAP) is easy to calculate from the data available in the first124 hours.[8] The BISAP is a new, convenient, prognostic multifactor scoring system. The BISAP score may be a useful tool for risk stratification and prognostication in acute pancreatitis patients.[9] Computed tomography severity index (CTSI) requires the use of intravenous contrast agents to determine the presence and extent of pancreatic necrosis, as well as inflammatory changes and local and/or extra-pancreatic complications.[10] Computed tomography severity index is highly precise & sensitive than any other method in both diagnosing as well as demonstrating the extent of pancreatitis.[11]

Abdominal imaging is useful to confirm the AP diagnosis. For the diagnosis of AP, contrast enhanced computed tomography (CECT) has a high sensitivity and specificity of 94.4%.[12] Contrast enhanced computed tomography should not be used routinely in patients with AP because the diagnosis is obvious in many patients and the majority of them have a mild,

uncomplicated path.[13] Contrast Enhanced CT is considered to be the gold standard imaging modality in the assessment of patients with acute pancreatitis.[14]

Ultrasonography is a medical diagnostic imaging modality that is widely used for AP because of its simplicity, portability, low cost, and low radiation exposure.[15] In a study, Fei et al. has shown sensitivity and specificity of ultrasonography in diagnosing acute pancreatitis as 92.0% and 84.0%, respectively.[16] The imaging role is not only to diagnose acute pancreatitis but to demonstrate the presence & extent of pancreatic necrosis and the complications of acute pancreatitis. On searching the literature, it has been observed that limited information is available regarding the diagnostic accuracy of ultrasonography for detection of acute pancreatitis as well as no local study done in this regard, so this study was planned to determine the diagnostic accuracy of ultrasonography for detection of acute pancreatitis. This study will not only provide the local stats of the issue but will also be a useful addition in the existing literature. Furthermore, it may serve as an alternate to CT hence a simple, economical and cost effective diagnostic tool can be offered to the patient.

METHODOLOGY

This cross sectional study was conducted from September 2020 to February 2021in the Radiology department of Sharif Medical & Dental College, Lahore after obtaining permission from the institutional board of the hospital (SMDC/SMRC/129-20, 06-08-2020). Informed written consent was obtained from the patients. A sample size of 156 was calculated with 95% confidence level by taking expected prevalence of acute pancreatitis as 85.20% and 5% desired precision for sensitivity and 15% for specificity of USG in diagnosing acute pancreatitis as 92.0% & 84.0%, respectively.[16]

All the patients presenting with clinical symptoms of suspected acute pancreatitis like sudden onset abdominal pain, fever (>101F), tachycardia (heart rate >120/min), and serum amylase >400U/L were taken as positive and were included in the study. Patients of both genders between 15-55 years and with a duration of disease <2 weeks were included in the study. Patients with history of abdominal trauma, history of hypersensitivity to iodinated contrast agent, chronic kidney failure (assessed on history and medical record (s/creatinine >1.1mg/dl), claustrophobic patients, and those who were unable to undergo CT scanning were excluded from the study.

After taking informed consent, ultrasonography of hepato-biliary system was performed by the consultant radiologist (at least 3 years of post-fellowship experience) and was looked for presence or absence of acute pancreatitis. All patients underwent CT scan and reports were interpreted by the consultant radiologist (at least 3 years of post-fellowship experience). Ultrasonography findings were compared with CT scan findings. All this data including the demographic data (age, gender, duration of disease, BMI) was recorded on a specially designed proforma.

STATISTICAL ANALYSIS

Data was entered in Statistical Package for the Social Sciences (SPSS) version 25. Age, duration of disease, BMI were presented as mean & standard deviation. Categorical data like gender and acute pancreatitis on USG and CT were presented as percentage & frequencies. A 2×2 contingency table was used to calculate sensitivity, specificity, positive & negative predictive value and diagnostic accuracy of multi slice CT scan in diagnosing necrotizing pancreatitis, taking histopathology as gold standard. Effect modifiers like age, gender, duration of disease, and BMI were controlled by stratification. Post-stratification 2×2 contingency table was used to calculate specificity, sensitivity, positive & negative predictive value & diagnostic accuracy of USG in diagnosing acute pancreatitis. A p-value ≤0.05 was taken as significant. Patients with acute pancreatitis on ultrasonography as well as on CT scan were taken as true positive. Patients with no acute pancreatitis on ultrasonography as well as on CT scan were taken as true negative. The patients with acute pancreatitis on ultrasonography but absent on CT scan were considered as false positive and those with no acute pancreatitis on ultrasonography but present on CT scan were considered false negative.

RESULTS

In our study, a total of 156 patients were included. The mean age of the patients was 43.98±7.01 years. One thirty seven patients (87.82%) were between 36 to 55 years of age. Out of these 156 patients, 97(62.18%) were males & 59(37.82%) were females with a ratio of 1.6:1. Average duration of disease and BMI was 7.27±3.35 days and 28.83±3.40 kg/m^2, respectively (Table 1).

Ultrasonography (USG) supported the diagnosis of acute pancreatitis in 71(45.51%) patients. CT findings confirmed acute pancreatitis in 81(41.67%) cases. In USG positive patients, 59 were true positive and 12 were false positive. Among 85, USG negative patients, 06 were false negative whereas 79 were true negative (p=0.0001) (Table 2). Sensitivity, specificity, positive, negative predictive value, and diagnostic accuracy of ultrasonography in diagnosing acute pancreatitis, taking computed tomography as gold standard was 90.77%, 86.81%, 83.10%, 92.94%, and 88.46%, respectively. Diagnostic accuracy stratification with respect to age group, gender, duration of disease &

BMI are shown in Table 3, 4, 5, and 6.

DISCUSSION

Pancreatitis is an inflammatory process in which pancreatic enzymes auto digest the gland. The gland sometimes heals without any impairment of function or any morphologic changes; this process is known as acute pancreatitis. Pancreatitis can also recur on a regular basis, leading to the gland's functional and morphologic loss; this is referred to as chronic pancreatitis. The pancreas is just 0.1 percent of total body weight, but it has 13 times the protein-producing capacity of the liver and reticuloendothelial system, which together accounts for 4% of the total body weight.[15] In the primary phase of acute pancreatitis, abdominal USG is the main imaging technique for assessment of biliary stones as the cause of acute pancreatitis & for assessment of the biliary tract.[8]

This study was done to see how much is the diagnostic accuracy of ultrasonography in diagnosing acute pancreatitis, taking computed tomography as the gold standard. The mean age of the patients in our study was 43.98±7.01 years. Most of the patients, 137 (87.82%) were between 36 to 55 years of age. Ultrasonography supported the diagnosis of acute pancreatitis in 71 (45.51%) patients. Computed tomography findings confirmed acute pancreatitis in 81 (41.67%) cases. Fifty nine patients were true positive and 12 were false positive in USG positive patients. Six were false negative whereas 79 were true negative in USG negative patients (p=0.0001).

In our study, total sensitivity, specificity, positive &

Table 1: Distribution of Patients According to Age, Gender, Duration of Symptoms and BMI

Study Variables		Results
Age (Years)	Mean±SD	43.98±7.01
	15-35	19(12.18%)
	36-55	137(87.82%)
Gender	Male	97(62.18%)
	Female	59(37.82%)
Duration of Symptoms (Days)	Mean±SD	7.27±3.35
	≤ 7	85(54.49%)
	> 7	71(45.51%)
BMI (kg/m^2)	Mean±SD	28.83±3.40
	≤27	56(35.90%)
	>27	100(64.10%)

Table 2: Diagnostic Accuracy of Ultrasonography in Diagnosing Acute Pancreatitis, taking Computed Tomography as Gold Standard

	Positive on CT Scan	Negative on CT Scan
Positive on USG	59(True positive)	12(False positive)
Negative on USG	06(False negative)	79(True negative)
p-value	0.0001	
Sensitivity	90.77%	
Specificity	86.81%	
Positive Predictive Value	83.11%	
Negative Predictive Value	92.94%	
Diagnostic Accuracy	88.46%	

Table 3: Stratification of Diagnostic Accuracy and Age

	Age (Years)			
	15-35 (n=19)		36-55 (n=137)	
	Positive on CT Scan	Negative on CT Scan	Positive on CT Scan	Negative on CT Scan
Positive on USG	10(True positive)	01(False positive)	49(True positive)	11(False positive)
Negative on USG	0(False negative)	08(True negative)	06(False negative)	71(True negative)
p-value	0.001		89.09%	
Sensitivity	100%		86.59%	
Specificity	88.89%		86.59%	
Positive Predictive Value	90.92%		81.67%	
Negative Predictive Value	100%		92.21%	
Diagnostic Accuracy	94.74%		87.59%	

Table 4: Stratification of Diagnostic Accuracy and Gender

	Gender			
	Male (n=97)		Female (n=59)	
	Positive on CT Scan	Negative on CT Scan	Positive on CT Scan	Negative on CT Scan
Positive on USG	41(True positive)	04(False positive)	18(True positive)	08(False positive)
Negative on USG	02(False negative)	50(True negative)	04(False negative)	29(True negative)
p-value	0.001		0.001	
Sensitivity	93.35%		81.82%	
Specificity	92.59%		78.38%	
Positive Predictive Value	91.11%		69.23%	
Negative Predictive Value	96.15%		87.88%	
Diagnostic Accuracy	93.81%		79.66%	

Table 5: Stratification of Diagnostic Accuracy and Duration of Disease

	Duration of Disease (Days)			
	≤7 (n=85)		>7 (n=40)	
	Positive on CT Scan	Negative on CT scan	Positive on CT scan	Negative on CT scan
Positive on USG	30(True positive)	06(False positive)	29(True positive)	06(False positive)
Negative on USG	06(False negative)	43(True negative)	00(False negative)	36(True negative)
p-value	0.001		0.001	
Sensitivity	83.33%		100%	
Specificity	87.76%		85.71%	
Positive Predictive Value	83.33%		82.86%	
Negative Predictive Value	87.76%		100%	
Diagnostic Accuracy	85.88%		91.55%	

Table 6: Stratification of Diagnostic Accuracy and BMI ≤27 kg/m^2

	BMI (kg/m^2)			
	≤27 (n=56)		>27 (n=100)	
	Positive on CT scan	Negative on CT scan	Positive on CT scan	Negative on CT scan
Positive on USG	21(True positive)	04(False positive)	38(True positive)	08(False positive)
Negative on USG	04(False negative)	27(True negative)	02(False negative)	52(True negative)
p-value	0.001		0.001	
Sensitivity	84.0%		95.0%	
Specificity	87.10%		86.67%	
Positive Predictive Value	84.0%		82.61%	
Negative Predictive Value	87.10%		96.30%	
Diagnostic Accuracy	85.71%		90.0%	

negative predictive value or diagnostic accuracy of ultrasonography in diagnosing acute pancreatitis, taking computed tomography as gold standard was, 90.77% sensitivity, which is the ability of USG to correctly identify those patients who had acute pancreatitis, 86.81% specificity which has the ability of USG to correctly identify those patients who did not have acute pancreatitis. Another study showed 92.0% sensitivity & 84.0% specificity of ultrasonography in diagnosis of patients with acute pancreatitis.[16]

In a study by Tenner et al., a total 110 consecutive patients with acute pancreatitis were included. In a patient with clinically serious acute pancreatitis, the probability of a positive ultrasound result was 89.60% (sensitivity). Ultrasound had a sensitivity of 77.80% in assessing moderate and extreme types of acute pancreatitis as defined at laparotomy. The low specificity of ultrasound was 44.00% in comparison with modified prognostic criteria, but high in comparison with CT (87.50%) & staging at laparotomy (85.69%). According to the author, the early ultrasound in acute pancreatitis is helpful in diagnosing the severity of the disease and also affect the decision making. As compared to our results, the sensitivity, specificity, positive & negative predictive value and diagnostic accuracy of ultrasonography in diagnosing acute pancreatitis, taking computed tomography as gold standard was 90.77%, 86.81%, 83.10%, 92.94%, and 88.46%, respectively.[17]

Ultrasonography of the pancreas is challenging, given its retroperitoneal position with overlying structures & comparatively small size. Initial works in the countries, describe the sign of pancreatic structural changes seen by trans-abdominal ultrasonography of around two-thirds in the diagnosed chronic pancreatitis cases.[18] Early diagnosis of acute pancreatitis is greatly modified after advent of USG & CECT scan because pancreas is a difficult organ to evaluate by conventional radiological techniques.

CONCLUSION

Ultrasonography is a highly sensitive & accurate non-invasive method in diagnosing acute pancreatitis. It has not only improved ability of detection of acute pancreatitis but also better patient care by proper pre-operative planning and management of acute pancreatitis patients.

LIMITATIONS & RECOMMENDATIONS

One of the limitations of the study was bowel gas, which can obscure the pancreas. These limitations are overcome by using CT, which provides more diagnostic information in the assessment of both acute and chronic pancreatitis pathologies. Sample size was small and the study was undertaken in a single center. Future studies should be multicentered. We recommend that USG should be used routinely for accurate detection of acute pancreatitis which will help in proper pre-operative planning for these particular patients in order to reduce the morbidity & mortality of such patients.

REFERENCES

1. Kuo DC, Rider AC, Estrada P, Kim D, Pillow MT. Acute pancreatitis: what's the score? J Emerg Med. 2015; 48(6):762-70. doi:10.1016/j.jemermed .2015.02.018.
2. Urooj T, Shoukat S, Bokhari I, Mahmood T. Diagnostic accuracy of contrast enhanced computed tomography (CECT) in detection of necrosis in acute pancreatitis by taking surgical findings as gold standard. J Pak Med Assoc. 2020; 70(11):1930-3. doi:10.47391/JPMA.1070.
3. Bruno MJ, Group DPS. Improving the outcome of acute pancreatitis. Dig Dis. 2016; 34(5):540-5. doi:10.1159/000445257.
4. Werge M, Novovic S, Schmidt PN, Gluud LL. Infection increases mortality in necrotizing pancreatitis: a systematic review and meta-analysis. Pancreatology. 2016; 16(5):698-707. doi:10.1016/j.pan.2016.07.004.
5. Schepers NJ, Bakker OJ, Besselink MG, Ali UA, Bollen TL, Gooszen HG, et al. Impact of characteristics of organ failure and infected necrosis on mortality in necrotising pancreatitis. Gut. 2019; 68(6):1044-51. doi:10.1136/gutjnl-2017-314657.
6. Chen HZ, Ji L, Li L, Wang G, Bai XW, Cheng CD, et al. Early prediction of infected pancreatic necrosis secondary to necrotizing pancreatitis. Medicine (Baltimore). 2017; 96(30):e7487. doi:10.1097/ MD.0000000000007487.
7. Chandra S, Murali A, Bansal R, Agarwal D, Holm A. The Bedside index for severity in acute pancreatitis: a systematic review of prospective studies to determine predictive performance. J Community Hosp Intern Med Perspect. 2017; 7(4):208-13. doi:10.1080/20009666.2017.1361 292.
8. Valverde-Lopez F, Matas-Cobos AM, Alegria-Motte C, Jimenez-Rosales R, Ubeda-Munoz M, Redondo-Cerezo E. BISAP, RANSON, lactate and other biomarkers in prediction of severe acute pancreatitis in a European cohort. J Gastroenterol Hepatol. 2017; 32(9):1649-56. doi:10.1111/ jgh.13763.
9. Sahu B, Abbey P, Anand R, Kumar A, Tomer S, Malik E. Severity assessment of acute pancreatitis using CT severity index and modified CT severity index: correlation with clinical outcomes and severity grading as per the revised Atlanta classification. Indian J Radiol Imaging. 2017; 27(2):152-60. doi:10.4103/ijri.IJRI_300_16.
10. Raghuwanshi S, Gupta R, Vyas MM, Sharma R. CT evaluation of acute pancreatitis and its prognostic correlation with CT severity index. J Clin Diagn Res. 2016; 10(6):TC06-11. doi:10. 7860/JCDR/2016/19849.7934.
11. Parniczky A, Kui B, Szentesi A, Balazs A, Szucs A, Mosztbacher D, et al. Prospective, multicentre, nationwide clinical data from 600 cases of acute pancreatitis. PLoS One. 2016;11(10):e0165309. doi:10.1371/journal. pone.0165309.

12. Harshit Kumar A, Singh Griwan M. A comparison of APACHE II, BISAP, Ranson's score and modified CTSI in predicting the severity of acute pancreatitis based on the 2012 revised Atlanta classification. Gastroenterology report. 2018; 6(2):127-31. doi:10.1093/gastro/gox029.

13. Cai D, Parajuly SS, Wang H, Wang X, Ling W, Song B, et al. Accuracy of contrast-enhanced ultrasound compared with conventional ultrasound in acute pancreatitis: diagnosis and complication monitoring. Exp Ther Med. 2016; 12(5):3189-94. doi:10.3892/etm.2016.3760.

14. Fei Y, Gao K, Hu J, Tu J, Li WQ, Wang W, et al. Predicting the incidence of portosplenomesenteric vein thrombosis in patients with acute pancreatitis using classification and regression tree algorithm. J Crit Care. 2017; 39:124-30. doi:10.1016/j. jcrc. 2017.02.019.

15. Yu X, Ding Q, Hu C, Mu G, Deng Y, Luo Y, et al. Evaluating micro-optical coherence tomography as a feasible imaging tool for pancreatic disease diagnosis. IEEE J Sel Top Quantum Electron. 2018; 25(1):1-8. doi.org/10.1109/JSTQE.2018. 2827662.

16. Fei Y, Li W. Effectiveness of contrast-enhanced ultrasound for the diagnosis of acute pancreatitis: a systematic review and meta-analysis. Dig Liver Dis. 2017; 49(6):623-9. doi:10.1016/j.dld. 2017. 03.017.

17. Tenner S, Baillie J, DeWitt J, Vege SS. American College of Gastroenterology guideline: management of acute pancreatitis. Am J Gastroenterol. 2013; 108(9):1400-15. doi:10. 1038/ajg.2013.218.

18. Shah AP, Mourad MM, Bramhall SR. Acute pancreatitis: current perspectives on diagnosis and management. J Inflamm Res. 2018; 11:77-85. doi:10.2147/JIR.S135751.

Original Article

Levels of Immature Platelet Fraction in Patients of Acute Coronary Syndrome

Sadia Ijaz, Israrul Haque, Muhammad Muzammil Bajwa, Junaid Mushtaq, Ghias un Nabi Tayyab, Mujtaba Hassan Siddiqui

ABSTRACT

Objective: To measure the level of immature platelet fraction in patients with the acute coronary syndrome.

Methodology: It was a cross-sectional comparative study conducted at the Department of Pathology, Postgraduate Medical Institute, Lahore from November 2017 to November 2018. One hundred and seventy respondents were included and divided into two groups, a case group, and a control group. In the case group, 85 patients of acute coronary syndrome and in the control group, 85 age-matched normal healthy individuals were included using a non-probability convenient sampling technique. The immature platelet fraction (IPF) was measured in both groups using Sysmex haematology analyser (XN-1000). An independent sample t-test was applied to compare the mean of normally distributed data in both groups.

Results: The ages of the patients in case group ranged between 18-86 years and in control group 17-80 years. No statistical significant difference was found when the age of the patients and the controls were compared (p-value >0.05). In the case group, there were 45(26.47%) males and 40(23.53%) females whereas in the control group there were 47(27.65%) male and 38(22.35%) female cases. The mean immature platelet fraction in the case group and control group was 8.716±6.2834% and 3.83±1.63%, respectively. A significant difference was found in the comparison of mean IPF in the case & control groups (p-value <0.001).

Conclusion: The levels of immature platelet fraction were raised among patients with the acute coronary syndrome. So, increased levels of IPF can lead to other thrombotic events or unfavorable prognosis in patients with acute coronary syndrome (ACS).

Keywords: *Immature platelet fraction. Mean platelet volume. Acute coronary syndrome. Cardiovascular disease.*

INTRODUCTION

Cardiovascular diseases are the major cause of death around the world.[1] Among cardiovascular diseases, acute coronary syndrome is the leading cause of morbidity and mortality. Acute coronary syndrome accounts for the first presentation of coronary vessel diseases and is a broader term used for describing signs and symptoms of cardiac ischemia.[2] On the basis of signs and symptoms, findings on ECG and certain laboratory parameters ACS can be sub-grouped as ST-segment & non-ST-segment elevation myocardial infarction, and unstable angina. The acute coronary syndrome can cause fatal events like cardiogenic shock causing the sudden arrest of cardiac activity further leading to death.[3] Amongst today's challenges, the major goal is to design such strategies which can prevent the occurrence of adverse coronary events and identify the individuals who are at greater risk of occurrence of ACS.[4]

Cardiac troponins and iso-enzymes of creatine kinase are the routine investigations that are being used for the diagnosis of ACS. Troponin is the most sensitive, specific, and reliable cardiac marker and is being currently used as a gold standard investigation for the diagnosis and risk stratification in ACS patients. However, it remains undetectable in 40-60% of the patients who are suffering from ACS. Platelet indices are a more reliable and accurate tool, as a new cardiac biomarker, of cardiovascular events and can be used potentially for the risk stratification of cardiovascular diseases.[5] Platelets are now being considered as the source of release of inflammatory mediators. These mediators further lead to platelet adhesion. The thrombotic potential of platelets causes the release of further mediators which leads to the activation of the inflammatory process and the propagation of the coronary vessel thrombosis predisposing to the thrombotic events.[6]

Platelets vary in properties like size, density, and activity. These variations can be associated with the initial triggering factor of ACS. Platelets that are large in size have stronger adhesion potential and aggregating effect than the platelets with smaller size. An increase in the volume of platelets is associated with the increased prothrombotic potential of atherosclerotic plaque in ACS and is the risk factor for thrombus formation in coronary vessels in patients of acute myocardial infarction (AMI).[7]

Mean platelet volume (MPV) is a component of complete blood count (CBC) and is the commonly used most reliable index for platelet size identification and the status of its activation. An increase in MPV is associated with various cardiovascular risk factors and

Sharif Medical & Dental College, Sharif Medical City. Sharif Medical City Road, Off Raiwind Road, Jati Umra, Lahore 54000, Pakistan.

Correspondence: Dr. Sadia Ijaz
Demonstrator Department of Pathology
Postgraduate Medical Institute, Lahore
E-mail: drsadia.amir87@gmail.com

Received: Mar 10, 2021; Accepted: June 27, 2021

comorbidities like diabetes mellitus, hypertension, hypercholesterolemia, and obesity.[8]

Amongst the platelets circulating, the youngest form is the reticulated platelets. They are bigger than the senescent platelets and they have the residual RNA that gives the reticulated appearance and are hyperactive because they express more GPIb and GPIIb/IIIa receptors. Now a days, a fast fully automated method is available for the quantification of reticulated platelets via a parameter called IPF, which is a ratio of reticulated platelets and a total number of platelets. Immature platelet fraction may be a more sensitive and specific indicator as compared to MPV for the measurement of platelet reactivity.[9] It is noticed that in subjects with coronary artery disease, IPF is increased as compared to normal healthy subjects. The formation of atherosclerotic plaque results in complications like myocardial infarction and stroke due to the occlusion of thrombotic vessels. Vascular damage repair and the maintenance of narrow capillaries to remain patent is a complex, mechanism and platelets act as a key for the regulation of the process.[10]

Platelets contribute to both the dysfunction of endothelium and the rupture of plaque in the process of atherosclerosis. The platelet interaction with endothelium lining vessels causes excessive activation of platelets which reduces the half-life and increases the turnover of platelets, hence influence the MPV and IPF.[11] Activation of platelets causes the release of specific proteins. β-TGF is the first platelet-specific protein that is released during the aggregation of platelets resulting in inflammatory and thrombotic processes that both play part in the pathogenesis of the development of ACS.[12]

Platelet activation parameters can be beneficial tools for coronary disease progression before the occurrence of cardiac cell necrosis.[13] Hence the goal of this study was to evaluate platelet morphological index in patients of ACS as compared to controls without ACS.

METHODOLOGY

It was a cross-sectional comparative study and carried out at the Department of Pathology, Postgraduate Medical Institute, Lahore. The study was approved by the ethical committee of the institution (ethical approval # UHS/Education/126-17/3368, 01-08-2017). The study patients were selected from the Punjab Institute of Cardiology Lahore, employing a non-probability convenient sampling technique. The duration of the study was from November 2017 to November 2018. A total of 170 subjects were included and divided into two groups, the case group, and the control group. In the case group, 85 patients of acute coronary syndrome, and in the control group, 85 age-matched normal healthy individuals were included. Both the study groups included individuals greater than 18 years of age. Patients included in the case group had raised levels of cardiac troponin I >0.04 ng/ml and at least one of the following was a must to be present for the inclusion in the current study: clinical symptoms of ischemia/significant ST-segment & T wave changes/ development of pathological Q waves.

Patients with acute inflammation, chronic circulatory insufficiency, cancer, renal failure, diabetes mellitus, history of acute coronary syndrome, patients on anticoagulant treatment (acenocoumarol, warfarin, dabigatran, rivaroxaban), and patients taking antiplatelet drugs (acetylsalicylic acid, clopidogrel, ticagrelor) were excluded from the study.

A questionnaire was filled for each patient, samples were collected and tests were performed to collect the required data. After obtaining the informed consent of the patients, the personal information of patients was recorded on the proforma designed for the study. The blood pressure of all the patients and controls was measured. Under aseptic measures, venous blood was collected in EDTA & gel vacutainers. Random blood sugar and serum creatinine were measured in both groups. Complete blood count was performed within 3-4 hours of sample collection using Sysmex automated hematology analyzer (XN-1000) and immature platelet fraction was checked.

STATISTICAL ANALYSIS

Data was entered and analyzed using Statistical Package for the Social Sciences (SPSS) version 24. Mean±standard deviation (SD) was used for quantitative data like age, blood pressure, random blood glucose, serum creatinine, and immature platelet fraction. An independent sample t-test was applied to compare the mean values of study variables of both groups. A p-value ≤0.05 was considered as significant.

RESULTS

The ages of the patients in case group ranged between 18-86 years and in control group 17-80 years. No statistical significant difference was found when the age of the patients and the controls were compared (p-value >0.05).

In the case group, there were 45(26.47%) males and 40(23.53%) females whereas in the control group there were 47(27.65%) male and 38(22.35%) female cases. Regarding gender, no significant results were seen when both groups were compared (p-value=0.758). Figure 1 shows gender distribution in both groups.

The mean systolic blood pressure (BP) in patients and controls was 137.68±15.621mmHg and 128.89±18.813 mmHg, respectively, while the mean diastolic BP in patients and controls was 86.36±9.716 mmHg and 81.39±11.536 mmHg, respectively. The

mean systolic and diastolic BP was statistically higher in the case group as compared to controls (p-value ≤0.05). The mean blood glucose levels in the case group were 132.21±33.63 mg/dL and in controls was 132.84±32.04 mg/dL. The mean glucose level was not statistically different in both groups (p-value=0.984).

The mean serum creatinine in ACS patients was 1.01±0.32 mg/dL and in controls was 0.913±0.26 mg/dL with statistically higher levels in ACS patients (p-value=0.02).

The mean immature platelet fraction in ACS patients and controls was 8.716±6.2834% and 3.83±1.63%, respectively (Table 1). Mean IPF was statistically high in the case group as compared to controls (p-value=0.001). Figure 2 shows immature platelet fraction (%) in both study groups.

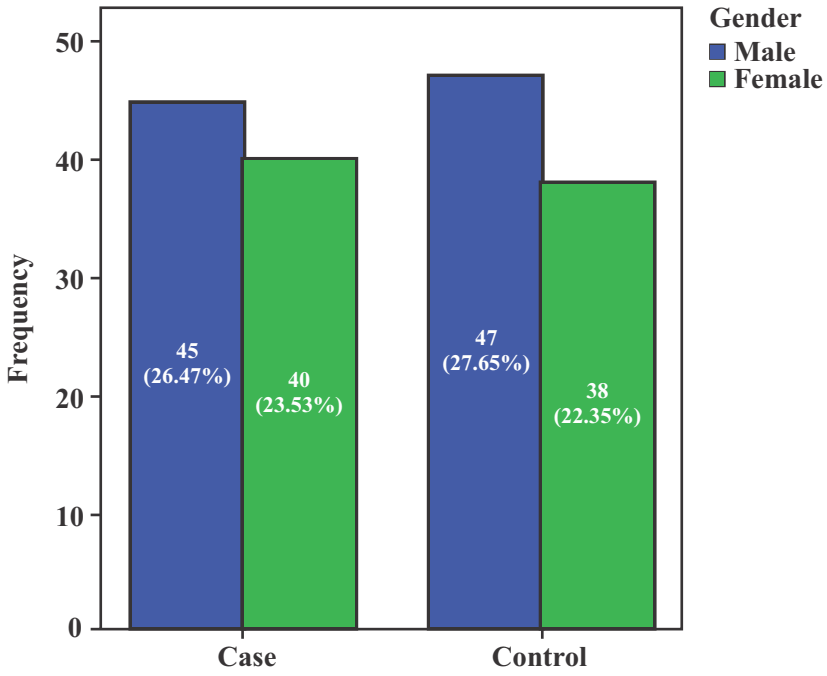

Figure 1: Gender Distribution in Both Groups

Table 1: Study Variables of Both Study Groups

Study Variables	Study Patients	Mean±SD	Minimum	Maximum	p-value
BP Systolic (mmHg)	Case	137.68±15.621	110	160	0.001
	Control	128.89±18.813	112	155	
BP Diastolic (mmHg)	Case	86.36±9.716	70	100	0.003
	Control	81.39±11.536	70	100	
Blood glucose levels (mg/dL)	Case	132.21±33.63	183	60	0.984
	Control	132.84±32.04	183	60	
Serum creatinine (mg/dL)	Case	1.01±1.10	0.3	1.7	0.02*
	Control	0.913±1.10	0.6	1.5	
Immature Platelet Fraction (%)	Case	8.716±6.2834	31.6	6.8	<0.001*
	Control	3.83±1.63	6.8	2.8	

**Significant p-value*

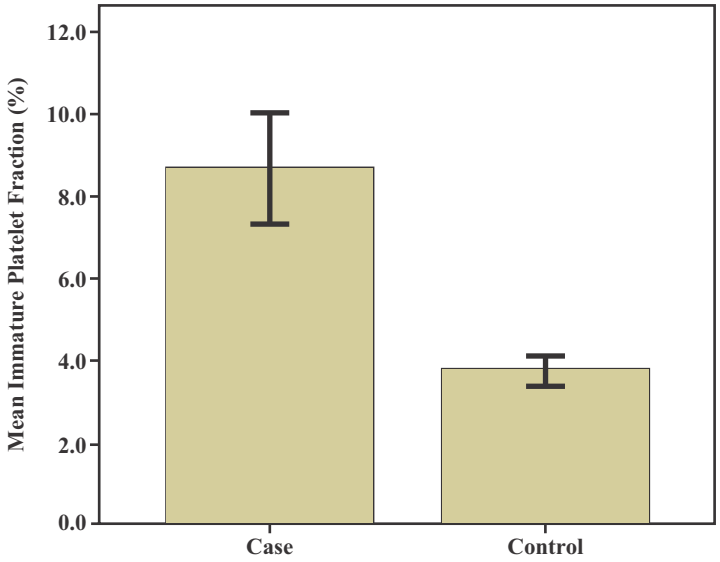

Figure 2: Immature Platelet Fraction (%) in Both Study Groups

DISCUSSION

Among the cardiovascular diseases acute coronary syndrome is considered to be one of the most prevalent and a major cause of mortality worldwide.[3] Raised levels of immature platelet fraction are observed among patients with acute coronary syndrome when compared with normal healthy individuals. Age is considered the most important factor that plays a significant role in the progression of numerous diseases because most of the diseases are prevalent among elderly people with increasing age.[1]

The present study indicated that the majority of the patients in both groups were more than 50 years old. Similar results were found in another study conducted by Pervin and teammates, who reported that most of the patients were more than 40 years old while some of them were up to 40 years old.[14] Our study indicated that the mean age of the cases was 57.04±11.62 years and the mean age of controls was 54.14±9.84 years. The results of a recent study performed by Khalifa and coworkers highlighted that the mean age of the cases was 61.32±7.20 years while the mean age of the controls was 57.40±7.89 years.[15] Another study indicated that the mean age of the cases was 50.87±11.02 years while among controls mean age was 47.31±12.09 years.[16]

High blood pressure and cholesterol are considerable risk factors associated with acute coronary syndrome.[4] It was found during the study that both systolic and diastolic blood pressure was raised in ACS patients as compared to the controls. The mean systolic BP in ACS patients and controls was 137.68±15.621 mmHg and 128.89±18.813 mmHg, while the mean diastolic in patients and controls was 86.36±9.716 mmHg and 81.39±11.536 mmHg, respectively. The findings of a study undertaken by Abdallah et al., showed results similar to our results indicating that mean systolic blood pressure among cases was 132±30 mmHg and 136±30 mmHg among controls while mean diastolic blood pressure was 80±17 mmHg and 79±15 mmHg in cases and controls, respectively.[17]

Our study showed that among patients with ACS the immature platelet fraction levels are raised as compared to normal healthy individuals. During this study when the levels of IPF were evaluated, the study demonstrated that among the majority of the controls, the levels of immature platelet fraction were found normal while in a major proportion of ACS patients, raised levels of immature platelet fraction were observed. The study pointed out that the mean immature platelet fraction in patients was 8.72±6.28% and among controls was 3.83±1.63% with statistically significant results showing raised levels in ACS patients. The findings of a study performed by Berny-Lang and fellows indicated that mean immature platelet fraction among patients suffering from ACS was 5.0±2.8% and in controls, it was 4.6±2.7% showing statistically insignificant results.[18] These findings are in contrast to the present study results.

The results of our study were supported by a similar study conducted in 2020 concluding that IPF is a novel biomarker for the prediction of major adverse cardiovascular outcomes in patients of ACS.[19]

Immature platelet fraction is a biomarker of ACS. A study conducted by Huang et al. concluded that MPV and IPF were significantly raised in patients of ACS. Mean platelet volume represents the volume of platelets and remains constant within 4 months after measurement whereas IPF represents the measure of platelet producing activity by the marrow. Hence MPV can be used for predicting the onset of ACS, whereas

peripheral immature platelets are degraded within 24 hours. Thus, a sudden increase of IPF may predict the prognosis of patients with ACS.[20]

Another study was conducted to evaluate platelet count, IPF, and MPV in patients undergoing coronary artery bypass grafting. Daily changes in platelet count, IPF, and MPV were observed along with the daily prognostic subjective improvements of the patients. Of the three markers used, immature platelet count was the most surrogate index for the production of platelets.[21]

The acute coronary syndrome includes ST elevation myocardial infarction (STEMI), non-ST elevation myocardial infarction (NSTEMI), and unstable angina (UA). A study was aimed to analyze the differences of platelet indices among subtypes of ACS in Dr. Soetomo hospital in 2019. The results of the study concluded that IPF values were significantly higher in STEMI patients than NSTEMI and UA and the values of NSTEMI patients were higher than the values of UA patients. The platelet count, MPV, platelet distribution width, and plateletcrit were higher in both STEMI and NSTEMI compared to UA. The median of IPF values of STEMI, NSTEMI, and UA patients showed a gradual decrease of 3.8%, 2.7%, and 2.0%, respectively. The IPF values were significantly different among each type of ACS patient giving an opportunity to use this marker to differentiate the ACS types.[22]

Several studies were conducted in regard to the immature platelets showing increased levels of reticulated platelets in patients with ACS. In patients of ACS, an evaluation showed that patients with an increase in reticulated platelet count came up with the increase in the incidence of major ischemic cardiovascular events, which again signifies the importance of IPF in the diagnosis of ACS.[23]

CONCLUSION

The levels of immature platelet fraction were raised among patients with the acute coronary syndrome. So, increased levels of IPF can lead to other thrombotic events or unfavorable prognosis in patients with ACS.

LIMITATIONS & RECOMMENDATIONS

- Immature platelet fraction should be used for screening of patients at risk of a thrombotic event.
- Further diagnostic studies should be carried out on a large scale in patients of ACS categorizing them in different types of ACS and with at least three months follow up for the evaluation of the extent of adverse outcomes.

REFERENCES

1. Morrad B, Eraslan S, Gorenek B. Prevalence and types of supraventricular and ventricular arrhythmias developing in patients with acute coronary syndrome. J Cardio Cardiovasu Med. 2017; 2(1):004. Available from: https://www.henrypublishinggroups.com/wp-content/uploads/2017/05/prevalence-and-types-of supraventricular-and-ventricular-arrhythmias-developing-in-patients-with-acute-coronary-syndrome.pdf.
2. Styczkiewicz K, Styczkiewicz M, Mycka M, Medrek S, Kondraciuk T, Czerkies-Bielen A, et al. Clinical presentation and treatment of acute coronary syndrome as well as 1-year survival of patients hospitalized due to cancer: a 7-year experience of a nonacademic center. Medicine (Baltimore). 2020; 99(5):e18972. doi:10.1097/ MD.0000000000018972.
3. Patil SK, Karchi SD. A comparative study of platelet indices in acute coronary syndrome. Int J Contemp Med Res. 2017; 4(3):657-60. Available from: https://www.ijcmr.com/uploads/7/7/4/6/77464738/ijcmr_1338_apr_4.pdf.
4. Schmoeller D, Picarelli MM, Munhoz TP, Poli de Figueiredo CE, Staub HL. Mean platelet volume and immature platelet fraction in autoimmune disorders. Front Med (Lausanne). 2017; 4:146. doi:10.3389/fmed.2017.00146.
5. Wada H, Dohi T, Miyauchi K, Shitara J, Endo H, Doi S, et al. Mean platelet volume and long-term cardiovascular outcomes in patients with stable coronary artery disease. Atherosclerosis. 2018; 277:108-12. doi:10.1016/j.atherosclerosis.2018.08.048.
6. Adam AM, Ali MA, Shah AA, Rizvi AH, Rehan A, Godil A, et al. Efficacy of hematological and coagulation parameters in the diagnosis and prognosis of patients with acute coronary syndrome. J Tehran Heart Cent. 2018; 13(3):115-25. doi:10.18502/jthc.v13i13.131.
7. Winter MP, Schneeweiss T, Cremer R, Biesinger B, Hengstenberg C, Pruller F, et al. Platelet reactivity patterns in patients treated with dual antiplatelet therapy. Eur J Clin Invest. 2019; 49(6):e13102. doi:10.1111/eci.13102.
8. Gonzalez-Porras JR, Martin-Herrero F, Gonzalez-Lopez TJ, Olazabal J, Diez-Campelo M, Pabon P, et al. The role of immature platelet fraction in acute coronary syndrome. Thromb Haemost. 2010; 103(1):247-9. doi:10.1160/TH09-02-0124.
9. Hristov M, Weber C. Myocardial infarction and inflammation: lost in the biomarker labyrinth. Circ Res. 2015; 116(5):781-3. doi:10.1161/ CIRCRESAHA.115.305919.
10. Nording HM, Seizer P, Langer HF. Platelets in inflammation and atherogenesis. Front Immunol. 2015; 6:98. doi:10.3389/fimmu.2015.00098.
11. Kaminska J, Koper OM, Siedlecka-Czykier E, Matowicka-Karna J, Bychowski J, Kemona H. The utility of inflammation and platelet biomarkers in patients with acute coronary syndromes. Saudi J Biol Sci. 2018; 25(7):1263-71. doi:10.1016/j.sjbs. 2016.10.015.
12. Khodadi E. Platelet function in cardiovascular disease: activation of molecules and activation by molecules. Cardiovasc Toxicol. 2020; 20:1-10. doi:10.1007/s12012-019-09555-4.
13. Cesari F, Marcucci R, Gori AM, Caporale R, Fanelli A, Casola G, et al. Reticulated platelets predict cardiovascular death in

acute coronary syndrome patients. Insights from the AMI-Florence 2 study. Thromb Haemost. 2013; 109(5):846-53. doi:10.1160/TH12-09-0709.

14. Pervin S, Islam M, Ferdoushi S, Hossain M, Sultana T, Hoque H, et al. Platelet distribution width is an early indicator of acute coronary syndrome. University Heart Journal. 2014; 9 (1):3-8. doi:10.3329/uhj.v9i1.19430.

15. Khalifa KA, Helwa MA, Mohammed Mousa AM. Reticulated platelets in acute coronary syndrome patients. Menoufia Med J. 2017; 30(3):880-6. doi:10.4103/1110-2098.218251.

16. Abideen Z, Salman F, Usman R, Shakireen N, Gul AM. Platelet indices in newly diagnosed patients of Myocardial Infarction. Khyber Med Univ J. 2017; 9(2):78-82. Available from: https:// www.kmuj.kmu.edu.pk/article/view/17393/pdf.

17. Abdallah M, Karrowni W, Shamseddeen W, Itani S, Kobeissi L, Ghazzal Z, et al. Acute coronary syndromes: clinical characteristics, management, and outcomes at the American university of Beirut medical center, 2002-2005. Clin Cardiol. 2010; 33(1):E6-13. doi:10.1002 /clc.20636.

18. Berny-Lang MA, Darling CE, Frelinger 3rd AL, Barnard MR, Smith CS, Michelson AD. Do immature platelet levels in chest pain patients presenting to the emergency department aid in the diagnosis of acute coronary syndrome? Int J Lab Hematol. 2015; 37(1):112-9. doi:10.1111/ijlh. 12250.

19. Bongiovanni D, Mayer K, Sdrchreiner N, Karschin V, Wustrow I, Gosetti R, et al. Immature platelet fraction is a strong predictor of adverse cardiovascular events in patients with acute coronary syndrome. Results of the ISAR-REACT 5 reticulated platelet sub study. Eur Heart J. 2020; 41(2): ehaa946.1668. doi:10.10393/ ehjci/ ehaa946.1668.

20. Huang HL, Chen CH, Kung CT, Li YC, Sung PH, You HL, et al. Clinical utility of mean platelet volume and immature platelet fraction in acute coronary syndrome. Biomed J. 2019; 42(2):107-15. doi:10.1016/j.bj.2018.12.005.

21. Xu K, Chan NC, Hirsh J, Ginsberg JS, Bhagirath V, Kruger P, et al. Quantifying immature platelets as markers of increased platelet production after coronary artery bypass grafting surgery. Eur J Haematol. 2018; 101(3):362-7. doi:10.1111/ejh.13109.

22. Indriastuti E, Hernaningsih Y, Indrasari YN, Andrianto A. Immature platelet fraction as a potential marker to differentiate types of acute coronary syndrome. Indones J Clin Path Med Laboratory. 2020; 27(1):16-21. doi:10.24293/ ijcpml.v27i1.1609.

23. Corpataux N, Franke K, Kille A, Valina CM, Neumann FJ, Nuhrenberg T, et al. Reticulated platelets in medicine: current evidence and further perspectives. J Clin Med. 2020; 9(11):3737. doi:10.3390/jcm 9113737.

Original Article

Status of Serum Electrolytes among Malnourished Children Presenting with Acute Diarrhea to the Emergency Department of a Teaching Hospital

Hafiza Itrat Naseem, Muhammad Awais, Rizwan Mehmood, Sadia Alam, Usman Nasir, Momna Riaz

ABSTRACT

Objective: To determine the frequency of hypokalemia and hyponatremia among malnourished children presenting with acute diarrhea to the emergency department of a tertiary care hospital of Lahore.

Methodology: It was a cross-sectional study including 144 malnourished children presenting in the pediatrics emergency of Akhtar Saeed Hospital from February to August 2019. Using aseptic techniques, 5 ml of blood sample of each patient was taken and sent to the pathology laboratory for determination of serum potassium and sodium levels. The presence of hypokalemia and hyponatremia was noted in the proforma. Confidentiality of the data was ensured. Serum potassium concentration of <3.5 mmol/L was taken as hypokalemia. Serum sodium concentration of <135 mmol/L was taken as hyponatremia.

Results: The mean age of all cases was 35.84±14.36 months with minimum and maximum age between 6 to 60 months. There were 84(58.3%) male and 60(41.7%) female cases. The mean serum sodium level was 134.82±8.63 mmol/L and the mean serum potassium level was 3.20±1.33 mmol/L. According to operational definition, the frequency & percentage of hyponatremia and hypokalemia was 47(32.6%) and 86(59.7%), respectively.

Conclusion: The current study concludes that serum electrolyte imbalances in malnourished children are significantly enhanced by an acute episode of diarrhea.

Keywords: *Acute diarrhea. Hypokalemia. Hyponatremia. Malnourishment.*

INTRODUCTION

Malnutrition is a major contributing factor in high childhood mortality and morbidity worldwide.[1] Malnourished children are more susceptible to other diseases like measles, chickenpox, diarrhea.[2] The National Nutrition Survey conducted by the United Nations Children's Emergency Fund and Government of Pakistan, showed a significant proportion of children suffering from stunting and wasting in all age groups.[3] Malnutrition interacts with diarrhea in a bidirectional way.[4] Severe prolonged episodes of diarrhea cause malnutrition in patients and on the other hand, malnourished children are more likely to develop complications with diarrhea. Many studies showed a detrimental effect of diarrhea in malnourished children. Children suffering from malnutrition already suffer from electrolyte abnormalities which worsen during an acute episode of diarrhea leading to life-threatening complications. However, literature regarding electrolyte imbalance has shown considerable variation in the frequency of hyponatremia and hypokalemia.[5] Studies have revealed that hyponatremia can be present in as low as 10.4% to as high as 32.5% of the children with malnutrition while hypokalemia can be present from 26.9% to 62.5% of the malnourished children suffering from an acute episode of diarrhea.[5,6] However, the majority of these children remain unscreened for electrolyte imbalance during routine emergency practices and they are treated using a similar regimen as that of normal children which prone them to further worsening of the condition. Moreover, the variations in the frequency of electrolyte imbalance reported in the existing literature warrant further exploration according to our local population.[6]

Hyponatremia is defined as a serum sodium level less than 135 mmol/L. A serum sodium level less than 125 mmol/L is considered as severe hyponatremia. Malnourished children excrete more sodium during diarrhea and they have significantly low gut net sodium balance and diminished total body sodium balance causing hyponatremia.[7]

Severe and rapidly evolving hyponatremia may cause generalized tonic-clonic seizures when sodium concentration decreases to 115 mmol/L.[2] Age and gender of the patient as well as other several factors influence the clinical outcome of neurological complications of hyponatremia. Many studies have documented potassium deficiency in severely malnourished children which rises to normal levels after therapy.[4,5]

The aim of this study was to determine the frequency of hyponatremia and hypokalemia in malnourished

Sharif Medical & Dental College, Sharif Medical City. Sharif Medical City Road, Off Raiwind Road, Jati Umra, Lahore 54000, Pakistan.

Correspondence: Dr. Sadia Alam
Assistant Professor Department of Pathology
Akhtar Saeed Medical & Dental College, Lahore
E-mail: laibasadia97@gmail.com

Received: June 4, 2021; Accepted: June 30, 2021

children presenting with an episode of acute diarrhea in an emergency of a teaching hospital. Educating the clinicians regarding the electrolyte status of these malnourished children suffering from diarrhea would help in timely screening and management of the child accordingly to decrease morbidity and mortality.

METHODOLOGY

It was a cross-sectional study including 144 malnourished children presented to the pediatrics emergency of Akhtar Saeed Hospital from February to August 2019. After approval by the institutional ethical committee (Letter No. ASTH/10401099, 15-01-2019), a total of 144 malnourished children presenting to the Paediatrics Emergency of Akhtar Saeed Hospital, Lahore were included in this study. A sample size of 144 cases was calculated with a 95% confidence level, 5% margin of error, and taking an expected percentage of hyponatremia as 10.4%.[2] Malnourished children aged between 6 months to 5 years of either gender who presented with an episode of acute diarrhea were included in this study. Children having weight less than 10th centile for age according to the Centers for Disease Control and Prevention (CDC) growth chart for both boys and girls were considered malnourished.

Children with congenital anomalies, known congenital cardiac diseases, chronic diarrhea (diarrhea for more than two weeks), and receiving diuretics treatment were excluded from the study. An informed consent was taken from their parents before enrolling in the study. Information regarding their demographic data was noted in the proforma. Using aseptic techniques, 5 ml blood was drawn and sent to the pathology laboratory for determination of serum sodium and potassium levels. The presence of hypokalemia and hyponatremia was noted in the proforma. Confidentiality of the data was ensured. Serum potassium concentration of <3.5 mmol/L was taken as hypokalemia. Serum sodium concentration of <135 mmol/L was taken as hyponatremia.

STATISTICAL ANALYSIS

Data was analyzed using Statistical Package for the Social Sciences (SPSS) version 22. Numerical variables i.e. age, serum sodium, and serum potassium were summarized as mean and standard deviation. Qualitative variables like gender, presence of hyponatremia, and hypokalemia were presented as frequency and percentages. Data was stratified for age and gender and a Chi-square test was applied for stratification. A p-value ≤0.05 was taken as statistically significant.

RESULTS

The mean age of all cases was 35.84±14.36 months with minimum and maximum age between 6 to 60 months. The frequency of males and females is shown in Figure 1. The mean serum sodium levels were 134.82±8.63 mmol/L and the mean serum potassium level was 3.20±1.33 mmol/L. According to operational definition, the frequency of hyponatremia and hypokalemia was 47(32.6%) and 86(59.7%), respectively (Figure 2 & 3).

The frequency of hyponatremia was 22(46.8%) in the age group of <3 years and 25(53.2%) in cases who were ≥3 years old. The frequency of hyponatremia was statistically the same in both age groups, p-value >0.05. The frequency of hyponatremia was 27(57.4%) in male cases and 20(42.6%) in female cases. The frequency of hyponatremia was statistically the same in both genders, p-value >0.05 (Table 1).

The frequency of hypokalemia was 29(33.7%) in the age group of < 3 years and 57(66.3%) in cases who were ≥3 years old. The frequency of hypokalemia was statistically higher in cases aged ≥3 years of age, p-value ≤0.05. The frequency of hypokalemia was 51(59.3%) in male cases and 35(40.7%) in female cases. The frequency of hypokalemia was statistically the same in both genders, p-value >0.05 (Table 2).

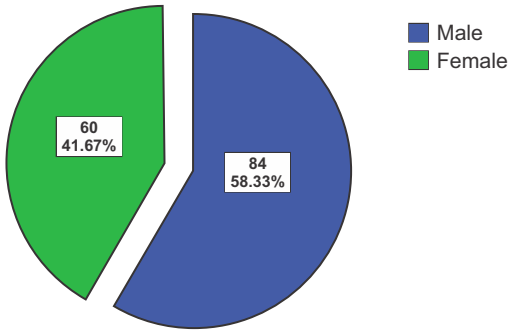

Figure 1: Gender Distribution of the Cases

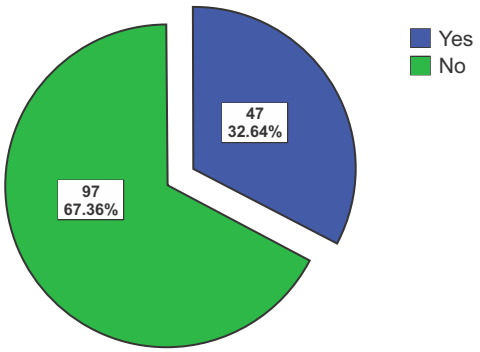

Figure 2: Frequency Distribution of Hyponatremia

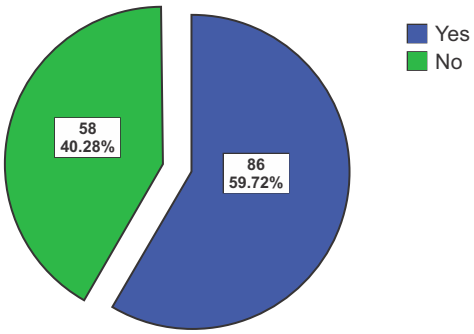

Figure 3: Frequency Distribution of Hypokalemia

Table 1: Comparison of Hyponatremia According to Age Groups & Gender

Demographic Variables		Hyponatremia		Total	p-value
		Yes	No		
Age Groups	<3 years	22(46.8%)	41(42.3%)	63(43.8%)	0.607
	≥3 years	25(53.2%)	56(57.7%)	81(56.2%)	
Gender	Male	27(57.4%)	57(58.8%)	84(58.3%)	0.881
	Female	20(42.6%)	40(41.2%)	60(41.7%)	

Table 2: Comparison of Hypokalemia According to Age Groups & Gender

Demographic Variables		Hypokalemia		Total	p-value
		Yes	No		
Age Groups	<3 years	29(33.7%)	34(58.6%)	63(43.8%)	0.003*
	≥3 years	57(66.3%)	24(41.4%)	81(56.2%)	
Gender	Male	51(59.3%)	33(56.9%)	84(58.3%)	0.774
	Female	35(40.7%)	25(43.1%)	60(41.7%)	

**Significant p-value*

DISCUSSION

Diarrheal disease worldwide has a great impact on mortality and morbidity in children of age less than 5 years.[7] diarrhea and malnutrition interact with each other in a vicious cycle. By aggravating each other they can cause serious clinical consequences.[8] Malnutrition contributes to 35% of the deaths in under-five age group children. Serum electrolytes disturbances are commonly found in malnourished children.[9] While diarrhea among severely malnourished children further worsens the clinical condition by affecting serum electrolytes thus causing hyponatremia (serum sodium <130 mmol/L) and hypokalemia (serum potassium <3.5 mmol/L). Moreover, these are associated with other symptoms including encephalopathy and seizures. If electrolyte imbalance was not identified and properly managed, children may develop neurological disorders.[10]

In this study, the mean age of all cases was 35.84±14.36 months with minimum and maximum age between 5 to 60 months. There were 84(58.3%) male and 60(41.7%) female cases. Similarly, another study showed males (61.3%) are more predominantly affected by diarrhea more than females (38.7%).[10]

According to operational definition, hyponatremia was observed in 47(32.6%) patients and hypokalemia in 86(59.7%). Raza et al. also revealed hypokalemia as most frequently reported (79.9%) in malnourished children with diarrhea while hyponatremia was found in 48.9%.[9] Hoque et al. explored whether malnourished

children with diarrhea are more prone to electrolyte disturbance as compared to children without diarrhea. The results showed that both hyponatremia and hypokalemia were more common in malnourished children with diarrhea.[11]

In this study mean serum potassium levels are 3.20(5.5-1.20) mmol/L and mean sodium levels 134.8(110-144) mmol/L. These serum electrolytes levels are comparable with the findings illustrated by Mosav et al. According to their results, in malnourished children with diarrhea mean sodium level was 136.61±8.85 mmol/L and its range was 116-156 mmol/L. Serum potassium was 4.2±0.64 mmol/L and it ranged from 3 to 6 mmol/L .[8]

Another cross-sectional study conducted at Military Hospital, Rawalpindi, Pakistan, included 80 patients presented with acute diarrhea. The age of the patients was 6 months to 5 years. They found hyponatremia in 26(32.5%) patients and hypokalemia was observed in 44(55%) patients.[10]

Moreover, the comparison of hyponatremia with age and gender showed no significant association in our study. Dastidar et al. explored electrolyte disturbances with diarrhea and also found out that there is no significant association of electrolytes abnormality with age and gender.[12] Contrarily, the frequency of hypokalemia was more in >3 year age group in our study but no gender differences were observed.

Another study concluded that in malnourished children of age less than 5 years, early management of hypokalemia is essential to reduce complications of the disease.[13]

Thus, the study has shown that hypokalemia is a common electrolyte imbalance in malnourished children with diarrhea. So, the use of interventions like oral rehydration solution is required in these patients to reduce morbidity and mortality from the acid-base and electrolyte disturbances commonly seen with acute diarrhea.[14,15]

CONCLUSION

The current study concludes that electrolyte imbalances in malnourished children are significantly enhanced by an acute episode of diarrhea. So, the children under treatment must be screened for electrolytes abnormality and promptly managed to avoid serious clinical consequences.

LIMITATIONS

The sample size was small and the study was conducted in a single institution so results cannot reflect findings in a generalized population.

REFERENCES

1. Achakzai P, Khan R. Nutritional Status and associated factors among children less than five years of age in tehsil Zarghoon Town, District Quetta, Baluchistan. J Ayub Med Coll Abbottabad. 2016; 28(1):146-51. Available from: https://www.jamc.ayubmed.edu.pk/jamc/index.php/jamc/article/view/569/235.

2. Khan GN, Turab A, Khan MI, Rizvi A, Shaheen F, Ullah A, et al. Prevalence and associated factors of malnutrition among children under-five years in Sindh, Pakistan: a cross-sectional study. BMC Nutr. 2016; 2(1):69. doi:10.1186/s40795-016-0112-4.

3. UNICEF. National Nutrition Survey. Nutrition Wing, Ministry of Health Services, Regulation and Coordination, Government of Pakistan. 2018. Available from: https://www.unicef.org/pakistan/media/2826/file/National%20Nutrition%20Survey%202018%20Volume%201.pdf.

4. Million M, Diallo A, Raoult D. Gut microbiota and malnutrition. Microb Pathog. 2017; 106:127-38. doi:10.1016/j.micpath.2016.02.003.

5. Fatima B, Sheikh MA, Naeem MM. The serum sodium, potassium and calcium levels in children 6-59 months of age with severe acute malnutrition. Pak J Med Health Sci. 2017; 11(1):292-4. Available from: https://www.pjmhsonline.com/2017/jan_march/pdf/292.pdf?utm_medium=email&utm_source=transaction.

6. Islam SB, Ahmed T, Mahfuz M, Mostafa I, Alam MA, Saqeeb KN, et al. The management of persistent diarrhea at Dhaka Hospital of the International Centre for Diarrhoeal Disease and Research: a clinical chart review. Paediatr Int Child Health. 2018; 38(2):87-96. doi:10.1080/20469047.2017.1315911.

7. Melese B, Paulos W, Astawesegn FH, Gelgelu TB. Prevalence of diarrheal diseases and associated factors among under-five children in Dale District, Sidama zone, Southern Ethiopia: a cross-sectional study. BMC Public Health. 2019; 19(1):1235. doi:10.1186/s12889-019-7579-2.

8. Mosav F, Malekzdeh I, Moghtaderi M. Incidence and type of electrolyte abnormalities Iranian children with acute gastroenteritis. Open J Pediatr Child Health. 2020; 5(1):011-5. doi:10.17352/ojpch.000024.

9. Raza M, Kumar S, Ejaz M, Azim D, Azizullah S, Hussain A. Electrolyte imbalance in children with severe acute malnutrition at a tertiary care hospital in Pakistan: a cross-sectional study. Cureus. 2020; 12(9):e10541. doi:10.7759/cureus.10541.

10. Bilal A, Sadiq MA, Haider N. Frequency of hyponatraemia and hypokalaemia in malnourished children with acute diarrhoea. J Pak Med Assoc. 2016; 66(9):1077-80. Available from: https://jpma.org.pk/PdfDownload/7890.pdf.

11. Hoque MA, Alam HSK, Sayeed MA, Mamun MAA, Islam MN. Electrolyte changes in malnourished under-5 children with or without diarrhoea. J Shaheed Suhrawardy Med Coll. 2020; 12(1):50-3. doi:10.3329/jssmc.v12i1.51619.

12. Dastidar RG, Konar N. A study of electrolyte disturbances in a child presenting with acute gastroenteritis, with special emphasis on hyponatremic dehydration-a hospital based cross-sectional study. Pediatr Ther. 2017; 7(2):322.

doi:10.4172/2161-0665.1000322.

13. Shahid ASMSB, Alam T, Shahrin L, Shahunja KM, Sarmin M, Afroze F, et al. Early management of hypokalaemia in severely malnourished children under five could help to reduce deaths in developing countries. Acta Paediatr. 2021; 110(5):1658-64. doi:10.1111/apa.15634.

14. Shane AL, Mody RK, Crump JA, Tarr PI, Steiner TS, Kotloff K, et al. 2017 Infectious diseases society of America clinical practice guidelines for the diagnosis and management of infectious diarrhea. Clin Infect Dis. 2017; 65(12):e45-80. doi:10.1093/cid/cix669.

15. Campion-Smith TJ, Kerac M, McGrath M, Berkley JA. Antimicrobial and micronutrient interventions for the management of infants under 6 months of age identified with severe malnutrition: a literature review. PeerJ. 2020; 8:e9175. doi:10.7717/peerj.9175.

Instructions to Authors

The Journal of Sharif Medical & Dental College (JSMDC) agrees to accept manuscripts prepared in accordance with the 'Uniform Requirements for a manuscript submitted to the Biomedical Journals' as approved by the International Committee of Medical Journal Editors (ICMJE) guidelines, published in the British Medical Journal 1991; 302:334-41. All manuscripts must be submitted online at **http://www.ojs.jsmdc.pk**.

AIMS & SCOPE: JSMDC is a peer-review biannual scientific journal, aims to publish latest research to improve healthcare outcomes. It publishes editorials, original research articles, systematic review & meta-analysis, KAP (Knowledge, Attitude, Practices) studies, review articles, systematic review articles, photo essays, case reports, recent advances, adverse drug reports, current practices, short communications, and audit reports. Studies more than three years old at the time of submission are not entertained as per journal policy. Any study ending three years before the date of submission is judged by the Editorial Board for its suitability as many changes take place over the time period, subject to the area of the study.

ETHICAL/LEGAL CONSIDERATIONS: The research should be prepared under strict observation of research and publication ethics guidelines recommended by the Council of Science Editors, International Committee of Medical Journal Editors, and World Association of Medical Editors. A submitted manuscript must be an original contribution not previously published (except as an abstract or preliminary report), must not be under consideration for publication elsewhere, and if accepted, it must not be published elsewhere in a similar form. Each person listed as an author is expected to have participated in the study according to ICMJE criteria. Although the editors and referees make every effort to ensure the validity of published manuscripts, the final responsibility rests with the authors, not with the Journal, its editors, or the publisher. Any study including human subjects or human data must be reviewed and approved by the responsible Institutional Review Board (IRB). Animal experiments should also be reviewed by an appropriate committee (IACUC: Institutional Animal Care and Use Committee) for the care and use of animals. Randomized Controlled Trial (RCT) should be registered and the trial registration number is mandatory.

CONFLICT OF INTEREST: The authors must provide a formal statement including any potential conflict of interest at the time of submitting the article. JSMDC follows the International Committee of Medical Journal Editors guidelines available at www.icmje.org. In case of any conflict of interest, the author must submit an ICMJE form for disclosure of potential conflicts of interest (Available at: http://www.jsmdc.pk).

FINANCIAL DISCLOSURE: Each author warrants that he or she has no commercial associations (e.g., consultancies, stock ownership, equity interest, patent/licensing arrangements, etc.) that might post a conflict of interest in connection with the submitted article, except as disclosed on a separate attachment. All funding sources supporting the work and all institutional or corporate affiliations of the authors are acknowledged in a footnote in the work.

PATIENT ANONYMITY AND INFORMED CONSENT: It is the author's responsibility to ensure that a patient's anonymity is carefully protected and to verify that any experimental investigation with human subjects reported in the manuscript was performed with informed consent and following all the guidelines for experimental investigation with human subjects required by the institution(s) with which all the authors are affiliated.

COPYRIGHT: All authors must sign a copy of the JSMDC author's certification proforma including information regarding the roles of authors and copyright transfer and submit it with the article.

PERMISSIONS: Authors must submit written permission from the copyright owner (usually the publisher) to use direct quotations, tables or illustrations that have appeared in copyright form elsewhere, along with complete details about the source.

PUBLICATION MISCONDUCT: Plagiarism and other publication misconduct, fabrication (picture as well), falsification, a duplicate submission, redundant publication, multiple submission, selective and misleading reporting, selective and misleading referencing are liable to strict action. All publication misconducts are dealt with first asking the corresponding author for an explanation because of the available evidence. In case of non-response or unsatisfactory response from the authors, the manuscript is rejected if unpublished and retracted if published. Due

notice of retraction will be given in print and on the website. The authors will be blacklisted for further submissions and considerations at the journal. The authors' institutional Head will also be informed of the misconduct and relevant action in such a case.

ARTICLE PUBLISHING CHARGES: JSMDC is an open-access journal and levies an article processing fee of PKR. 1000/- for the original research article. The journal will charge an article publishing fee of PKR. 9000/- for original research article and PKR. 2000/- for review article/case report/photo essay upon acceptance of the submitted article. A non-refundable bank draft in favor of Sharif Medical & Dental College A/C No. 15800002100303, HBL SECT branch should be sent via TCS to the editor JSMDC.

AUTHORSHIP CRITERIA: As stated in the uniform requirements, credit for authorship requires substantial contributions to **(a)** the conception and design or analysis and interpretation onto data, **(b)** the drafting of the article or critical revision for important intellectual content, critical appraisal of findings with the literature search and actual write up of manuscript, **(c)** final approval of the version to be published. Each author must sign a statement attesting that he or she fulfills authorship criteria of the uniform requirements. Up to six authors are allowed in a single-institution study. In a multi-institution and international collaborative research, the Editorial Board shall guide on an individual case basis. JSMDC strongly discourages gift authorship. The journal discourages the submission of more than one article dealing with related aspects of the same study. The author's certification proforma (available on the website) should be filled and submitted along with the manuscript.

PLAGIARISM POLICY: Journal of Sharif Medical & Dental College follows the ICMJE and HEC criteria for plagiarism. The criteria can be accessed at www.icmje.org & www.hec.gov.pk. All the submitted manuscripts will be checked for plagiarism by "TURNITIN" software. Articles with a similarity index of more than 19% will not be published. If the submitted article is found to have been totally or substantially plagiarized then the article is rejected outright with information to the author. The plagiarism certificate is sent to the corresponding author and the article is reconsidered after amendments.

PEER REVIEW: JSMDC follows a double-blind peer review process in which both the reviewer and the author remain anonymous throughout the process of review. Reviewers or selected according to their specialty and expertise. The reviewer database is updated constantly. Each manuscript is sent to two external peer reviewers. Once the reviewed manuscript is received from both the reviewers, their comments/suggestions are communicated to the author for correction. The revised manuscript received from the author is re-assessed by the editor and the final decision regarding article acceptance/rejection is also made by the editor. The review form is available at the official website of JSMDC.

ORIGINAL ARTICLES: Original articles should report original research of relevance to clinical medicine. The article should not exceed 4500 words in length (excluding title page, abstract, tables, figures, and references). The original article should follow the basic structure of abstract, introduction, methodology, statistical analysis, results, discussion, and conclusion.

Abstract: It should contain a structured abstract of about 250 words. The abstract must have four sections: objectives, methodology, results, and conclusion. Three to five keywords should be given for an original article as per Medical Subject Heading (MeSH).

Introduction: The introduction should clearly describe the topic with a brief literature review. All abbreviations used should be first preceded by the word for which it stands. At the end of the introduction, mention the rationale or scientific significance of the study.

Methodology: The methodology should include the study design, place of the study conducted, sample size, sampling technique, ethical consideration, and method & equipment used for research work.

Statistical Analysis: Mention the software used for data analysis and the statistical tests applied.

Results: Text, tables, and figures should be used for illustration of results. Figures and tables should be numbered in order of appearance in the text. Legends for the tables and figures should be typed double-spaced and should include a description of the features shown. All numbers and percentages should be triple-checked. Previously published material and figures should include permission to reproduce from the original publication and original author. Photographs with faces should be accompanied by permission to publish from the subject of the photograph or by a

parent in case of a minor. Colored photographs should be submitted in JPEG format. Journal reserves the right to charge authors for publishing colored pictures.
Discussion: The results of the study should be interpreted with reference to other studies.
Conclusion: The conclusion should be clear and concise.
Limitations of the study (if any)
Recommendations of the study (if any)
References: References must be numbered consecutively according to their appearance in the text. References should be cited in the correct "Vancouver style" with a DOI number. List all authors if the total number of authors is six or less and for more than six authors use et al. after six. Journal names should be abbreviated according to the Index Medicus/MEDLINE. The date of access should be provided for online citations. References should not be older than the last five years.

CLINICAL CASE REPORTS: Must be of academic & educational value and provide relevance of the disease being reported as unusual. It should have a non-structured abstract of about 100-150 words (case-specific) with around 5-6 references and 3 keywords.

LETTER TO THE EDITOR (LTE): It is usually a type of short communication that can be written on any topic that attracts the attention of the reader. There are different types of letters to the editor. If the purpose of the LTE is to comment on a published article, the first sentence of the LTE should include the name of the published article's first author along with the title of the published article and then the comments. If the LTE is a reply to a previously submitted LTE, the first sentence should include the name of the letter's author and cite the letter as a reference. The previously published article should then be referenced as well either in the body of the text or at the end of the response to the LTE.

PHOTO ESSAYS: The journal accepts manuscripts for consideration as photo essays. These essays include the visual presentation of material where the prima, emphasis is on the images. These images can include colored images, angiograms, optical coherence tomography, histologic sections, x-rays, ultrasounds, and other studies. The images can be an outstanding presentation of classic findings, atypical findings or new findings. These are not case reports, but rather a visual presentation of material as a teaching tool. The images need to be of the highest quality. The accompanying manuscript should be limited to a total of 300 words. A maximum of 5 separate images and 5 references can be included. Please refer to the rest of the author's instructions for other requirements for manuscripts submitted to JSMDC.

REVIEW ARTICLE: Should consist of critical overview/analysis of some relatively narrow topic providing background and the recent development with the reference of original literature. It should incorporate the author's original work on the same subject. The review article should be 2500 to 3000 words in length. It should have a non-structured abstract of 150 words with a minimum of 3 keywords. An author can write a review article only if he/she has written a minimum of three original research articles.

SYSTEMATIC REVIEW ARTICLE: It should consist of a well-defined research question and should provide a detailed review of a specific topic based on the existing literature. It should include the collection and analysis of data from all the relevant research in support of the research question being asked. The text should be 2500-3000 words. It should have a nonstructured abstract with a minimum of three keywords.

META-ANALYSIS: It should comprise a statistical analysis of combined results of numerous scientific studies addressing the same research questions. Meta-analysis is a quantitative and epidemiological study design that should critically analyze the results of previous scientific researches, mostly randomized controlled trials.

OTHER SECTIONS: The journal also accepts manuscripts for other sections such as diagnostic & therapeutic challenges, clinicopathological correlations, surgical techniques, and new instruments. Diagnostic & therapeutic challenges require no abstract and have no limit for figures and references. Surgical techniques and clinicopathological correlations are treated as a full manuscript and require an abstract. All correspondence and new instruments should have a standard title page with a full-length title, running title, and author information. Keywords

anti summary statement should be on the second page. An abstract is not required by the journal for correspondence and new instruments. A summary statement of 50 words is necessary for publication and indexing and must be included at the time of submission. All pages must be numbered starting with the title page being page one. Each figure must be submitted separately.

SHARIF TRUST

SHARIF
Medical & Dental College

Sharif Medical & Dental College

Sharif Medical City Road, Off Raiwind Road, Jati Umra, Lahore 54000, Pakistan.
Tel: +92-4237860101-4 Fax: +92-4237860122 UAN- 042-111-123-786
E-mail:editors@jsmdc.pk Web:www.jsmdc.pk