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Original Scientific Paper

THE IMPACT OF SARCOPENIA ON FRACTURE PATTERNS OF THE PROXIMAL FEMUR

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SUMMARY – A single-centre cross-sectional study was performed to investigate the potential association between the presence of sarcopenia and fracture patterns in patients with a proximal femoral fracture. We identified all consecutive patients who were admitted due to proximal femoral fracture. The patient's demographic data and the presence of sarcopenia were assessed. The presence of sarcopenia was investigated preoperatively according to EWGSOP2 criteria using the SARC-F questionnaire and the hand grip strength test. According to the presence of sarcopenia, two groups were formed and analysed. We identified 70 patients who matched the inclusion criteria and were analysed in this study. In the sarcopenic group, there was a significantly higher proportion of extracapsular fractures (63.6 % vs. 26.9 %; p = 0.00298, z = 2.9684) with an increased proportion of pertrochanteric fractures (52.3 % vs. 23 %; p = 0.0164, z = 2.396) compared to the non-sarcopenic group. Also, we observed a significant difference in the proportions of femoral neck fractures between two analysed groups (36.4 % vs. 73.1 %; p = 0.0029, z = -2.9684). It is important to screen for sarcopenia and apply comprehensive geriatric care to all hip fracture patients, especially those with pertrochanteric fracture patterns.

Keywords: *Sarcopenia, Hip Fractures, Trauma*

INTRODUCTION

The European Working Group on Sarcopenia in Older People in its revised form (EWGSOP2) defines the diagnosis of sarcopenia as low muscle strength connected with low muscle quantity or quality. If a diagnosis is associated with low physical performance, sarcopenia is considered severe[1]. Sarcopenia carries a higher risk for fractures, cognitive impairment, depression, frailty, impaired ability to perform daily activities, and mortality[2-5]. The prevalence of sarcopenia in patients with hip fractures is, based on diagnosis definition and observed population, 17–74 %[6-8]. Sarcopenia diagnosis primarily requires the measurement of muscle strength and function. However, in clinical practice, this is challenging due to the pain and altered mobility of the hip fracture patients. Therefore, there are simple validated tools to screen for and diagnose sarcopenia in such clinical settings, as the SARC-F questionnaire and the hand grip strength test[1-9]. To our knowledge, the correlation between sarcopenia and proximal femoral fracture patterns hasn't been investigated in the literature, while the association with age, ABO blood group, parathyroid hormone levels, serum calcium levels, steroids use, fall direction, mechanism of injury, morphology and geometry of the hip joint, and a preexisting grade of hip osteoarthritis have been described by a number of authors[10-18].

Therefore, this study aimed to investigate the potential association between the presence of sarcopenia and fracture patterns in patients with a proximal femoral fracture.

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MATERIALS AND METHODS

Data collection

After obtaining institutional review board approval (Class: 8.1-22/81-2 No: 02/013 AG), a cross-sectional study was performed at the Department of Surgery, University Hospital Centre Zagreb, Croatia. We assessed for eligibility all consecutive patients who were admitted to the Department of Surgery due to proximal femoral fracture. The patients under the age of 18, those with delirium, severe dementia, and pathologic fracture, and those who were not willing to participate in this study were excluded from further analysis. The variables collected were patient age, gender, proximal femur fracture type, and the presence of sarcopenia.

The presence of sarcopenia was investigated preoperatively according to EWGSOP2 criteria upon the patient's arrival to the hospital ward, in the first 48 h[1]. To screen for patients at risk for sarcopenia, the SARC-F questionnaire was used[9] (Table 1).

Patients who were identified as at risk were further assessed for evidence of sarcopenia by hand grip strength tests, modified for patients with hip fractures[19]. Hand grip strength was measured with the dynamometer (Baseline® BIMS™ Digital 5-Position Grip Dynamometer, Clinic model, Fabrication Enterprises Inc., New York, USA) while the patient was laying on their back with the elbows flexed at 90°. The maximal isometric contraction of both hands was measured three times on each side, and the highest value was used in the analyses. The hand grip strength cut-off points for sarcopenia were < 16 kg for women and < 27 kg for men[1,19].

According to the presence of sarcopenia, two groups were formed and analysed. Also, different proximal femoral fracture types (femoral neck, pertrochanteric, and subtrochanteric fractures) were analysed independently.

Statistical analysis

Continuous variables are reported using median and range, and categorical variables are presented as count (percent). To compare two different periods, an independent two-sample t-test and Chi-square test were used as appropriate. To compare two proportions, a two proportions z test was used. All p values are at a significance level < 0.05. Data were analysed by statistical procedures using the program "MedCalc statistical software version 16.4.3 (MedCalc Software bv, Ostend, Belgium; https://www.medcalc.org; 2016)".

RESULTS

In the period from January 2022 to July 2022, we identified 100 admissions to the Department of Surgery, due to proximal femoral fracture. We excluded 30

Table 1 - A SARC-F questionnaire is a self-administered tool used to determine the difficulty level in 5 observed components: strength, assistance in walking, rising from a chair, stairs climbing, and history of falls. A score of 0–2 points is assigned for each component. The total score ranges from 0 to 10, with scores of ≥4 points indicating the risk of sarcopenia.

Component	Question	Scoring
Strength	How much difficulty do you have in lifting and carrying 4.5 kg?	None = 0 Some = 1 A lot or unable = 2
Assistance in walking	How much difficulty do you have walking across a room?	None = 0 Some = 1 A lot, use aids, or unable = 2
Rise from a chair	How much difficulty do you have transferring from a chair or bed?	None = 0 Some = 1 A lot, or unable without help = 2
Climb stairs	How much difficulty do you have climbing a flight of 10 stairs?	None = 0 Some = 1 A lot or unable = 2
Falls	How many times have you fallen in the past year?	None = 0 1-3 falls = 1 ≥ 4 falls = 2

Table 2 - Demographical data and general characteristics of the sarcopenic and non-sarcopenic group, A – all eligible patients admitted due to proximal femoral fracture, B - all overweight eligible patients admitted due to proximal femoral fracture, C – different proximal femoral fracture types. Significant value is in italics; % percentage, BMI - body mass index.

	Non-sarcopenic	**Sarcopenic**	**P value**
A			
Total	26	44	*0.0131*
Age, median (range)	80 (60-92)	81 (70-92)	0.9372
Women (%)	17 (65.4 %)	31 (70.4 %)	*0.0433*
B			
BMI > 25	25	15	0.1138
Women (%)	21 (84 %)	10 (66.6 %)	*0.0482*
C			
Pertrochanteric	6	23	*0.0016*
Women (%)	3 (50 %)	19 (82.6 %)	*0.0006*
Subtrochanteric	1	5	0.1025
Women (%)	0 (0 %)	3 (60 %)	0.0833
Femoral neck	19	16	0.6121
Women (%)	11 (57.8 %)	12 (75 %)	0.8348

patients (5 with dementia and 25 who were not willing to participate) from the further analysis. Therefore, 70 admissions matched the above-mentioned inclusion criteria and were analysed in this study.

The overall median age of the patients was 80 (range 60-92) years and 68.6 % (48/70) were women. There were more women in the sarcopenic group (31 vs. 17; p = 0.0433) but no statistically significant difference was found in the age between the two analysed groups. The demographical data and general characteristics of each group are reported in Table 2.

In the sarcopenic group, there was a significantly higher proportion of extracapsular (pertrochanteric and subtrochanteric) fractures (63.6 % vs. 26.9 %; p = 0.00298, z = 2.9684) with an increased proportion of pertrochanteric fractures (52.3 % vs. 23 %; p = 0.0164, z = 2.396) compared to the non-sarcopenic group. Also, we observed a significant difference in proportions of femoral neck fractures between the two analysed groups (36.4 % vs. 73.1 %; p = 0.0029, z = -2.9684). The proportion of subtrochanteric fractures was similar in both groups (11.3 % vs. 3.9 % p = 0.2757, z = 1.0856).

There was an increased proportion of women in both sarcopenic groups (70.5 % vs. 29.5 %, p = 0.0001, z = 3.837) and the non-sarcopenic group (65.4 % vs. 34.6 %, p = 0.0264, z = 2.2188).

DISCUSSION

The main finding of our study is that patients who suffer from sarcopenia and sustain a proximal femoral fracture are more likely to have an extracapsular fracture pattern, especially the pertrochanteric type.

Current evidence shows no difference in short-term outcomes like lengths of hospital stay, destination on discharge, and in-hospital mortality between different proximal femoral fracture patterns[20-21]. However, many published series implicate higher medium to long-term mortality of pertrochanteric fracture patterns[15,21,22]. Therefore, there is potential space for improving the treatment of patients with pertrochanteric fractures and sarcopenia, especially since many studies suggest that outcomes can be improved by involving geriatricians, nutritional interventions, and increasing the intensity of rehabilitation efforts[23-25]. Accordingly, recent data suggests that younger, female patients with higher pre-fracture and instrumental activities of daily living function will benefit the most from such comprehensive geriatric intervention[26].

Sarcopenia is associated with decreased bone density, vitamin D deficiency, malnutrition, and disuse which altogether predisposes those patients to falls and hip fractures [27,28]. Accordingly, we may hypothesise that sarcopenic patients have weakened trochanteric regions, and therefore a higher proportion of extracapsular, especially pertrochanteric, fractures. Earlier reports found a predictive value of lowered bone mineral density for the occurrence of osteoporotic hip fractures[29]. This is especially valid for extracapsular fractures in the elderly which have a lower bone mineral density in the trochanteric area compared to intracapsular fractures[30-32]. The authors proposed that the trochanteric region is composed of 80 to 90 % cancellous bone, and is therefore more affected by the osteoporotic remodelling imbalance. However, this study did not investigate the trochanteric bone mineral density of the enrolled sarcopenic patients, so the underlying reason for the higher proportion of extracapsular fractures remains undefined. For this reason, further research is necessary to accurately determine the impact of sarcopenia on proximal femoral fracture patterns, with the aim of creating better therapeutic guidelines.

There was an increased proportion of women in both sarcopenic and non-sarcopenic groups which can be explained by the fact that generally more women suffer from hip fracture[33]. Also, more women among the sarcopenic patients who sustained a pertrochanteric fracture support previous reports of hip fracture epidemiology[34].

This study has several limitations due to its cross-sectional single-centre design and the sample size. However, we believe that the results can be used as a reminder to screen for sarcopenia and apply comprehensive geriatric care to all hip fracture patients and as a foundation for future research.

DISCLOSURE OF CONFLICT OF INTEREST

None.

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Sažetak

UTJECAJ SARKOPENIJE NA VRSTU PRIJELOMA PROKSIMALNOG DIJELA BEDRENE KOSTI

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Presječno istraživanje bolesnika primljenih zbog prijeloma proksimalnog femura provedeno je u trauma centru s ciljem utvrđivanja povezanosti sarkopenije i vrste prijeloma kosti. Analizirani su demografski podatci i prisutnost sarkopenije. Za postavljanje dijagnoze sarkopenije korišteni su SARC-F upitnik i test snage stiska šake, prema EWGSOP2 kriterijima. Formirane su i analizirane dvije skupine bolesnika, sarkopenični i ne-sarkopenični. Identificirano je 70 bolesnika koji su odgovarali uključnim kriterijima te su analizirani u ovoj studiji. U sarkopeničnoj skupini utvrđen je značajno veći udio ekstrakapsularnih prijeloma (63.6 % prema 26.9 %; p = 0.00298, z = 2.9684) sa značajno većim udjelom pertrohanternih prijeloma (52.3 % prema 23 %; p = 0.0164, z = 2.396) u odnosu na ne-sarkopeničnu skupinu. Također, utvrđena je značajna razlika u udjelima prijeloma vrata femura između dvije analizirane skupine (36.4 % prema 73.1 %; p = 0.0029, z = -2.9684). Stoga je od velike važnosti probir na sarkopeniju i primijena sveobuhvatne gerijatrijske skrbi za bolesnike s prijelomom proksimalnog femura, posebno s pertrohanternim prijelomom.

Ključne riječi: *Sarkopenija, Prijelom proksimalnog femura, Traumatologija*