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Original Article

Pelvic Trauma in The Elderly Versus Younger Individuals: A Comparative Analysis of Non-Orthopedic Management and Outcomes

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Abstract

Objectives: This study aimed to evaluate patients with pelvic trauma involving damage to other organs who were admitted to non-orthopedics wards. It also sought to explore the diagnostic and therapeutic interventions and compare outcomes between elderly and younger populations.
Design: This research was conducted as a descriptive cross-sectional study.
Setting(s): The study was carried out at Imam Reza Hospital, a trauma center in Tabriz, Iran.
Participants: Multiple trauma patients with pelvic fractures were included in this study.
Outcome Measures: The primary outcomes measured included the types of injuries, admitting departments, need for orthopedic intervention, and final patient outcomes such as mortality, recovery status, and patient transfers.
Results: The average age of patients was 47.56 years (95% CI, 43.36-51.76). The minimum age was 12 years, and the maximum age was 87 years. Out of the total patients, 49 patients (72.1%) were male, while 19 (27.9%) were female. Elderly patients demonstrated a significantly higher prevalence of thoracic injury compared to younger patients (47.1% vs. 15.7%, $P<0.01$) despite similar mortality rates. The most commonly observed injuries include pelvic ring fractures and isolated ramus fractures. Abdominal injuries were the most common findings, leading to admission to the surgical department. A total of 63 patients were discharged from the hospital with either partial or complete recovery, 4 patients died, and 1 patient was transferred to another province upon the request of her companions.
Conclusions: The majority of patients with pelvic fractures were young males. The most common types of fractures were pelvic ring and ramus fractures. Associated injuries in these patients mostly included abdominal and head trauma. Most patients experienced favorable outcomes with a low mortality rate. No significant relationship was observed between the type of injury and patient outcomes during hospitalization.
Keywords: Multiple trauma, Pelvic fracture, Non-orthopedic management, Elderly trauma, Multidisciplinary care

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Introduction

Pelvic ring fractures represent a significant global health burden, particularly among elderly populations with age-related bone demineralization. These injuries typically involve combined damage to both the anterior (pubic symphysis and rami) and posterior (iliac wing, sacrum, and sacroiliac joint) pelvic structures, resulting in complex biomechanical challenges for clinical management.[1,2] Pelvic injuries account for 3-8% of all skeletal fractures and are considered among the most severe orthopedic emergencies due to their association with life-threatening complications and substantial morbidity.[3,4]

Recent epidemiological studies have revealed alarming trends, with French data demonstrating a 65% increase in the incidence of pelvic fractures among individuals aged ≥ 75 years, rising from 129.30 to 210.69 per 100,000 population between 2010 and 2019. This trend aligns with global patterns of aging populations and the rising prevalence of osteoporosis.[5-7]

The etiology of pelvic fractures shows distinct geographical variation. In developing countries, high-velocity trauma caused by road accidents (accounting for 45% to 60% of cases) and falls from heights (accounting for 20% to 30%) predominate, while industrialized countries

reported increasing low-energy fragility fractures among elderly patients with osteoporosis [7]. A 2023 multinational cohort study found that 38% of pelvic fractures in patients over 65 years resulted from ground-level falls, compared to only 12% in younger populations.[8] This demographic shift necessitates the need for tailored treatment approaches that account for bone quality, comorbidities, and the preservation of functional capacity.

While 60% to 70% of pelvic fractures are stable injuries and can be managed conservatively, unstable fracture patterns (e.g., Young-Burgess APC II/III, LC II/III, VS) and open fractures pose substantial clinical challenges.[9,10] Acute mortality rates can approach 30% in unstable fractures due to massive hemorrhage (ranging from 8 to 15 liters of blood loss within the first 6 hours), with coagulopathy and traumatic shock complicating approximately 40% of cases.[11,12] Associated injuries significantly compound these risks. Genitourinary trauma occurs in 15% to 20% of cases, rectal or intestinal injuries in 5% to 10%, and lumbosacral plexus damage in 8% to 12% of patients.[13-16] The "deadly triad"- hypothermia, acidosis, and coagulopathy- develops in 25% of patients with high-energy pelvic trauma, necessitating urgent multidisciplinary damage control strategies.[12]

Long-term outcomes reveal significant disability burdens following pelvic fractures. At 12-month follow-up, 45% of patients report persistent pelvic pain, 30% demonstrate gait abnormalities, and 15% to 20% experience sexual or urinary dysfunction.[17,18] Post-traumatic osteoarthritis develops in 22% of patients with sacroiliac joint injuries, while 18% of surgically treated patients require hardware removal due to irritation or infection.[19,20] Psychological sequelae are also significant, with 35% of survivors meeting the diagnostic criteria for post-traumatic stress disorder (PTSD) and 28% developing major depressive disorder within two years of injury.[21,22]

Diagnostic challenges persist, particularly in elderly patients with atypical or subtle symptoms. Although computed tomography (CT) scanning remains the gold standard with a sensitivity of approximately 97%, over 20% of fragility fractures are initially missed on standard plain radiographs.[23,24] Emerging clinical protocols increasingly recommend the routine use of advanced imaging in high-risk elders with mechanical hip pain and negative X-ray findings.[25] Additionally, serum biomarkers such as CTX-1 and PINP have shown promise in identifying occult insufficiency fractures, although clinical validation is still underway.[26]

Treatment paradigms for pelvic fractures have evolved significantly, with angioembolization achieving hemorrhage control in 85% to -90% of cases compared to a 60% to 70% success rate with external fixation alone.[27,28] Minimally invasive surgical techniques, including percutaneous screw fixation and robot-assisted reduction, now account for 40% of operative cases, contributing to reduced perioperative morbidity in elderly cohorts.[29,30] Furthermore, enhanced recovery after surgery (ERAS) protocols have decreased hospital stays by an average of 2.3 days while maintaining equivalent clinical outcomes.[31]

While the majority of existing literature focuses exclusively on the orthopedic management of pelvic trauma, a significant knowledge gap exists regarding patients whose primary care occurs in non-orthopedic settings due to associated injuries. This research gap is particularly pronounced when examining the potential differences in clinical presentation, management strategies, and outcomes between elderly and younger patients with pelvic trauma managed outside of traditional orthopedic departments.

Therefore, this study aimed to explore the diagnostic approaches, therapeutic interventions, and comparative outcomes of patients with pelvic trauma managed primarily in non-orthopedic wards. A specific focus is placed on analyzing differences between elderly and younger patient populations. Understanding these patterns is crucial for optimizing multidisciplinary care protocols and improving overall outcomes for this challenging and high-risk patient population.

Methods

Study Design and Setting

This descriptive cross-sectional study was conducted over three years at Imam Reza Hospital, a designated trauma center in Tabriz, Iran.

The Rational for Non-Orthopedic Ward Focus

This study specifically focused on pelvic trauma patients admitted to non-orthopedic wards to address a critical knowledge gap in the literature. While most existing research on pelvic trauma centers on orthopedic management, a substantial proportion of patients with pelvic fractures are primarily admitted to other hospital services due to concomitant injuries of greater immediate concern such as abdominal hemorrhage or traumatic brain injury. This creates unique management challenges and potentially different clinical trajectories that remain understudied.

It is acknowledged that this approach introduces a potential selection bias, as patients with isolated or predominant orthopedic injuries would typically be admitted directly to orthopedic wards and thus excluded from this analysis. Consequently, our cohort likely represents patients with more severe multisystem trauma, potentially leading to an overestimation of complication rates and an underestimation of the overall prevalence of pelvic trauma. Additionally, orthopedic interventions may have been influenced by the prioritization of non-orthopedic injuries, which could affect fracture-specific outcomes. These limitations are addressed further in the discussion section of the study.

Participants

The study included 68 patients who sustained pelvic

fractures as a result of multiple trauma. The inclusion criteria were as follows:

- Patients who experienced a pelvic fracture due to multiple traumas within the specified study period over three years,
- Age ≥ 12 years to exclude pediatric trauma patterns,
- Acute pelvic fracture confirmed by imaging (CT scan or X-ray),
- Admission to non-orthopedic wards, including general surgery, trauma intensive care unit (ICU), or neurosurgery,
- Patients with pre-existing conditions (e.g., osteoporosis, chronic obstructive pulmonary disease, cardiovascular disease) were included if trauma was the primary reason for hospital admission,
- Multi-trauma patients with at least one additional injury rated as Abbreviated Injury Scale (AIS) ≥ 2.

Exclusion criteria included individuals with multiple traumas without pelvic injuries, those admitted to Tabriz Shohada Hospital (an orthopedic center), patients with pre-existing pelvic pathology unrelated to trauma, and those with incomplete or missing medical records.

For comparative analysis, patients were stratified into younger (< 60 years) and elderly (≥ 60 years) cohorts.

Data Collection

Data collected included demographic characteristics such as age and gender, trauma type, and injuries diagnosed both in the emergency and inpatient departments. Additional data included records of orthopedic consultations, interventions, patient outcomes, and documented causes of death obtained from forensic sources.

Statistical Analysis

The normality of data was assessed using the Kolmogorov-Smirnov test. Normally distributed continuous variables were reported as means ± standard (SD) deviation with 95% confidence intervals (CIs) and analyzed using parametric tests (independent t-tests for between-group comparisons). Non-normally distributed variables were expressed as medians with interquartile ranges and analyzed using non-parametric tests such as the Mann-Whitney U test. Categorical variables were expressed as frequencies and percentages, with between-group comparisons performed using chi-square or Fisher's exact tests, as appropriate. Relationships between variables were examined using Pearson or Spearman correlation coefficients based on the data distribution. Statistical significance was set at $P < 0.05$. All statistical analyses were conducted using SPSS version 20.0 (IBM Corp., Armonk, NY).

Ethical Approval and Consent to Participate

This study received formal approval from the Ethics Committee of the affiliated university (approval number was obtained but is not included here to maintain anonymity). Due to the retrospective nature of the study, the committee granted a waiver of individual informed consent, in accordance with institutional guidelines for retrospective chart reviews, wherein patient identifiers are removed during analysis. All data collection and handling procedures complied with the Declaration of Helsinki and institutional privacy regulations. The hospital administration provided formal permission for access to medical records, and a data-sharing agreement was established between departments to ensure appropriate data governance throughout the research process.

Results

Study Population

The cohort comprised 68 patients with pelvic trauma and multi-organ injuries (male: 72.1%, n = 49), demonstrating normal age distribution (Kolmogorov-Smirnov $P = 0.200$), ranging from 12 to 87 years (mean ± SD: 47.56 ± 17.36; 95% CI: 43.36-51.76). Patients were stratified by age: < 60 years (n = 51, 75%) and ≥ 60 years (n = 17, 25%).

Injury Patterns and Emergency Presentation

Initial assessments in the emergency department revealed that 94.1% (n = 64) of patients presented with multi-system trauma (Figure 1). The distribution of injury patterns showed that pelvic ring fractures were the most common orthopedic injury overall (58.8%), followed by isolated ramus fractures (29.4%) (Figure 2), with all elderly patients (100%) demonstrating involvement of multiple organ systems, compared to 92.2% in the younger group. Pelvic ring fractures were the most common orthopedic injury overall (58.8%), followed by isolated ramus fractures (29.4%). Notable differences in fracture patterns emerged between age groups: younger patients demonstrated a higher proportion of isolated ramus fractures (29.4% vs. 5.9% in elderly, $P = 0.047$), while pelvic ring fractures occurred at similar rates in both groups (29.4%).

Non-Orthopedic Pathologies and Departmental Distribution

Abdominal injuries were the leading cause of non-orthopedic admission across both age groups (overall: 61.8%, younger: 62.7%, elderly: 58.8%, $P = 0.772$), as depicted in Table 1 However, significant age-related differences emerged in other organ systems. Elderly patients exhibited a 2.8-fold higher prevalence of thoracic injuries requiring intervention (47.1% vs. 15.7% in younger patients, $P = 0.008$) and a 1.7-fold increase in

Table 1. The Frequency of Pathological Findings Categorized by the Department Handling the Patient

Pathological Finding	Frequent	Percentage
Brain or Spinal Cord	16	23.5
Chest	16	23.5
Abdominal	42	61.8
Vessels	17	25

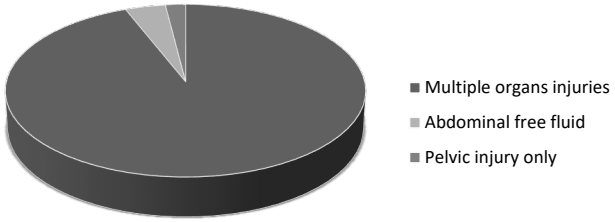

Figure 1. Occurrence Rate of Observations in the Emergency Departmen

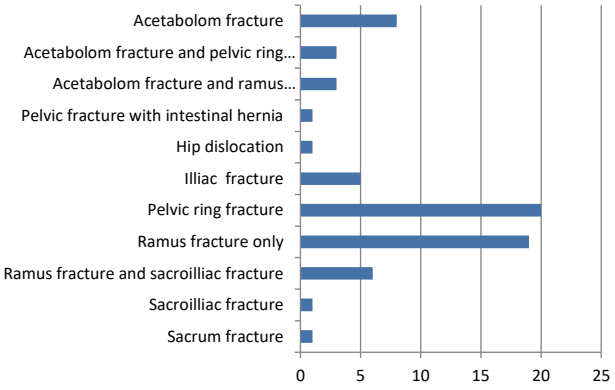

Figure 2. The Frequency of Fracture Types

neurosurgical conditions (35.3% vs. 19.6%, $P=0.182$), although the latter was not statistically significance. Vascular injuries occurred at similar rates across both groups (younger: 25.5%, elderly: 23.5%, $P=0.868$).

Orthopedic Consultation and Interventions

Orthopedic consultation was obtained for 94.1% (n = 64) of all patients, with similar consultation rates in both age groups (younger: 94.1%, elderly: 94.1%, $P=1.000$). Immediate orthopedic intervention in the emergency department was performed in 88.2% (n = 60) of all patients, with a slightly higher rate in the elderly group (94.1% vs. 86.3% in younger patients, $P=0.382$), although this difference was not statistically significant.

Clinical Outcomes

Overall mortality was 5.9% (n = 4), with one patient (1.5%) transferred to another facility at the family's request. The remaining 92.6% (n = 63) were discharged with either partial or complete recovery (Figure 3). Age-stratified analysis revealed identical mortality rates between groups (younger: 5.9%; elderly: 5.9%, $P=1.000$), despite the higher burden of multi-system involvement in elderly patients. Among the deceased, causes of death included hemorrhagic shock due to unstable pelvic fracture (n = 1), peritonitis (n = 1), and multiple organ failure (n = 2).

Discussion

This study provides valuable insights into the management and outcomes of pelvic trauma patients treated primarily in non-orthopedic settings, with a particular emphasis on age-related differences in clinical presentation and progression. Our findings demonstrate that although

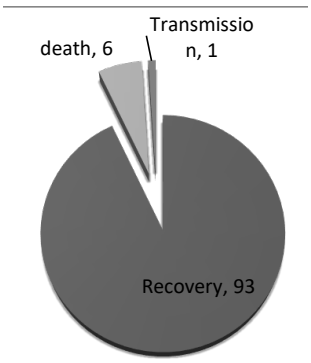

Figure 3. Patients' Outcomes

elderly patients with pelvic fractures exhibit distinct injury patterns and a greater degree of multi-system involvement compared to younger counterparts, mortality rates remain comparable across age groups when managed through appropriate multidisciplinary approaches.

The demographic profile of our cohort aligns with existing literature, confirming the predominance of male patients (72.1%) among individuals with pelvic trauma. This gender disparity has been consistently reported in previous studies, with males typically comprising 65% to 75% of pelvic trauma cases, largely due to greater exposure to high-risk behaviors and occupational hazards [32]. However, our age-stratified analysis reveals that this male predominance persists across age groups, contradicting some reports that suggest a more balanced gender distribution in elderly pelvic trauma populations.

A key finding of our study is the significant difference in injury patterns between age groups. The universal presence of multi-system trauma among elderly patients (100% vs. 92.2% in younger patients) and significantly higher rates of thoracic injuries (47.1% vs. 15.7%, $P<0.008$) underscore the increased physiological vulnerability of older individuals to traumatic forces (Tables 2, 3). This aligns with established knowledge regarding decreased physiological reserve and increased tissue fragility in the elderly populations.[33] The higher prevalence of neurosurgical conditions in the elderly cohort, although not reaching statistical significance, further reinforces the pattern of increased physiological vulnerability in this population.

Perhaps most noteworthy is our observation of equivalent mortality rates between age groups, despite the greater injury burden observed in elderly patients (Figure 3). This finding contrasts with conventional expectations and much of the existing literature, which typically reports mortality rates 2-3 times higher among elderly pelvic trauma patients compared to their younger counterparts.[34] We propose several possible explanations for this unexpected finding. First, our study's focus on non-orthopedic management may have inherently selected patients who received early multidisciplinary care, potentially mitigating age-related disparities in clinical outcomes. Second, the advanced trauma system at our institution, characterized by rapid access to

specialized services such as interventional radiology and critical care may have particularly benefited high-risk elderly patients. Finally, our sample size may have limited the statistical power required to detect true differences in mortality between groups.

The detailed analysis of fracture patterns by age group is presented in younger patient (Figure 4) and elderly patients (Figure 5). The distribution of fracture types remained relatively consistent across age groups, with pelvic ring fractures and isolated ramus fractures representing the most common injury patterns in both populations. This suggests that while physiological responses to trauma differ substantially with age, the biomechanical patterns of pelvic ring failure remain largely consistent regardless of bone quality (Figure 5).

Context for Abdominal Injuries as Common Co-Injuries

The predominance of abdominal injuries (61.8%) as the primary indication for non-orthopedic admission merits specific discussion (Table 1). This trend likely reflects a combination of anatomical and regional factors. Anatomically, the proximity of pelvic structures to abdominal organs creates vulnerability to concurrent injury, particularly in high-energy trauma scenarios.[35] The retroperitoneal space, which connects the pelvis and abdomen, provides minimal resistance to force

Table 2. The Frequency of Pathological Findings Categorized by the Department Handling the Patient

Pathological Finding	Frequent	Percentage
Brain or Spinal Cord	10	19.6
Chest	8	15.7
Abdominal	32	62.7
Vessels	13	25.5

Table 3. The Frequency of Pathological Findings Categorized by the Department Handling the Patient

Pathological finding	Frequent	Percentage
Brain or Spinal Cord	6	35.3
Chest	8	47.1
Abdominal	10	58.8
Vessels	4	23.5

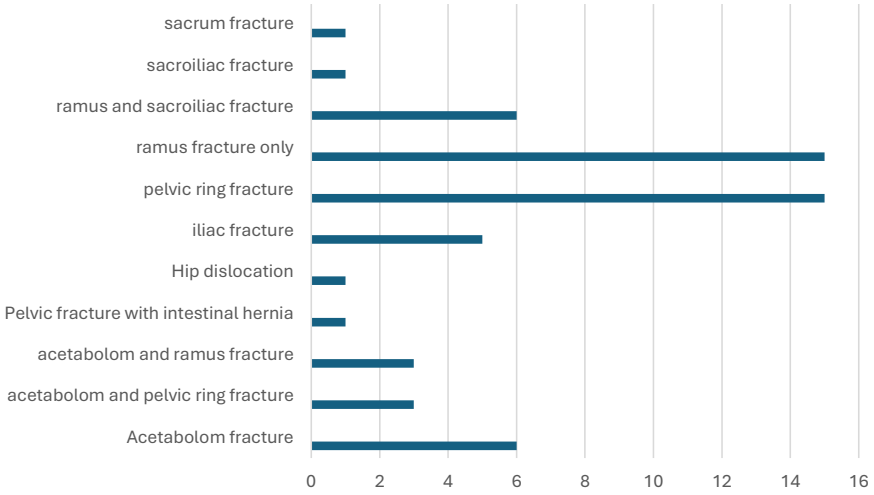

Figure 4. The Frequency of Fracture Types

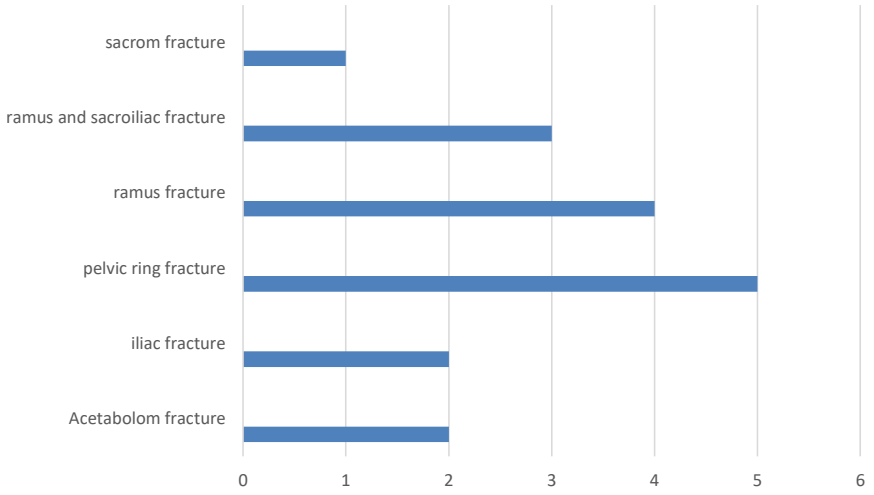

Figure 5. The Frequency of Fracture Types

transmission. As a result, structures such as the iliac vessels, urinary bladder, and distal gastrointestinal tract are especially susceptible to injury during pelvic ring disruptions.[36]

Regional factors unique to our setting may also explain this finding. Tabriz, as a major urban center in northwestern Iran surrounded by mountainous terrain, experiences a high incidence of high-speed motor vehicle accidents and falls from heights.[37] These trauma mechanisms typically generate substantial force vectors that simultaneously impact both pelvic and abdominal regions. Additionally, our institution serves as the primary referral center for industrial accidents originating from surrounding manufacturing zones, which frequently result in combined pelvic-abdominal trauma patterns. Understanding these anatomical and regional contributors is essential for optimizing emergency protocols and effectively allocating resources for polytrauma patients in our setting.

Our study uniquely contributes to the literature by specifically examining pelvic trauma cases managed outside traditional orthopedic settings. While most existing research focuses exclusively on orthopedic management of these injuries, our findings demonstrate that a significant proportion of pelvic trauma patients require primary treatment for associated non-orthopedic injuries, with orthopedic intervention serving a complementary rather than primary role.[38] This perspective is particularly valuable given the evolving landscape of trauma care, which increasingly emphasizes coordinated multidisciplinary approaches over siloed specialty-specific management.

Study Limitations

Several limitations must be acknowledged when interpreting these findings. First, the retrospective single-center design introduces potential selection bias, particularly given that our analysis focused exclusively on patients admitted to non-orthopedic wards. This may limit the generalizability of our findings to other healthcare settings. Second, the modest sample size (n = 68), including only 17 elderly patients, constrained statistical power to detect clinically significant differences, especially in mortality analyses, where only four deaths occurred. Although we included patients with chronic conditions, the lack of systematic comorbidity assessment using validated indices prevents a comprehensive analysis of how pre-existing diseases have influenced outcomes. Furthermore, the absence of long-term follow-up data precludes the assessment of key functional recovery metrics. Additionally, the observational design further restricts the ability to draw causal inferences about management strategies. Regional factors may also limit generalizability, as the high proportion of abdominal injuries (61.8%) likely reflects trauma patterns unique to northwestern Iran rather than universal distributions. Furthermore, the lower-than-expected mortality rate (5.9%) compared to the global rate (ranging from 15 % to 30%) may result from the exclusion of pre-hospital deaths and advanced capabilities available at our institution. Future multicenter prospective studies incorporating standardized comorbidity assessment tools, matched comparison groups, and longitudinal functional outcomes need to address these limitations and provide more definitive evidence to guide the development of optimal management strategies for this complex patient population.

Conclusions

This study demonstrates that, despite higher rates of multi-system involvement and distinctive injury patterns among elderly patients with pelvic trauma, mortality outcomes remain comparable to those of younger patients when managed through appropriate multidisciplinary care in non-orthopedic settings. The predominance of abdominal pathology as the primary reason for non-orthopedic admission highlights the need for collaborative care models that integrate trauma surgery, orthopedics, and other relevant specialties. These findings support the importance of comprehensive trauma systems capable of addressing both the orthopedic and non-orthopedic aspects of pelvic trauma across age groups. Further research is needed to optimize and implement care protocols specifically tailored to elderly patients with complex pelvic injuries, ensuring multidisciplinary management.

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Writing–review & editing: Hosein Jalilzadeh, Alireza Ala, Parham Maroufi, Samad Shams Vahdati, Mahsa Taghavi Zenouz.

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Data availability statement

the datasets used and analyzed during the current study are available from the corresponding author on reasonable request.

Ethical approval

This study was conducted in accordance with the Declaration of

Helsinki and approved by the Ethics Committee of Tabriz University of Medical Sciences (Ethics Code: IR.TBZMED.VCR.REC.1402.XXX). All procedures involving human participants were performed in accordance with the institutional and national research committee ethical standards.

Consent for publication

Not applicable.

Conflict of interests

The authors declare that they have no competing interests.

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