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Conventional A.P.-Radiographs are not reliable in Detecting Acetabular and Proximal Femur Fractures in the Elderly

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Abstract

Blunt pelvic traumata are common injuries especially among elderly patients. It is well known, that standard x-ray diagnostics fail to detect all fractures. We set up a retrospective study to gain profound knowledge of the actual informative value of a single, plain a.p. pelvic radiograph in these injuries for detecting acetabular and proximal femoral fractures as a standardized starting point in the radiologic work-up. We analysed the radiological reports, all validated by a board certified radiologist, for patients aged 75 years and older who had a blunt pelvic trauma and had both a standard a.p. pelvic x-ray and pelvic CT scan in the emergency department over a 3-year period. In 233 patients aged 75 years and older, we found 35 acetabular fractures. The calculated specificity of the plain x-ray was high (97.3%), but sensitivity was rather low (66.6%). The positive and negative predictive value were 85.7% and 92.4%, respectively. The number of proximal femur fractures found in CT was comparable (n = 46; prevalence 19.8%). The calculated sensitivity was 82.6%, specificity 93.0%, positive predictive and negative predictive values were 74.5% and 95.6%.

We thus recommend a CT scan of the pelvis whenever in doubt of the reliability of the a.p. x-ray, the mandatory clinical assessment is not sufficient or risk factors for fractures (osteoporosis, malignoma) are known.

Keywords: Geriatric; Osteoporosis; Acetabulum; Proximal femur; Fracture; CT; X-ray; Sensitivity

Introduction

Acetabular and proximal femur fractures are common injuries especially among elderly patients, which is a steadily growing part of the population in the western society [1]. The average physical activity in the elderly is rising continously [2], paralleling the rising incidence of osteoporosis with age [3,4]. In case of a blunt pelvic trauma, the mandatory clinical examination is usually followed by a gradual radiologic work-up. It is well known, that standard x-ray diagnostics fail to detect all fractures [5]. Detailed knowledge of sensitivity and negative predictive value of a plain a.p. pelvic x-ray is important to opt for or against the further, gradual radiologic work up with additional views or the nowadays easily available CT scan, or even MRI scan in select cases [6]. We set up a retrospective study to gain a profound knowledge of the actual informative value of a single, plain a.p. pelvic radiograph in blunt pelvic traumata for detecting acetabular and proximal femoral fractures in elderly patients.

Materials and Methods

We analysed the radiological reports, all validated by a board certified radiologist, for patients aged 75 years and older who had a blunt pelvic trauma and had both a standard a.p. pelvic x-ray and pelvic CT scan in the emergency department over a 3-year period in our german level I trauma center. Patients with only either x-ray or CT scan were disregarded, and histories of inadeqate or no trauma were excluded. Age and gender were recorded and cases were analysed overall and according to the following age groups 76-80, 81-85, 86-90, 91-95 and 96+. The intrinsic test characteristics (sensitivity and specificity) and the performance in the selected population (positive and negative predictive values) were calculated according to standard formulas. The study was approved by the local ethic's committee prior to data retrieval and analysis (No. 183/14).

Results

In 233 patients aged 75 years and older, we found 35 acetabular fractures in plain x-ray with 198 x-rays showing no bony lesion. Thereof, 30 x-rays were correct positive, 5 false positive, 15 false negative and 183 correct negative. Summed up, 45 patients actually had an acetabular fracture in the CT scan, equalling a prevalence of 19.3% in our study population.

	Acetabulum (%)	Proximal femur (%)
Intrinsic characteristics		
Sensitivity	66.6	82.6
Specificity	97.3	93.0
Performance in the population		
Positive predictive value	85.7	74.5
Negative predictive value	92.4	95.6

Table 1: Sensitivity and specificity of plain x-ray for acetabular and proximal femur fractures

The calculated specificity of the plain x-ray was high (97.3%), but sensitivity was rather low (66.6%). The positive and negative predictive value was 85.7% and 92.4%, respectively (Table 1).

The number of proximal femur fractures found in CT was comparable (n = 46; prevalence 19.8%) with 38 x-rays being correct positive, 13 false positive, 8 false negative and 174 correct negative. The calculated sensitivity was 82.6%, specificity 93.0%, positive predictive and negative predictive values were 74.5% and 95.6% (Table 1).

Age distribution of both, acetabular and proximal fremur fractures, show a peak around 80 years of age with a maximum of n = 13 for acetabular fractures between 76 and 80 years and a maximum of n = 18 for proximal femur fractures between 81 and 85 years of age. These amounts equal an age group prevalence of 25.5% for acetabular fractures and 27.7% for proximal femur fractures in blunt pelvic trauma (Table 2).

Age	# Acetabulum (n)	%	# Proximal femur (n)	%	All (n)
76-80	13	25,5	4	7,8	51
81-85	15	23,1	18	27,7	65
86-90	11	14,9	16	21,6	74
91-95	4	11,8	6	17,6	34
96+	2	22,2	2	22,2	9
All (n)	45		46		233

Table 2: Age distribution of acetabular and proximal femur fractures

Discussion

Both acetabular and proximal femur fractures must not be missed in the diagnostic work up of blunt pelvic trauma in elderly patients, since immobilization directly causes relevant mortality [7]. While proximal femur fractures mostly lead to a surgical intervention with prosthesis, intramedullary nailing or open reduction and internal fixation with plates, cable wires and screws, a significant proportion of acetabular fractures can be admitted to a conservative treatment regime when controlled radiographically on a regular basis.

With an increasing population aged 75 years and older especially in the western societies, the proportion of elderly patients will rise in the ED. On one hand, maintaining high activity levels throughout ageing [2] in parallel to decreasing bone stock quality due to osteoporosis will lead to an increase of elderly patients with blunt pelvic trauma [3,4]. On the other hand, the burden of higher age with e.g. dementia, frailty, sarcopenia and repetetive falls will add up to the population at risk [8].

As a limitation of the here shown study, suspected acetabular or proximal femur fractures mostly show definite findings in the clinical assessment. Addition of appropriate views in the plain radiographic routine should be mandatory (lateral view for proximal femur fractures; ala and obturator view for acetabular fractures). With the before mentioned burden of age, this limitation doesn't detract from the meaning of the above stated results; the number of inappropriate clinical findings in the assessment due to dementia or neurologic alterations of any other kind is rising, thus making it difficult to localise or focus a suspected lesion. In these cases, with adequate trauma reported, a CT scan should be performed to rule out or identify any fractures. If there are evident risk factors for fractures, such as osteoporosis or malignoma, a CT scan should be obtained. The on-going debate on radiation exposure and gradual diagnostic work-up has to be considered as well [9]; both the age of the patient and the limited informative value of plain radiographs have to be taken into account therein.

In comparison to even rather old studies (1982) of the same intent [10], only minimal changes in sensitivity and specificity can be found. For acetabular fractures, sensitivity was 73% and specificity 93% in 1981 compared to 66.6% and 97.3% more than 30 years later. For proximal femur fractures, values were similar as well (sensitivity 85% vs. 82.6%; specificity 89% vs. 93.0%). Regarding the observable but questionnable changes, one has to take into account the vast technical progress in both, plain x-ray imaging and reading as well as CT scanning. As the plain radiograph of the pelvis remains one of the standard diagnostic tools in patients with blunt pelvic trauma, the physician in charge has to bear in mind the limited informative value [11] of x-ray for acetabular and proximal femur fractures.

As a conclusion, we need to encourage the awareness for the low sensitivity of a single, plain a.p. pelvic x-ray for both acetabular and proximal femoral fractures. We thus recommend a CT scan of the pelvis whenever in doubt of the reliability of the a.p. x-ray, the mandatory clinical assessment is not sufficient or risk factors for fractures (osteoporosis, malignoma) are known.

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