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Simultaneous bilateral femoral fractures: systemic complications in 14 cases

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Abstract We have retrospectively reviewed 14 patients with bilateral femoral shaft fractures who attended our institution between January 1993 and March 1999. The mean age of the patients was 38 years (19–75) and the median injury severity score (ISS) was 16 (interquartile range 10–20). Thirteen patients were treated with intramedullary nailing and 1 with plating and nailing within 24 h of admission to hospital. The mean resuscitation requirements were 10.6 (6–16) litres of colloid and crystalloid and 8.6 (4–30) units of blood. The mean intensive care unit/high dependency unit (ICU/HDU) stay was 4 days (1–14) and the mean hospital stay was 36.3 days (3–210). There were 6 cases of adult respiratory distress syndrome (ARDS), 1 compartment syndrome, 1 case of osteomyelitis, 1 above-knee amputation and 2 deaths (14.2%). The mean time to union was 24.5 weeks (12–37). Comparison to patients with unilateral injuries revealed a higher ISS, resuscitation requirements, ARDS, hospital stay and mortality.

Résumé Nous avons examiné rétrospectivement 14 patients avec une fracture fémorale bilatérale traités dans notre institution entre janvier 1993 et mars 1999. L'age moyen était de 38 ans (19–75) et le score moyen de la sevérité de la blessure (ISS) 16 (10–20). 13 malades ont été traités par enclouage centro médullaire et un avec plaque et clou dans les 24 heures suivant l'admission. Les exigences moyennes de la réanimation étaient de 10.6 (6–16) litres de colloîde et cristalloide et 8.6 (4–30) unités de sang. Le ratio séjour en soins intensifs/séjour en soins hautement intensifs était de 4 (1–14) et la durée moyenne de séjour à l'hôpital était 36.3 jours (3–210). Il y avait 6 cas de syndrome de détresse respiratoire adulte (ARDS), 1 syndrome de loge, 1 cas d'osteomyelite, 1 amputation au-dessus du genou et 2 morts (14.2%). La comparaison avec des patients atteints de façon unilatérale a révélé un plus haut degré de score ISS, d'exigences de la réanimation, de détresse respiratoire, de séjour de l'hôpital et de mortalité.

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Introduction

In order to examine the hypothesis that patients with bilateral femoral shaft fractures (BFSF) display relatively poorer morbidity and mortality, we retrospectively studied a group of 14 patients treated at our institution and compared them to a control group with unilateral femoral shaft fractures.

Patients and methods

Between January 1993 and March 1999 we treated 300 consecutive adult patients with femoral shaft fractures in our unit. Among them there were 14 patients (1 female) identified with simultaneous bilateral femoral shaft fractures. The patients' characteristics are shown in Table 1. We retrospectively reviewed their medical records and radiographs. Details such as patients' age, sex, Injury Severity Score (ISS) [1], resuscitation requirements, transfusion requirements, intensive care unit (ICU) or high dependence unit (HDU) stay, hospital stay, systemic complications, mortality and time to union were recorded and computerized. Similarly, the same parameters were recorded and analyzed in a comparable group of 40 patients (7 women) randomly selected from our database with unilateral femoral shaft fractures, who formed the control group of the study (Table 2).

The mean age in the BFSF group was 38.2 (19–75) years and 42.4 (18–85) years in the control group. No significant difference was noted between the two groups regarding age and sex. The median ISS of the BFSF group was 16 (10–20) compared to 9 (9–10) of the unilateral femoral fracture group. Three fractures were open in the BFSF group and 2 in the control group. The bilateral fractures were always associated with multiple injuries (Table 3).

All the patients had their femoral fractures stabilized within 24 h of injury. All but one of the fractures were stabilized with intramedullary nailing, and this was treated with plating; in total 27 nails were inserted. The surgery was performed with the patient

Table 1 Patient characteristics (*IHD* ischaemic heart disease, *RF* renal failure, *RFN* reamed femoral nail, *UFN* unreamed femoral nail)

Case	Age	Sex	ISS	Nail type	Units of bloods	ICU/HDU stay (days)	Chest injury	Complications
1	20	Male	16	RFN	5	1	No	
2	18	Male	10	UFN[a]	6	6	Yes	ARDS
3	50	Male	10	UFN	5	1	No	
4	81	Male	16	RFN	9	7	No	ARDS
5	19	Male	22	RFN	15	6	Yes	ARDS
6	69	Male	34	UFN	25	4	No	
7	40	Male	18	RFN	7	2	Yes	
8	30	Male	20	UFN	6	2	No	
9	35	Male	14	RFN	9	2	No	
10	45	Male	16	RFN	10	14	Yes	ARDS
11	28	Male	13	UFN	5	9	No	ARDS
12	25	Male	29	RFN[c]	12	3	Yes	
13	78	Female	10	UFN	9	5	No	IHD/RF[b]
14	28	Male	9	RFN	6	3	No	ARDS[b]

[a] Retrograde nailing.
[b] Mortality.
[c] Plating femur.

Table 2 Control group characteristics (*RFN* Reamed femoral nail, *UFN* unreamed femoral nail)

Case	Age (years)	Sex	ISS	Nail type	Units of bloods	ICU/HDU stay (days)	Chest injury	Complications
1	73	Male	13	RFN	2	1	No	
2	37	Male	10	UFN	0	0	No	
3	30	Male	10	UFN	1	0	No	
4	23	Male	10	RFN	0	0	No	
5	36	Male	9	RFN	0	0	No	
6	26	Male	13	UFN	2	0	No	
7	72	Male	9	UFN	2	0	No	
8	22	Male	9	UFN	0	0	No	
9	29	Male	9	RFN	0	0	No	
10	29	Male	9	RFN	0	0	No	
11	18	Male	9	UFN	0	0	No	
12	85	Male	9	UFN	2	0	No	
13	83	Female	9	UFN	1	0	No	
14	32	Male	9	RFN	0	0	No	
15	25	Female	13	RFN	2	0	No	
16	40	Male	9	RFN	2	0	No	
17	82	Female	9	UFN	2	0	No	
18	18	Male	9	RFN	0	0	No	
19	33	Female	9	UFN	0	0	No	
20	30	Male	9	UFN	0	0	No	
21	46	Male	9	UFN	3	0	No	
22	32	Female	9	UFN	2	2	No	
23	85	Male	9	UFN	0	0	No	
24	63	Male	9	UFN	0	0	No	
25	26	Female	9	RFN	0	0	No	
26	18	Male	14	UFN	3	2	No	
27	25	Female	10	RFN	0	0	No	
28	26	Male	22	RFN	7	4	Yes	ARDS
29	31	Male	10	UFN	3	1	No	
30	75	Male	9	RFN	0	0	No	
31	81	Male	2	UFN	2	0	No	
32	34	Male	10	UFN	3	0	No	
33	37	Male	9	UFN	0	0	No	
34	80	Male	9	UFN	1	0	No	
35	51	Male	9	UFN	0	0	No	
36	36	Male	9	UFN	0	0	No	
37	24	Male	50	UFN	8	16	Yes	ARDS
38	58	Male	9	RFN	0	0	No	
39	19	Male	25	UFN	5	6	Yes	
40	27	Male	9	UFN	2	2	No	

supine on a fracture table. All the nails were statically locked. In 8 patients 15 AO hollow nails were inserted after preparation of the medullary cavity with reaming. In the remaining 6 patients, 12 solid femoral nails (AO) inserted with an unreamed technique. A 9-mm solid nail (UFN) was inserted on each occasion.

Following surgery patients who developed systemic complications were treated in the intensive care unit or high dependency unit. Adult respiratory distress syndrome (ARDS) was defined as a PaO_2/FiO_2 ratio of less than 200 for at least 5 consecutive days and bilateral diffuse infiltrates seen on the radiograph of the chest

Table 3 Comparison of bilateral (BFSF) vs unilateral femoral fracture groups

Parameter	BFSF group	Control group
ISS*	16 (10–20)	9 (9–10)
Intravenous fluids (l)*	10.6 (6–16)	5 (4–10)
Blood transfusion (units)*	8.6 (4–30)	1.5 (0–8)
ICU/HDU stay (days)*	4 (1–14)	0.8 (0–16)
Hospital stay (days)*	36.3 (4–210)	11(7–44)
ARDS (no. of patients)*	6 (42.8%)	2 (5%)
Mortality (no. of patients)	2 (14.2%)	0

*$P<0.05$

Table 4 Comparison of associated injuries among groups

Associated injuries	BFSF group	Control group
Chest	5 (35.7%)	3 (7.5%)
Abdominal	1 (7.1%)	2 (5%)
Craniofacial	2 (14.2%)	3 (7.5%)
Musculoskeletal		
Tibia/Fibula	6 (42.8%)	4 (10%)
Pelvis	4 (28.5%)	2 (5%)
Ankle	5 (35.7%)	1 (2.5)
Hand	5 (35.7%)	2 (5%)
Wrist	6 (42.8%)	1 (2.5%)
Other	10 (71.4%)	8 (20%)

in the absence of pneumonia and cardiogenic pulmonary oedema [4]. Prophylactic antibiotics were given to all patients. Full active weight-bearing was encouraged according to the patient's tolerance. All the patients were followed up clinically and radiologically as indicated by their general condition. The minimum follow up was 1 year.

Comparison of data between groups was performed on a personal computer using SPSS version 6.0. Univariate data analysis was performed to assess whether there was statistical difference between the unilateral (control group) and bilateral group with respect to age, ISS, percent mortality, presence of ARDS and presence of associated injuries. Fisher's exact test was used for categorical data, and the Mann-Whitney U-test was used for all other data. A *P* value of less than 0.05 was considered statistically significant.

Results

The overall incidence of bilateral fractures was 4.6%. The mean operation time was 1 (35–85 min) h in the control group and 4.5 (4–7) h in the BFSF group. The mean resuscitation requirements were 10.6 (6–16) l and 5 (4–10) l of colloid and crystalloid and blood units transfused 8.6 (4–30) and 1.5 (0–8) in patients with bilateral femoral fractures and control patients, respectively.

The mean ICU/HDU stay was 4 days (1–14) in the BFSF group and 0.8 days (0–16) in the control group whereas the mean hospital stay was 36.3 days (5–108) and 11 days (7–44), respectively. There were 2 deaths in the bilateral group compared to none in the control group (Table 1).

In the BFSF group there were 6 cases of ARDS, 1 case of osteomyelitis and 1 above-knee amputation due to deep sepsis. In the control group there were 2 cases of ARDS, 1 compartment syndrome and 1 failure of hardware. Comparison of the parameters under investigation between the 2 groups is shown in Table 4. The mean time to union in the BFSF group was 24.5 weeks (12–37) and 23.8 weeks in the control group.

Discussion

It is a common problem with musculoskeletal injures that scoring systems tend to ignore the effect of combined injuries. It appears that bilateral femoral shaft fractures are indeed a more severe injury than has been hitherto described and may well be significantly underevaluated. While there are many accounts of unilateral fractures [14,16], there are few reports of bilateral fractures [2,7]. These are uncommon injuries and in our study have an incidence of 4.6%. This is comparable to the incidence rate reported by other authors [6,8] and such combination of injuries are rarely seen in isolation, as other authors have noted [17].

In our study patients with bilateral fractures had significantly more resuscitation requirements and a higher incidence of other injuries. Of particular importance is the development of ARDS following femoral fractures; this has been noted to be a significant cause of morbidity and mortality in the past [3,5] and the beneficial effect of early stabilization is well known. All of our patients had their femoral fractures stabilized early but the incidence of ARDS was significantly higher in the bilateral femoral group than in the patients with the unilateral fractures. This is in agreement with Copeland et al. [7], who also reported a significant incidence of ARDS in patients with bilateral femoral fractures. Our mortality rate was also higher in the bilateral femoral group.

Of the six patients who developed ARDS, 3 had concomitant chest injuries; in 2 of the cases the femoral fractures were stabilized with reamed intramedullary nailing and in the third case the fracture was treated with unreamed femoral nailing. Some authors have attributed the occurrence of pulmonary complications (ARDS) after primary intramedullary nailing to an associated pulmonary injury [15] and advised against primary femoral nailing in the presence of lung contusion [11]. Due to the small group of patients studied we are unable to make any recommendations as to whether there is a relationship between the pattern of injury (lung contusion) in multiple trauma patients and the timing of femoral nailing and the development of ARDS.

It is not clear why this higher incidence of ARDS develops. Clearly these patients have been subjected to a higher energy of injury and the associated injuries are very important. However, the pathological event leading to the development of ARDS is controversial. It seems to point to an increased risk, which is specifically related to the femoral fracture. The use of femoral nailing has also

been questioned in these patients [12]. While this study does not offer any firm conclusion, we are concerned that the bilateral nature of the injury may compound the effect of femoral nailing. It is possible that reaming both sides may contribute to the development of ARDS as whatever the pathological process is it is likely to be significantly increased. It is not clear whether this is purely due to bone marrow fat embolization as has been demonstrated by Reikeraas [13] or increased immune activation. It is clear that, when both femurs are injured, more marrow contents are likely to be released into the circulation. The alternate theory involves interactions of activated leukocytes and endothelial cells under the stimulus of cytokines and other inflammatory molecules released as part of the injury or reaming process [10]. While we have noted this effect before [9] it remains unclear as to the importance of each potential damaging process on the lungs.

This study is unable to differentiate between the inflammatory or the fat embolus effects of femoral fractures but it is interesting that we identified an increased rate of ARDS when both femurs are fractured. This does suggest that there is a specific quantitative event associated with femoral fractures, which is damaging to the lungs. It appears that the special effect of the bilateral fracture is indeed systemic as local problems around the femur are not increased, as healing times are both the same.

In conclusion, this study demonstrates that increased vigilance should be paid to a patient with bilateral fractures, because this patient is at greater risk of significant morbidity and mortality than one with a unilateral fracture. The additional femoral fracture is not quantified by the standard scoring systems, including the ISS, and therefore it is important that the treating clinician should be aware of the potential problems associated with this injury. If ARDS is a potential problem complicating isolated femoral fractures, then the effect of a bilateral femoral fracture could be much greater.

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