Psoas muscle index as indicator of sarcopenia in patients with colorectal carcinoma during oncological treatment

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Abstract— The purpose of this study was to evaluate whether psoas muscle index (PMI) was a predictive indicator of sarcopenia in colorectal carcinoma (CRC) patients during their oncological treatment. Retrospective study was conducted where we analised 49 patients of newly diagnosed CRC patients whose initial CT examination was preformed at the Clinic of radiology University clinical center of Sarajevo. All images were avaliable on postprocessing workstations and sarcopenia was assessed by calculating PMI which is measured on a single cross sectional CT image at the L3 vertebral body level. We measured the surface of the right and left psoas muscle at the level of L3 vertebral body level using IMPAX tool for surface measuring and then normalized it by using each patient's height to produce a PMI in cm^2/m^2. Average difference between initial CT and follow up (6-12 months) scores was significant and score of initial CT appeared superior with the follow up (6-12 months) showing a statistically signifcant difference ($P < 0.05$). Our study shows decrease PMI for 10,28% (females 12,17%, males 11,06%) in patients with CRC under continous oncological treatment within 6-12 months time interval between two CT exams. Further improvement of the measure technique would make it even more sensitive in detecting sarcopenia and it is promising in everyday clinical use.

Index Terms— Psoas mucle index, sarcopenia, computed tomography, colorectal carcinoma, malignant disease, weight lost, skeletal muscle mass

1 INTRODUCTION

Colorectal carcinoma (CRC) has become the third most frequent malignant disease in men and the second in women and the incidence of colorectal cancer is increasing rapidly in world (1,2). In the last years patient survival has dramatically improved thanks to contremporery oncological management: combining cytotoxic drugs, targeted therapies, radiotherapy and surgical resection of metastases (3). Malignancy can result in a hypercatabolic state caused by tumor metabolism, systemic inflammation, and other tumor-mediated effects (4). Muscle loss is also exacerbated by the administration of cytotoxic chemotherapy (5). Impared general well-being and performance status, reduced treatment tolerability and overall survival of patient with colorectal carcinoma are in most cases the result of malnutrition which became a new challenge for oncological patients (6). Weight loss includes and the loss of lean body mass - especially the loss of the skeletal muscle mass. Loss of skeletal mass is a part of the syndrom named sarcopenia. Psoas cross sectional area provides an estimation of overall muscle mass and has been used in a number of studies to predict lean muscle mass (7,8). A few studies defined sarcopenia based on measuring psoas musle area at the L3 level and calucluating psoas muscle index (PMI) without using any additional software. The purpose of this study was to evaluate whether PMI was a predictive indicator of sarcopenia in CRC patients during their oncological treatment.

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2 MATERIAL AND METHODS

We conducted retrospective study where we analised 49 patients of newly diagnosed CRC patients whose initial computed tomography (CT) examination was preformed at the Clinic of radiology University clinical center of Sarajevo. Second CT examination was preformed 6-12 months after the initial one. Between those two CT scans patients were under oncological treatment and some of them had surgical treatment as well. Patients included in this study had an abdominal CT examination at the time of diagnosis and in the 6-12 months onwards and they were older than 18 at the time of the first scanning. Excluding criteria were lack of one CT scan as listed above or interrupted oncological treatment. CT examination was performed on CT „GE LightSpeed" and Toshiba using thin slice of 2.5 mm.

Radiological images were avaliable on postprocessing workstations (IMPAX 6.5.2.114 2011, AGFA HealthCare N.V., Mortsel, Belgium) Sarcopenia was assessed by calculating psoas musle index (PMI) which is measured on a single cross sectional CT image at the L3 vertebral body level (Fig 1). We measured the surface of the right and left psoas muscle at the level of L3 vertebral body level using IMPAX tool for surface measuring and then normalized it by using each patient's height to produce a muscle psoas index (PMI) in cm2/m2 . All data analysis was performed using the statistics program IBM SPSS Statistics Version 23. Age, body mass index and muscle psoas index were described by means and standard

deviations and treated as continuous variables in the analyses. Data was tested for normal distribution using the Shapiro–Wilk test. Correlations between continuous variables were assessed using paired sample t-test. A P-value less than 0.05 was considered statistically significant.

3 RESULTS

Characteristics of patient that were included in this study are presented in Table 1. Of 49 patients 53.19% were female with the mean age of 65.7. Mean BMI was 25.27 ± 3.61. All patients were diagnosed with colorectal cancer at the time when the first CT scan was done. Overall mean PMI was 5.45 ± 1.55 cm2/m2 on initial CT and on control CT that was condutcted after 6-12 months PMI was 4.89 ± 1.76 cm2 /m2. This shows a decrease of 10.28% in PMI between two CT scans.

TABLE 1
Demographic and Characteristics of Study Population

Characteristic	*All patients n=49*
Age, mean (SD)	
Gender	
Male	24
Female	25
BMI, mean (SD) (kg/m²)	25.27 (3.61)
Psoas index	
CT – initial, mean (SD) (cm²/m²)	5.45 (1.55)
CT – 6-12 monsth, mean (SD) (cm²/m²)	4.89 (1.76)

Mean PMI for female patients on initial CT was 4.6 ± 1.24 and on control CT mean for PMI was 4.04 ± 1.39. This shows a decrease of 12.17% between two CT scans. Male patients on initial CT had mean PMI values of 6.06 ± 0.98 and on control CT PMI mean was 5.39 ± 1.07. This shows a decrease of 11.06% between two CT scans. There was a significant average difference between initial CT and follow up (6-12 months) scores ($t_{48} = 4.43$, $p < 0.001$).

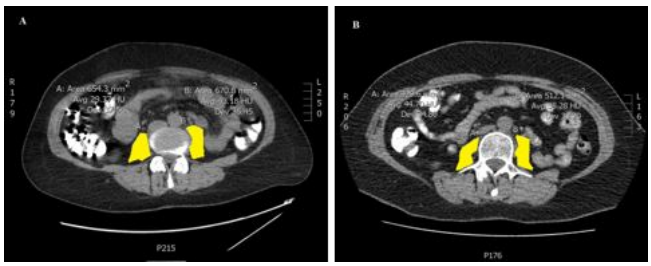

Fig 1. Psoas muscle (yellow area) at the L3 vertebral body (A) initial CT exemination (B) control CT after 6-12 months. showing decrease in PMI after oncological therapy

The score of initial CT presented in Table 2 appeared superior with the follow up (6-12 months), with a statistically signifcant difference (P <0.05).

TABLE 2
Corelation between inital CT and follwo up (6-12 months)

Grade Level	*n*	*Mean*	*SD*	*t*	*df*	*p*
Initial CT - Follow up (6-12 months)	49	0.55	0.88	4.43	48	p<0.001

4 DISCUSSION

Sarcopenia is defined as a progressive generalized depletion of skeletal muscle mass, strength, and physical function resulting primarily from aging or secondary to certain disease, malnutrition, and decreased activity (3,6). The prevalence of sarcopenia has been rapidly increasing as the number of elderly is increasing. Sarcopenia is associated with numerous poor outcomes including: mortality, length hospital stays, falls, disability, risks of infection, postoperative complications, and poorer quality of life (7–9). The impact of sarcopenia in cancer patients has been studied across a broad range of malignancies. In patients treated with chemotherapeutic agents, it has been shown that sarcopenia predicts drug toxicity, time of tumor progression, and mortality [5,10,11]. Moreover, sarcopenia is independently associated with postoperative outcomes following resection of malignancy in colorectal cancer, colorectal liver metastasis, esophageal carcinoma, hepatocellular carcinoma, melanoma [12-18]. Sarcopenia is an independent predictor of clinical outcomes in multiple gastrointestinal cancers. In recent years diagnosis of malnutrition is recognised as an important factor in order to improve quality of life and to increase treatment tolerability and to improve survival of cancer treated patients.

Various definitions and measurement methods have been used to quantify and diagnose sarcopenia. However, there is still no consensus on measurement and cutoff values (19). Radiological image analysis is being increasingly utilized to diagnose sarcopenia in patients with carcinoma and chronic disease because computed tomography (CT) is avaliable and it is routinely performed pre-operatively and before oncological treatment for the staging of cancer or chronic disease (20-22). Our study shows decrease PMI of 10,28% (females 12,17%, males 11,06%) in patients with CRC under continous oncological treatment with 6-12 months time interval between two CT exams. Unfortunately, we havent found any other studies with the same or similar scope of study.

Published reports to date frequently use image analysis software to measure muscle cross sectional area accurately. This software is frequently expensive, time consuming and does not form part of routine radiological reporting. Whilst these techniques are useful in the research setting, clinical application requires a more efficient and cost effective method of estimating lean muscle mass. Transverse psoas muscle thickness, defined as diameter of the psoas muscle perpendicular to the longest axial diameter of the muscle at L3 vertebral body level, normalizes the value to the patient's height by dividing transverse psoas muscle thickness by height is applicable, costless and in everyday practise useful way of estimating psoas muscle index as a predictor of sarcopenia.

5 CONCLUSION

Patients under continous oncological treatment have a significant decrease of PMI which is an independent indicator of sarcopenia and malnutriton. Measurement of PMI is a simple and practical method which is applicable in an everyday working environment.

6 CONFLICT OF INTERESTE

None

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