

# Isolated rib fractures in elderly patients: mortality and morbidity

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**Objectives:** To describe the management, morbidity and mortality seen with isolated rib fractures in elderly patients and assess the need for hospitalization. **Design:** A case series. **Setting:** A tertiary care centre in Tel Aviv. **Methods:** Hospital records of 77 elderly patients (age 65 yr and older) admitted with isolated rib fractures were reviewed over a 9-year period. **Main outcome measures:** Demographic, medical and hospitalization data, blood hemoglobin and oxygen saturation levels. **Results:** The number of fractured ribs was found to correlate with the morbidity ( $p = 0.027$ ) and mortality ( $p = 0.006$ ). There were no significant differences in these rates with respect to comorbidity except for diabetes (higher morbidity) and congestive heart failure (higher mortality). Twenty-eight patients (36%) had pulmonary complications and 1 had cardiac complications. Pulmonary complications were fatal in 6 patients (7.8%). Multivariate analysis of the factors related to morbidity demonstrated that only oxygen saturation ( $p = 0.0009$ ) and diabetes ( $p = 0.03$ ) correlated significantly. **Conclusions:** In spite of significant morbidity and mortality in elderly patients with isolated rib fractures, prediction of the prognosis for these patients is presently not possible. Admission for observation and treatment is therefore justified and beneficial.

**Objectifs :** Décrire la prise en charge, la morbidité et la mortalité reliées à des fractures de côtes isolées chez les patients âgés et évaluer le besoin d'hospitalisation. **Concept :** Série de cas. **Contexte :** Centre de soins tertiaires de Tel Aviv. **Méthodes :** On a étudié, sur neuf ans, le dossier d'hôpital de 77 patients âgés (65 ans et plus) admis pour une fractures de côtes isolées. **Principales mesures de résultats :** Données démographiques, médicales et hospitalières, taux d'hémoglobine et taux de saturation en oxygène. **Résultats :** On a constaté qu'il y avait un lien entre le nombre de côtes fracturées et la morbidité ( $p = 0,027$ ) et la mortalité ( $p = 0,006$ ). Il n'y avait pas de différences significatives entre ces taux en ce qui concerne la comorbidité, sauf dans le cas du diabète (morbidité plus élevée) et de l'insuffisance cardiaque globale (mortalité plus élevée). Vingt-huit patients (36 %) avaient des complications pulmonaires et un autre avait des complications cardiaques. Les complications pulmonaires ont été fatales dans six cas (7,8 %). Une analyse à variables multiples des facteurs reliés à la morbidité a démontré l'existence d'un lien significatif entre la saturation en oxygène ( $p = 0,0009$ ) et le diabète ( $p = 0,03$ ) seulement. **Conclusions :** En dépit de taux importants de morbidité et de mortalité chez les patients âgés victimes de fractures de côtes isolées, il n'est pas possible actuellement d'établir le pronostic dans le cas de ces patients. L'admission pour observation et traitement est donc justifiée et bénéfique.

Rib fracture is commonly seen in the emergency department. It is manifested in a wide variety of signs, symptoms, mechanism of injury and associated injuries. Rib fractures are usually a sign of a more severe injury, with high morbidity and mortality from associated injuries such as head, chest, abdomen and extremity trauma.<sup>1</sup> Isolated rib fractures are de-

defined as rib fractures with no associated injury, regardless of the number of fractured ribs. Such trauma is considered to be minor and treatable on an ambulatory basis with no need for hospital admission, especially in younger patients.<sup>2</sup>

Isolated rib fractures are one of the most common fractures among the elderly (about 12% of all frac-

tures), with an increasing incidence recorded over the past 30 years.<sup>3</sup> Studies have shown that although trauma affects principally the young, elderly persons are at risk of higher morbidity and mortality when similarly injured.<sup>4,5</sup> For this reason, our policy is to admit for observation all elderly patients who present with isolated rib fractures.

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The aim of this study is to document the incidence, morbidity and mortality of isolated rib fractures in the elderly and to assess the need for hospitalization.

### Patients and methods

We reviewed the hospital records of all patients admitted to our department of surgery with rib fractures and no associated injuries between January 1990 and December 1998. All rib fractures were confirmed radiologically.

Data on age, sex, mechanism of injury, number and location of rib fracture, length of hospital stay, complications, comorbidity and discharge disposition were retrieved. Blood hemoglobin and oxygen saturation (SaO<sub>2</sub>) levels that were measured on the patient's arrival to the hospital were recorded. All patients were followed up for a minimum of 6 months after discharge.

### Statistical analysis

Discrete variables were compared using  $\chi^2$  analysis. Continuous variables were compared using Student's *t*-test. Analysis of multivariable parameters was performed using logistical regression. Differences were considered significant when the *p* value was less than 0.05.

### Results

During the study period 148 patients were admitted with isolated rib fractures. Of these, 77 (52%) were 65 years of age or older and had isolated rib fractures. There were 40 (52%) men and 37 (48%) women. The mean (and standard deviation) age was 79.9 (7.9) years (range 65–93 yr). The fractured ribs were on the left side in 39 (51%) patients, and no patient had a bilateral rib fracture.

The mechanism of injury is summarized in Table 1. The fractures were due to a fall from standing

height or less in 69% of patients, to motor vehicle crashes in 14% of patients, and to miscellaneous causes such as assault, sports-related accidents and impact with moving objects in the rest. There was no correlation between the mechanism of injury and the morbidity and mortality.

The average number of fractured ribs was 2.6 (range 1–6 ribs). The number of fractured ribs was found to correlate with the morbidity (*p* = 0.027) and mortality (*p* = 0.006) but not with the side of the fracture (Table 2).

Fifty-five patients (71%) had at least 1 concomitant disease (Table 3). Comorbidity had no effect on morbidity and mortality rates with 2 exceptions: the morbidity was significantly higher among diabetic than nondiabetic patients (*p* = 0.0095) and only patients with congestive heart failure had a significantly higher mortality (*p* = 0.001).

The mean (and SD) hospital stay was 4.5 (4.1) (range 1–33 d). Forty-eight patients (62%) had no complications during their hospitalization (Table 4). The mean (and SD) hemoglobin level on arrival to the

hospital was 12.7 (1.3) g/L, and the mean SaO<sub>2</sub> was 96% (3.5%).

Twenty-eight patients had pulmonary complications. Active cardiac ischemia developed in only 1 patient, who received appropriate treatment. The pulmonary complications are summarized in Table 4. Eight patients were admitted to the intensive care unit for treatment of their pulmonary complications. Low SaO<sub>2</sub> was found to correlate with the morbidity of the study group (*p* = 0.002). Pulmonary complications were fatal in 6 patients (8%). Two patients died of respiratory failure and 4 patients died of pulmonary-induced sepsis. Five patients died during hospitalization and 1 patient died of pneumonia and sepsis 1 month after discharge.

No statistical correlation was found between the age or arrival hemoglobin level of the patients and morbidity. No statistical correlation was found between the age, hemoglobin level or SaO<sub>2</sub> and mortality (data not shown).

Multivariate analysis of the factors related to morbidity demonstrated that only SaO<sub>2</sub> level (*p* = 0.0009) and the presence of diabetes (*p* = 0.03)

**Table 1**

**Correlation Between the Mechanism of Injury and the Morbidity and Mortality of 77 Elderly Patients With Isolated Rib Fractures\***

Mechanism	Patients, no. (and %)	Morbidity, no. (and %)	Mortality, no. (and %)
Fall	53 (69)	20 (38)	3 (6)
Motor vehicle crash	11 (14)	4 (36)	1 (9)
Miscellaneous	13 (17)	5 (38)	2 (15)
Total	77 (100)	29 (38)	6 (8)

\*Differences were not significant.

**Table 2**

**Effect of the Number of Fractured Ribs on the Morbidity and Mortality In 77 Elderly Patients With Isolated Rib Fractures**

No. of ribs	Patients, no. (and %)	Morbidity, no. (and %)	Mortality, no. (and %)
1–2	41 (53)	10 (24)	0
3–4	30 (39)	15 (50)	6 (20)
5–6	6 (8)	4 (67)	0
Total	77 (100)	29 (38)	6 (8)
<i>p</i> value*		0.027	0.006

\* $\chi^2$  analysis

had significant correlation. Multivariate analysis of the mortality was statistically insignificant.

## Discussion

The results of this study demonstrate significant morbidity (38%) and mortality (8%) in elderly patients with isolated rib fractures. Although these patients had no associated injuries except for the fractured ribs, many suffered from complications and several died.

In their study on trauma in the elderly, Osler and colleagues<sup>4</sup> stated that trauma is a different disease in the elderly from that in young people and that the elderly respond differently to their injuries. Elderly patients are more poorly endowed than younger ones in the anatomic (decreased muscle mass, thinned vertebral bodies, osteoporosis) and physio-

logic (low cardiopulmonary and immune system reserves) aspects related to rib fractures. These differences contribute to the higher overall morbidity and mortality in the elderly population.<sup>5</sup> Younger patients (14–64 yr of age) with 1 or 2 fractured ribs with no associated injury have low morbidity and mortality and are best treated on an ambulatory basis with no need for hospital admission.<sup>1,2</sup> However, elderly patients with 2 or fewer rib fractures with no associated injury demonstrated a morbidity of 24% in our study.

We attempted to find risk factors that might correlate with the morbidity and mortality. The importance of these correlations is the ability to predict the prognosis of elderly patients with isolated rib fractures and to identify the risk factors that predispose to morbidity. This study suggests that patients with multiple rib

fractures, low SaO<sub>2</sub> or the presence of diabetes have a higher morbidity and a poorer prognosis. The mortality was found to correlate with the number of fractured ribs and the presence of congestive heart failure, but this correlation was not found to be significant on the multivariate analysis. Other risk factors that predispose to morbidity and mortality in these patients are still unclear and warrant more research, especially since the clinical symptoms presented by these patients are not a good predictor of the prognosis.<sup>6</sup> The finding that diabetic patients have a higher morbidity than nondiabetic patients could be explained by the basic immunocompromised state of the diabetic patients that results in more infections, slower healing rate and higher morbidity.

Because of this inability to adequately predict the prognosis of elderly patients with isolated rib fractures and in view of the significant morbidity and mortality that are involved, we find it justified and beneficial to admit these patients for observation and treatment. Nevertheless, it is imperative to conduct a prospective study on elderly patients with isolated rib fractures to look into other comorbid factors, for better prediction of the prognosis. Such a study could result in an admittance policy and guidelines for emergency department staff in these cases.

It is important for physicians to be aware of the special features of these injuries, not only to provide better care for elderly trauma patients but also to apply more aggressive measures of trauma resuscitation in these patients. Special attention should be given to high-risk patients with multiple rib fractures, low SaO<sub>2</sub> or the presence of diabetes in light of their higher morbidity. Once admitted, these patients should receive stricter triage and treatment protocols that include aggressive pulmonary toilet, vigorous cardiac monitoring, careful fluid management and strong analgesic medication.<sup>7</sup> A high degree of awareness should be maintained throughout the

**Table 3**

**The Influence of Pre-trauma Comorbidity of the 77 Patients on Their Morbidity and Mortality After Rib Fracture**

Concomitant disease	Patients, no. (and %)	Morbidity, no. (and %)	<i>p</i> value*	Mortality, no. (and %)	<i>p</i> value*
Diabetes mellitus	11 (14)	8 (73)	0.0095	2 (18)	NS
Congestive heart failure	14 (18)	7 (50)	NS	4 (29)	0.001
Ischemic heart disease	22 (29)	8 (36)	NS	2 (9)	NS
Atrial fibrillation	11 (14)	6 (54)	NS	1 (9)	NS
Hypertension	28 (36)	13 (46)	NS	3 (11)	NS
Cerebrovascular accident	10 (13)	3 (30)	NS	0	NS
Chronic lung disease	13 (17)	6 (46)	NS	2 (15)	NS

\* $\chi^2$  analysis  
NS = not significant.

**Table 4**

**Morbidity of 77 Elderly Patients With Isolated Rib Fractures in Relation to Risk Factors**

Complication	Patients, no. (and %)	Age (yr), mean (and SD)	SaO <sub>2</sub> (%), mean (and SD)*	Hemoglobin (g/L), mean (and SD)*
None	48 (62)	80.5 (7.8)	97.4 (1.9)	127 (13)
Pleural effusion	18 (23)	80.8 (8.8)	94.4 (4.7)	127 (13)
Lung contusion	13 (17)	81.9 (7.7)	94.7 (4.6)	129 (15)
Pneumothorax/hemothorax	10 (13)	77.6 (8.4)	94.6 (3.6)	125 (16)
Pneumonia	10 (13)	80.3 (7.9)	94.0 (4.1)	120 (14)
Cardiac ischemia	1 (1)	72	91	129
<i>p</i> value†		NS	0.002	NS

\*On arrival to the emergency department  
†Student's *t*-test  
SaO<sub>2</sub> = oxygen saturation, NS = not significant.

hospitalization and any sign or symptom of pulmonary compromise should be dealt with expeditiously.

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**SESAP Critique  
Critique SESAP**

**Category 3, Items 41–45**

Primary malignancies of the appendix constitute less than 1% of all intestinal tumors. These malignancies most commonly present with acute right lower quadrant pain prompting a diagnosis of acute appendicitis. The malignancy is rarely recognized at operation and is usually first discovered by histologic examination.

Carcinoid tumors account for 85% of appendiceal malignancies. They are most commonly diagnosed in young women, which may be attributed to the large number of incidental appendectomies performed in that subset of patients. Metastatic disease and the malignant carcinoid syndrome are rare in patients with appendiceal carcinoids. Seventy-five percent of carcinoids measure less than 1 cm in diameter in vivo. These tumors are typically circumscribed, encapsulated, yellow-white in color, and involve the appendiceal tip. Long-term follow-up studies indicate that appendectomy is curative in patients with tumors less than 1 cm in greatest diameter and the overall five-year survival rate of patients with carcinoid tumors is greater than 95%. The muscle deficient walls of the appendix make microscopic invasion of the subserosal lymphatics and mesoappendix common, but involvement of the regional lymph nodes is rare.

Adenocarcinomas of the appendix behave like other adenocarcinomas. Most of these tumors occur near the base of the appendix and occasionally may be of sufficient size to produce acute intestinal obstruction or be palpable on abdominal examination. Because the paucity of muscle in the appendiceal wall predisposes to the development of mesenteric and lymphatic involvement, most adenocarcinomas are Duke's B or C stage when diagnosed. Right hemicolectomy is recommended as treatment for appendiceal adenocarcinomas and is associated with a significant increase in survival compared with appendectomy alone. In patients with pseudomyxoma peritonei, long-term survival has been obtained by repeat celiotomy with resection of mucinous material.

Adenocarcinomas of the appendix include a subset of tumors classified as mucinous cystadenocarcinomas. These slowly progressive tumors have a ten-year survival rate of 65% when treated by right hemicolectomy, but this is reduced to 50% if pseudomyxoma peritonei is present. The rate of synchronous metastases in patients with adenocarcinoma of the appendix is surprisingly high. The most common sites are colon and ovary, or taking the form of carcinomatosis. At least two studies have indicated that appendiceal perforation does not influence the five-year survival rate of patients with adenocarcinoma of the appendix who present with acute appendicitis.

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