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Clinical implications of additional posterior fractures in combined anterior-posterior pelvic ring fractures in elderly patients

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ABSTRACT

Objectives: Historically, pelvic ring fractures (PRF) are considered to occur predominantly in the anterior ring and therfore to be mechanically stable. Combined anterior and posterior ($A + P$) PRF are expected to be less mechanically stable and therefore to be associated with higher levels of pain and reduced mobility compared to isolated anterior fractures. The current study investigates the clinical relevance of combined $A + P$ PRF in elderly patients.

Methods: A prospective multicentre cohort study was conducted in patients >70 years of age with anterior PRF after low-energy trauma diagnosed on conventional radiographs. All patients underwent an additional CT-scan. Patients were divided into two groups; isolated anterior or combined $A + P$ fractures. Patients were treated conservatively with adequate analgesia for at least one week. If patients could not be mobilised after conservative treatment, surgical fixation was performed. Numerical Rating Scale (NRS) pain scores, dependence on walking aids and Activities of Daily Living scores (ADL) were measured at 2–4 weeks, and 3, 6 and 12 months after fracture.

Results: 102 patients (age 81.1 ± 7.6 years) were included. Isolated anterior fractures were diagnosed in 25 (24.5%) and $A + P$ fractures in 77 (75.5%) patients. Baseline characteristics did not differ between the two groups. Most patients were successfully treated conservatively and 5 (4.9%) underwent percutaneous trans-iliac, trans-sacral screw fixation after failure of conservative treatment. At 2–4 weeks post trauma, patients with $A + P$ fractures had similar median pain scores (3 (range 0–8) vs. 5 (0–10), $p = 0.19$) and ADL scores (85 (25–100) vs. 78.6 (5–100), $p = 0.67$), but were more dependent on walking aids (92.8% vs. 72.2%; $p = 0.02$) compared to patients with isolated anterior fractures. There were no significant differences at 3 months. At one year follow-up the median NRS pain and ADL scores for both fracture groups were 0 and 100, respectively. Mortality was 10.8%, and additional loss to follow-up was 17.6%.

Conclusions: The vast majority of elderly patients with PRF have combined $A + P$ fractures. The clinical implications of additional posterior pelvic ring fractures in elderly patients appears to be limited.

Introduction

Because of the increasing general life expectancy, osteoporotic fractures of the pelvis are becoming a clinically significant health problem [1,2]. The associated loss of autonomy, institutionalization, morbidity and healthcare costs appear to be comparable to those of patients with hip fractures [3,4]. Fragility fractures of the pelvis predominantly affect elderly women with osteoporosis and often occur after a low energy fall, or even happen spontaneously [3]. These types of fractures are rarely associated with haemodynamic instability or damage to important intrapelvic organs [4]. Not only mechanism of trauma and patient characteristics, but also the fracture patterns observed in elderly patients are different from those seen in young adults. Historically, it was thought that pelvic ring fractures in elderly following

Abbreviations: A+P, Combined anterior and posterior; ADL, Activities of Daily Living; ED, Emergency departments; FFP, Fragility Fractures of the Pelvis; DECT, Dual Energy CT-scans; MRI, Magnetic Resonance Imaging; NRS, Numerical Rating Scale; PPIs, Proton pump inhibitors; PRF, Pelvic ring fractures; TITS, Trans-Iliac Trans-Sacral screw fixation.

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low-energy trauma were thought to involve only the anterior pelvic ring, which was considered stable and generally treated conservatively [5]. However, several studies have reported additional involvement of the posterior pelvic ring with percentages up to 60% on CT-scan and 90% on MRI [6–8]. The aim of this prospective study was to identify additional posterior pelvic ring fractures using CT-scan evaluation, and to investigate the clinical impact of these additional posterior fractures in terms of pain and mobility in elderly patients. It was hypothesised that combined anterior and posterior ($A + P$) pelvic ring fractures are associated with higher levels of pain and reduced mobility, compared with isolated anterior ring fractures and may subsequently lead to a higher rate of complications (e.g. respiratory infections, decubitus and thromboembolism) and increased mortality. If so, early detection of additional posterior pelvic ring fractures by routine CT-scan evaluation would be important.

Methods

This prospective multicentre cohort study was conducted in two level-1 trauma centres in the Netherlands: the Leiden University Medical Center in Leiden and the Haaglanden Medical Center in The Hague. The study protocol was approved by the regional Medical Ethics Review Board.

Between 2018 and 2021, all elderly (> 70 years) patients presenting to the emergency departments (ED) of the participating centres with an anterior pelvic ring fracture (superior/ inferior ramus) diagnosed on plain pelvic radiographs of the pelvis after a low-energy trauma were considered for inclusion. Patients were excluded if they (1) had associated injuries that would interfere with mobilization using walking aids, (2) had insufficient knowledge of the Dutch language or another situation that interfered with answering questions about pain and mobility, (3) had a pathological fracture caused by bone malignancy or metastasis, (4) had received irradiation therapy of the pelvis or (5) had undergone any form of early (<1 week) surgical treatment for the acquired pelvic ring fracture. If a patient met the inclusion criteria and gave written informed consent, the pre-trauma pain score, Barthel Index of Activities of Daily Living score, use of walking aids and current living situation were assessed with a short questionnaire in the ED of the participating hospitals. After inclusion, the patient work-up was according to the standard protocol including pelvic x-rays series (AP, Inlet/Outlet radiographs). If an anterior fracture was diagnosed, a CT-scan was performed to identify additional posterior fractures. Fractures were classified according to the Rommens' classification of Fragility Fractures of the Pelvis (FFP) [8]. All patients were treated conservatively for at least one week. The treatment consisted of a regimen of analgesics and physiotherapist-guided mobilization. Analgesics included paracetamol and naproxen or diclofenac in combination with proton pump inhibitors (PPIs). If necessary, opioid agonists were prescribed, usually extended-release tablets (OxyContin®) of 5–10 mg (mg) in combination with immediate-release tablets (OxyNorm®) of 5 mg. If patients were not able to ambulate despite the analgetic medication within 7 days after trauma, percutaneous screw fixation of the pelvic ring was considered.

Follow-up data were collected via telephone consultations, using questionnaires: a Numerical Rating Scale (NRS) for pain, the Barthel Index of Activities of Daily Living (ADL; scoring range 0 (total dependence) to 100 (no dependence)) and questions about dependence on walking aids and living situation (living independently at home, living at home but dependent on home care or institutionalised in a nursing home) [9,10]. These follow-up data were collected at 2–4 weeks, and 3, 6 and 12 months after the fracture.

Statistical analysis

Continuous baseline characteristics and outcome measures were compared between patients with an isolated anterior fracture and patients with combined $A + P$ fractures using the Student *t*-test for normally distributed data or the Mann-Whitney test for skewed data. Categorical characteristics and outcome measures were compared using the Chi-squared test or, in case of expected cell counts <5, with the Fisher's Exact test. All outcome measures were univariably compared between the groups at each time point. Although initially planned, the repeated outcome measures were not analysed using multivariate mixed models, because the linearity assumption for linear regression analysis was not met due to the extremely skewed pain and ADL scores even after transformation, and because the baseline characteristics of the study groups were very similar.

Results

Baseline

The overall mean age was 81.1 ± 7.6 years and 85.3% were female. Ninety-four (92.2%) patients had fallen from a standing position, 8 patients had a low-energy road traffic accident. The median baseline ADL score was 100 (range 10–100), indicating no dependence. Of the total study population 25 patients (24.5%) were dependent on walking aids indoors and outdoors prior to trauma. Twenty-five (24.5%) patients had an isolated anterior pelvic fracture (FFP Ia:22, FFP Ib:3), and 77 (75.5%) patients suffered from combined anterior and posterior ($A + P$) fractures of pelvic ring (FFP IIa:1, FFP IIb:52, FFP IIc:23, FFP Vc:1). Baseline characteristics did not differ between the two fracture groups (Table 1).

Follow-up

The median NRS pain score at 2–4 weeks was 3 (range 0–8) for patients with an isolated anterior fracture versus 5 (0–10) for patients with combined $A + P$ fractures ($p = 0.19$). No differences in NRS pain scores and ADL scores were found between the groups during the remainder of the follow up period (Table 2). At 2–4 weeks patients with $A + P$ fractures were significantly more dependent on walking aids indoors compared to patients with isolated pelvic ring fractures (92.8% vs.

Table 1
Patient characteristics.

	All patients $n = 102$	Isolated anterior fracture $n = 25$	Combined fracture $n = 77$	*P*
Age; mean (standard deviation)	81.3 (7.6)	82.7 (7.6)	80.9 (7.6)	*0.29*
Female; n (%)	87 (85.3)	23 (92.0)	64 (83.1)	*0.35*
Trauma mechanism; n (%)				*1.00*
Fall from standing	94 (92.2)	23 (92.0)	71 (92.2)	
Other	8 (7.8)	2 (8.0)	6 (7.8)	
Living situation before trauma				*0.16*
Independent (with or without help)	92 (93.9)	21 (87.5)	71 (95.9)	
Nursing home	6 (6.1)	3 (12.5)	3 (4.1)	
Barthel Index; median (range)	100 (10–100)	100 (50–100)	100 (10–100)	*0.31*
Dependence on walking aid; n (%)				*1.00*
No	61 (62.2)	15 (62.5)	46 (62.2)	
Only outdoors	12 (12.2)	3 (12.5)	9 (12.2)	
Indoors and outdoors	25 (25.5)	6 (25.0)	19 (25.7)	
Pain score at arrival in ER; median (range)	4 (0–10)	3 (0–9)	5 (0–10)	*0.12*
Pain score on leaving ER; median (range)	4 (0–9)	3 (0–9)	4 (0–9)	*0.29*

Table 2
Outcomes per follow-up moment and fracture type.

	2–4 Weeks			3 Months			6 Months			1 Year		
	Isolated anterior $n = 18$	Combined $n = 69$	*P*	Isolated anterior $n = 16$	Combined $n = 63$	*P*	Isolated anterior $n = 16$	Combined $n = 61$	*P*	Isolated anterior $n = 15$	Combined $n = 58$	*P*
Pain (NRS); median (range)	3 (0–8)	5 (0–10)	*0.19*	0 (0–8)	1 (0–8)	*0.27*	0 (0–2)	0 (0–8)	*0.06*	0 (0–5)	0 (0–7)	*0.39*
Daily Activity Score (Barthel Index); median (range)	85 (25–100)	85 (5–100)	*0.67*	90 (35–100)	95 (5–100)	*0.20*	100 (30–100)	100 (20–100)	*0.56*	100 (15–100)	100 (15–100)	*0.90*
Dependent on walking aid indoors; n (%)	13 (72.2)	64 (92.8)	***0.03***	7 (43.8)	28 (44.4)	*0.96*	4 (23.5)	23 (37.7)	*0.28*	5 (33.3)	20 (34.5)	*0.93*
Dependent on walking aid outdoors; n (%)	17 (94.4)	67 (97.1)	*0.51*	7 (43.8)	40 (63.5)	*0.15*	8 (47.1)	31 (50.8)	*0.78*	7 (46.7)	32 (55.2)	*0.56*
Fixation performed; n (%)	0 (0)	4 (5.8)	*0.58*	0 (0)	1 (1.5)	*1.0*	0 (0)	0 (0)	–	0 (0)	0 (0)	–
Lost to follow-up; n (% of initial group)	7 (28.0)	8 (10.4)		9 (36.0)	14 (18.2)		9 (36.0)	16 (20.8)		10 (40.0)	19 (24.7)	
Mortality; n	0	4		0	9		0	10		0	11	
Due to cognitive impairment; n	7	4		9	5		9	6		10	8	

72.2%; $p = 0.03$) (Table 2). A total of five patients with FFP IIb:3 or FFP IIc:2 type fractures (4.9 of the study population) underwent surgical fixation during the follow-up period (Table 2). Minimally invasive fixation of the posterior fracture was performed using trans-iliac transsacral screw (TITS) fixation in all five cases after mean period of 13.6 ± 15.4 days. No major complications (including pneumonia, decubitus uclers, wound infection) occured during the conservative treatment period or after surgery. Additional anterior fixation was not performed as it was assumed that sufficient stability was achieved with posterior fixation alone, given that the anterior fractures were not displaced. No surgical complications were reported. A total of 11 patients (10.7%) died during follow-up. A further 18 patients (17.6%) were lost to follow-up due to progression of cognitive impairment, making them unable to complete the questionnaire during follow-up (Table 2).

Discussion

The current study including 102 mainly conservatively treated patients shows that geriatric patients with or without an additional posterior pelvic ring fracture have similar results regarding pain levels, mobility and ADL. At 6 months, both fracture groups showed complete recovery to pre-injury levels regarding pain levels and ADL (Table 2). Based on these results, the clinical relevance of additional posterior pelvic ring fractures seems limited.

According to hospital protocols, all included patients underwent a period of conservative treatment of at least 1 week including physiotherapist-supervised weightbearing and adequate analgesia. Only 5 patients required surgical intervention due to persistent immobilizing pain. Historically, low-energy pelvic ring fractures in elderly patients have been treated conservatively, with analgesics and early full weight bearing as soon as tolerated [11,12]. Since the development of minimally invasive surgical techniques and improved perioperative imaging, an increasing number of studies have been published advocating early fixation [13,14].

The duration of the conservative treatment period in the participating hospitals (mean 13.6 ± 15.4 days) was longer when compared to the current literature [15,16]. Nevertheless, the majority of the patients recovered to pre-injury levels of pain and mobility levels and no immobility-related complications (e.g. pneumonia, urinary tract infections, decubitus ulcers) were observed. The overall mortality rate of 10.7% in this study is lower when compared to other conservatively treated cohorts and similar to cohorts in which early surgery is performed [17–19].

We recognize that the methods and results of the current study differ from the body of literature advocating early surgical fixation. [20,21]. However, it seems that the prolonged period of observation and mobilization under analgesia does not increase the complication rate. We might even advocate a less aggressive treatment strategy for these injuries, despite the fact that surgical results in these patients are very promising [19,22,23].

The results of the current study suggest that the clinical relevance of additional posterior pelvic ring fractures is limited. Therefore, it seems unnecessary to routinely perform a CT-scan in every geriatric patient with a pelvic ring fracture upon presentation to the emergency department. The results of the current study are consistent with our previously published review of the literature, which showed that patients' pain and the mobility levels dictate the treatment regime rather than the presence of additional posterior pelvic ring fractures [24]. However, if conservative treatment fails, a CT-scan is recommended to assess for additional posterior injuries or signs of instability [19,22].

Emerging evidence supports the use of Magnetic Resonance Imaging (MRI) or Dual Energy CT-scans (DECT) for occult posterior pelvic ring fractures. These modalities have superior sensitivity for bone marrow abnormalities (including edema and bone bruising) surrounding the fractures when compared with standard CT scans [18,25,26]. In patients with persistent pain, these bone bruises may be the only evidence for an occult fracture and a good reason for their complaints.

Limitations

NRS pain scores varied widely in both fracture groups at all time points (Table 2). Although the NRS is a widely accepted and valid measure of pain intensity, there are several external factors that potentially influence these scores (e.g. psychological factors and older patients report more accurate pain scores when using a Visual Analogue Scale) [27,28]. In the current study we used the NRS instead of the VAS because the latter could not be conducted over the phone, but we did not correct the NRS for potential external factors that may have contributed to the large variation. Furthermore, a recent study reported additional posterior fractures in up to 90% of the patients when using MRI assessment [18,29]. This may mean that the 75% of $A + P$ fractures on the routine CT scan evaluation in this study is an underestimation. This implies that there may have been patients in the isolated fracture group who actually had an additional occult posterior fracture that was missed on CT-scan evaluation. Finally, the relatively short follow-up period of one year does not allow us to report on long-term outcomes, but our study showed full recovery to pre-injury levels for pain, mobility, and ADL after one year.

Conclusion

The current study shows that most geriatric patients with pelvic ring fractures have both an anterior and a posterior fracture. The clinical relevance of additional posterior pelvic ring fractures seems limited

since it is not associated with higher pain scores or decreased mobility compared with isolated anterior fractures. However, the exact extent of the injury becomes more relevant when conservative treatment fails.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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