BODY COMPOSITION IN BED-RIDDEN ADULT PATIENTS BY HIP FRACTURE

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SUMMARY

Hip fractures are a major cause of hospitalization among the elderly, and constitute a considerable social and economic burden. The current mortality rate one year after hip fracture is over 33%, the risk of death is greatest 4 to 6 months after fracture. The objective of this study was to use anthropometric methods and physiological energy-expenditure values to assess changes in body composition during hospitalization, in elderly patients admitted for fractures of the proximal femur. A prospective study was performed using a consecutive sequence of 45 patients with diagnosed hip fracture. In all cases, direct measurements and indirect estimate-based anthropometric evaluation were performed in the first 24 hours following admission, and again one week after admission. By one week after admission, there was a decrease in mean arm girth (0.73 cm, p=0.0052) and in triceps fold thickness (1.41 mm, p=0.0181), but not in the other variables tested. Anthropometric evaluation as a means of charting body composition, in conjunction with the indirect estimates suggested here, may help to determine nutritional status and calorie requirements in elderly patients.

Keywords: *Anthropometry, hip injuries, Body Weights and Measures.*

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INTRODUCTION

The importance of fractures of the proximal femur is evident not only in their high incidence in the elderly population and the accompanying morbidity and mortality, but also in the considerable economic and social burden they represent. The current mortality rate one year after hip fracture is over 33%[(1)], the risk of death is greatest 4 to 6 months after fracture.

Hence the crucial need for suitable multidisciplinary hospital care, aimed at avoiding wherever possible the postoperative complications which are a major predictor of mortality during the first year post-fracture[(2)].

Little information is available on changes in body composition following hip fracture.[(3)]

The risk of sustaining a hip fracture is greater in patients with reduced bone mineral density[(4,5)] and low body weight[(6)].

Hospitalization itself entails, for the elderly patient, a number of specific risks including malnutrition; thus, surgical treatment is not in itself sufficient to ensure complete functional recovery and social reintegration.

Anthropometric evaluation and estimation of nutritional status are essential in enhancing the monitoring of patients during their stay in hospital[(7)]. The chief tools for this purpose are blood and blood biochemistry tests, nutrition surveys and analysis of anthropometric parameters[(8-11)].

The objective of this study was to use anthropometric methods and physiological energy-expenditure values to assess changes in body composition during hospitalization, in elderly patients admitted for fractures of the proximal femur.

METHODS

A prospective study was performed using a consecutive sequence of 45 patients admitted to Reina Sofia University Hospital in Cordoba-Spain with diagnosed hip fracture.

In all cases, direct measurements and indirect estimate-based anthropometric evaluation were performed in the first 24 hours following admission, and again one week after admission.

The following data were collected: patient age and sex, personal medical history and associated pathologies, fracture type (intracapsular v. extracapsular fracture of the proximal femur), type of surgical treatment (intramedullary Ender nailing, total or partial arthroplasty, osteosynthesis using screw plate or cannulated screws) and anthropometric measurements such as knee height, triceps skinfold thickness, subscapular fold, submandibular fold, mean arm girth and maximum leg girth.

Study conducted at Reina Sofia University Hospital. Cordoba, Spain.
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Patients underwent surgery no later than 48 hours after admission. All anthropometric measurements were taken three times, accepting the median or the mode value. Although these measurements are generally made on the left side in this type of patient, here measurements were made on the non-fractured side.

Since these patients had to stay in bed, height and total body weight could not be measured directly; so proxy variables such as body segment heights, muscle girths and fatty skinfolds were measured, to obtain an indirect estimate of the following anthropometric variables: height[12], weight[13], basal energy expenditure by Harris-Benedict equation, arm muscle area and skeletal muscle mass[14], body mass index (BMI); allometry was used to estimate body surface, oxygen intake and basal metabolic rate[15,16]. Subcutaneous fat was estimated from the submandibular fold[17]; the fat percentile as a function of sex was noted.

Statistical analysis

Measurements and estimates were made twice for each patient (on the day of admission and one week later), and values were analyzed using the SPSS® version 13.0 and G-Stat® version 2.0 (GlaxoSmithKline) statistical software packages.

The normality of the variables studied was tested using the Kolmogorov test with Lilliefors correction. Student's t test was used for paired data when sample number and distribution allowed, and Signs tests or Wilcoxon Signed-rank test were used in cases of non-normal distribution. It was performed using Student's t test for independent data; for non-normal conditions, the Mann-Whitney U test or the Wilcoxon W test were used. Multivariate stepwise binary logistical regression was applied to compare a dichotomous variable (e.g. fracture type) with other variables.

Factorial ANOVA was performed to compare quantitative variables and linear regression analysis.

In all cases, differences were considered statistically significant where $p < 0.05$.

RESULTS

Mean patient age was 78.59 years, range 44 to 97 years. 84.37 % were women.

Seventy-five percent of fractures of the proximal femur were extracapsular, and the rest intracapsular.

Five patients were excluded from the study: of these, two were discharged less than one week after admission, and three could not be evaluated (one due to generalized edema that distorted measurements, and the other two due to their serious general condition); these patients were excluded from all studies subsequent to demography and fracture type.

Mean values for anthropometric measurements at admission and after one week of hospitalization are shown in tables 1 and 2.

As these tables show, all variables displayed a slight decrease after one week of hospitalization.

Descriptive analysis of data showed that with the exception of fat percentile, there was a slight decrease in all variables after one week of hospitalization (table 3).

Data for estimations using 95% confidence intervals for the most significant variables are shown in table 4. Values are also shown for mean central tendency trimmed 5%, and for median central tendency for comparative purposes.

Application of Mann-Whitney-Wilcoxon tests disclosed no significant differences in fat percentile as a function of fracture type on admission, either for both sexes taken together or for women.

Comparison of values for these variables at admission and after one week (table 3), using Wilcoxon's test or Student's t test for paired data, revealed a significant difference in mean arm girth (mean difference 0.73 cm), and in triceps skinfold thickness (mean decrease 1.41 mm), but not for the remaining variables tested. All variables except maximum leg girth and fat percentile displayed a very slight decrease, although this was not statistically significant.

In order to establish whether there was any correlation with fracture type, sex and type of surgery, differences in mean arm girth and triceps skinfold thickness were subjected to factorial analysis

Patients	KH		MAG		MLG		TST		SSST		SMST	
n	$\bar{\chi}$	SD	$\bar{\chi}$	SD	$\bar{\chi}$	SD	$\bar{\chi}$	SD	$\bar{\chi}$	SD	$\bar{\chi}$	SD
40*	48.22	2.89	30.77	5.27	33.05	4.42	21.48	8.41	21.92	8.04	13.24	4.01

KH: knee height in cm. – **MAG**: mean arm girth in cm. – **MLG**: maximum leg girth in cm. – **TST**: triceps skinfold thickness in mm. – **SSST**: subscapular skinfold thickness in mm. – **SMST**: submandibular skinfold thickness in mm. * 38 data for subscapular skinfold thickness.

Table 1 – *Anthropometric values at admission.*

Patients	KH		MAG		MLG		TST		SSST		SMST	
n	$\bar{\chi}$	SD	$\bar{\chi}$	SD	$\bar{\chi}$	SD	$\bar{\chi}$	SD	$\bar{\chi}$	SD	$\bar{\chi}$	SD
40*	48.16	2.44	30.04	4.96	33.42	4.19	20.07	7.8	21.72	7.37	13.2	3.75

KH: knee height in cm. – **MAG**: mean arm girth in cm. – **MLG**: maximum leg girth in cm. – **TST**: triceps skinfold thickness in mm. – **SSST**: subscapular skinfold thickness in mm. – **SMST**: submandibular skinfold thickness in mm. * 38 data for subscapular skinfold thickness.

Table 2 – *Anthropometric values after one week of hospitalization.*

	AT ADMISSION			AFTER ONE WEEK		
	n	$\overline{\chi}$	SD	n	$\overline{\chi}$	SD
Height (cm)	40	154.99	7.39	40	154.86	6.7
Weight (kg)	40	53.56	10.8	40	53.16	9.79
Basal energy expenditure (kcal/day)	40	984.57	271.45	40	981.85	267.39
Arm muscle area (cm^2)	40	19.66	3.71	40	19.43	3.56
Total skeletal muscle mass (kg)	40	12.92	1.66	40	12.80	1.56
Body mass index (kg/m^2)	40	22.22	3.98	40	22.11	3.69
Fat percentile (%)	38	62	29.66	38	63.12	30.06
Body surface area (cm^2)	40	14690.15	1979.37	40	14629.33	1796.1
O_2 intake (ml/min)	40	202.97	30.12	40	202	27.33
Basal metabolic rate (Kjoules/day)	40	11557.46	1782.14	40	11499.11	1617.1

***Table 3** – Sampling data for variables studied.*

	$\overline{\chi}$	SEM	CI for 95% mean Lower limit	Upper limit	Mean trimmed 5%	Median
TST1	21.48	1.62	18.15	24.81	21.30	20.00
TST2	20.07	1.50	16.99	23.16	19.92	18.00
WT1	53.56	2.08	49.29	57.84	53.86	55.35
WT2	53.158	1.884	49.285	57.032	53.521	55.470
BMI1	22.2207	0.7655	20.6472	23.7943	22.2309	22.2500
BMI2	22.1133	0.7107	20.6524	23.5743	22.0848	22.0900
MM1	12.9178	0.3186	12.2630	13.5726	12.9321	12.9600
MM2	12.8011	0.3001	12.1843	13.4179	12.8324	12.9700
$O_2$11	202.9667	5.7962	191.0524	214.8809	204.0669	208.6800
$O_2$12	201.9989	5.2595	191.1877	212.8100	203.2124	209.0100
BMR1	11557.4559	342.9723	10852.4663	12262.4456	11620.7533	11890.8300
BMR2	11499.1130	311.2100	10859.4116	12138.8143	11569.6478	11910.6500

TST1: triceps skinfold thickness in mm at admission. – TST2: triceps skinfold thickness in mm after one week. – WT1: weight in kg at admission. – WT2: weight in kg after one week. – BMI1: body mass index in kg/m2 at admission. – BMI2: body mass index in kg/m2 after one week. – MM1: total-body skeletal muscle mass in kg at admission. – MM2: total-body skeletal muscle mass in kg after one week. – O211: O2 intake in ml/min at admission. – O212: O2 intake in ml/min after one week. – BMR1: basal metabolic rate in Kjoules/day at admission. – BMR2: basal metabolic rate in Kjoules/day after one week.

***Table 4 –** Estimation of anthropometric and physiological variables at admission and after one week.*

of variance, which yielded no significant differences. Linear regression analysis disclosed no correlation between age and the decrease in these two variables after one week of hospitalization.

DISCUSSION

These results show a very slight difference between data recorded at admission and after one week of hospitalization.

At data collection, it proved difficult to measure triceps skinfold thickness prior to surgery, since some patients could not be shifted onto their sides due to strong pain on moving the fracture site.

There were no significant differences in fat percentile as a function of fracture type on admission, either for both sexes taken together or for women; however, in both cases mean and median values for fat percentile were considerably lower in patients with extracapsular fractures, suggesting that if data numbers were increased, differences may well become significant. Other studies of body composition and fracture type in elderly women report lower body fat mass and lower fat percentile, independently of other variables, in cases of trochanteric fracture than in cases of cervical fracture[18].

There was a generalised, though not statistically significant, decrease in values after one week of hospitalization for most variables except mean arm girth and triceps skinfold thickness, as was indeed to be expected. The absence of significant differences may partly be due to the very short duration of the monitoring period.

In this respect, it should be noted that the trend is currently towards early surgery for hip fractures, wherever the patient's general health allows it; implantation of stable osteosynthesis devices allowing physiotherapy encourage early hospital discharge, and thus a shorter stay.

It may therefore be useful to repeat measurements of the variables tested here on an outpatient basis over a number of weeks, and at the same time collect data on the patient's return to normal activity.

Although anthropometry is not the only method for evaluating nutritional status, it is effective, inexpensive and useful for monitoring the type of patients studied here. Using the estimations suggested here, it provides a way of determining calorie requirements, thus enabling adjustment of patient diets. It is also a way of indirectly estimating patient body composition, and of evaluating the need for early physiotherapy to combat the deterioration caused by prolonged bed rest. Finally, it may help in optimizing the timing of surgery.

The authors therefore believe, like others[19,20], that anthropometric evaluation is a useful tool for determining and monitoring nutritional status in patients hospitalized for fracture of the proximal femur.

Few studies have addressed short-term changes in anthropometric and physiological parameters attributable to hospitalization following hip fracture. While most papers focus on changes in anthropometric parameters in the medium or long term (around one year), there has been some research into the changes taking place during hospitalization: several studies report a loss of bone mineral density and muscle mass only a short time after fracture, and an increase in fat mass from two months post-fracture onwards[3,21].

The relationship between BMI and various types of disorder is well-documented. Fractures are associated with a low BMI**[22,23]**, which is considered a risk factor**[24]**; some authors refer to an ideal BMI of 25 – 27.4 kg/m^2, a lower index being seen as a major predictor for mortality among young and elderly hospitalized patients. However, high BMI are not associated with minimum risk in elderly patients; indeed the risk is slightly greater over 35 kg/m^2**[25]**. Other authors prefer a wider range of "safe" BMI values: the risk of complications through malnutrition in elderly hospitalized patients is therefore greater at BMI below the optimum value of 24 to 29 kg/m^2 or when there has been a loss of over 5% of body weight over the previous year**[26]**. Here, mean BMI on admission was 22.22 kg/m^2, suggesting a high baseline risk of complications. Nevertheless, it is necessary to consider that according to recent studies BMI may affect function after hip fracture, apart from hip fracture risk: subjects with higher BMI and low hip fracture risk may have poorer functional recovery in case of hip fracture, despite prolonged rehabilitation. Conversely, subjects with lower BMI and high hip fracture risk may have better functional recovery in case of hip fracture**[27]**.

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