

ORIGINAL PAPER

Endoprosthesis and Obesity

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Introduction: Obesity represents a significant risk factor in the pathophysiology of degenerative changes in coxarthrosis. **Objective:** The study aims to investigate obesity as a risk factor in the examined sample comprising 136 patients who underwent hip endoprosthesis implantation. **Material and methods:** The series comprised 136 patients with a hip endoprosthesis implanted, where the patients' BMI, amount of blood used, duration of surgery, number of assistants, and type of anaesthesia were observed. Wounds and late post-operative complications, infections, haemorrhage, vein thrombosis, endoprosthesis dislocations, length of inpatient stay, start of physical therapy and full weight-bearing were also observed. The observation period lasted six months on average. **Discussion:** In simple terms, the three greatest factors when implanting a hip endoprosthesis are as follows: properties of the endoprosthesis, the orthopaedic surgeon's skill and experience, and individual characteristics of the patient, i.e. age, sex, health condition, body weight, BMI, adequate physical therapy. **Conclusion:** We believe that the implantation of a hip endoprosthesis should be postponed for patients with a BMI exceeding 29.99. Such patients should receive endocrine treatment, they should undergo a weight loss programme in order to reduce their body weight and in order to reduce their BMI to under 29.99. **Key words:** obesity, endoprosthesis

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1. INTRODUCTION

Obesity means over accumulation of fat in the body (1) and it is connected with arterial hypertension, diabetes mellitus type 2, cardiovascular diseases, carcinomas (endometrial, renal, colon, prostate, vesica phela, mammary, ...) (2) and development of arthritis of the hip, knee .. (2).

There are a number of formulae based on which „ideal“ body weight is determined. Nowadays, the most commonly used is the so-called body mass index (BMI) (1). In order to define obesity (with different body heights) the BMI that is taken into account is the one calculated by dividing a person's weight by the square of their body height (although there is a margin of error of approximately 4% when calculating BMI).

Example: a patient who weighs 100 kilograms and stands 2 metres tall has a BMI of 25, i.e. $(\text{BMI} = 100/2^2 = 25)$ (1).

If a patient's BMI is less than 18.5, we say that the patient is thin/underweight (1). A patient with a BMI between 18.5 and 24.99 has normal weight. Patients with a BMI between 25.00 and 29.99 are called overweight. They have increased comorbidity rates (1). Patients with a BMI between 30.00 and 34.99 have obesity Class I and a medium risk of comorbidities is characteristic of it. Patients with a BMI between 35.00 and 39.99 have obesity Class II which carries a serious risk of comorbidities. Patients with a BMI over 40 have obesity Class III and they are very prone to comorbidities (1). In everyday clinical practice we come across both android and

gynoid obesity (1). Android obesity (apple-shaped body) is characterised by the storage of fat in the abdominal area, upper chest region, nape of the neck, ... People suffering from this type of obesity are prone to heart diseases, metabolic syndrome, gout, hypertension, .. (3). Gynoid obesity is characterised by the presence of fat on the hips, thighs and buttocks. These people have pear-shaped bodies and are less prone to heart diseases. Technically, it is more difficult to implant an endoprosthesis in such patients (3).

In their study, Oliveira *et. al* maintain that obesity causes degenerative changes of the hip 25% more often in fat people and the risk is five times greater in women who have had their BMI greater than 30 since they were 18 (4). In the obese, coxarthrosis is more connected with clinical symptoms than with X-ray finding (4, 5).

In their study, Bergschmidt and Chee state that the risk factors for development of coxarthrosis are as follows: age, BMI and physical activity (5,6). Possible complications that may occur when implanting an endoprosthesis in obese people are pre-operative: wounds do not heal easily, infections, thrombophlebitis, dislocations, and frequently manifested post-operative complications are dislocations and prosthesis instability (6). As for fat people, deep vein thrombosis and pulmonary embolism are 50% more common in patients whose BMI is over 40 (7). In their study, Kessler S. *et. al* also state

Body mass index	Secondary illness												Total	
	Renal failure		Diabetes mellitus		Chronic cardiomyopathy		High blood pressure		Rheumatoid arthritis		No secondary illness			
	f	%	f	%	f	%	f	%	f	%	f	%	f	%
25-29.99	2	40.00	12	27.27	2	11.76	19	33.33	0	0.00	11	22.00	46	26.59
> 29.99	3	60.00	32	72.73	15	88.24	38	66.67	0	0.00	39	78.00	127	73.41
Total	5	100.00	44	100.00	17	100.00	57	100.00	0	0.00	50	100.00	173	100.00

Table 1. Distribution of patients by body mass index in relation to secondary illness

that the risk of knee arthritis is three-four times greater in people with a BMI greater than 30(8).

Obese people comprise up to 30% of population in developed countries. There are over one billion obese people in the world, and over 300 million suffer from severe obesity (4).

2. OBJECTIVE

The study is aimed at establishing, in the examined sample comprising 136 patients, how great a risk factor obesity is when implanting a hip endoprosthesis.

3. MATERIAL AND METHODS

136 patients were treated for hip fractures and coxarthrosis by implantation of total hip endoprosthesis at the Orthopaedics and Traumatology Clinics in Banja Luka and Nis in the period between 1 September 2010 and 31 December 2011. All patients were treated identically, and the research results were recorded in a questionnaire containing the following data: first and family name, sex, age, secondary illnesses, BMI, amount of blood used, duration of surgery, number of assistants, type of anaesthesia. Both early and late post-operative complications, such as infections, haemorrhage, vein thrombosis, endoprosthesis dislocations, length of inpatient stay, start of physical therapy and full weight-bearing, were observed. The observation period lasted six months on average.

4. RESULTS

The research was conducted on 136 patients treated for hip fractures and coxarthrosis at the Orthopaedics and Traumatology Clinics in Banja Luka and Nis between 1 September 2010 and 31 December 2011.

There were no patients in the examined sample with a BMI under 25, i.e.

there were no underweight patients. Out of the 136 patients, 35 (25.74%) (13 men and 22 women) had a BMI between 25 and 29.99, and they belonged to the overweight group. The obese group with a BMI over 30 (I^o, II^o, III^o) was made up of 101 patients (74.26%); 37 men and 64 women.

As far as age is concerned, we had 35 patients (25.74%) with a BMI between 25 and 29.99: 10 of them were aged between 40 and 50, 13 between 51 and 60, 9 between 61 and 70, and 3 were aged between 81 and 90. 101 patients (74.26%) with a BMI over 30 were aged as follows: 25 were aged between 40 and 50, 38 between 51 and 60, 30 between 61 and 70, 2 between 71 and 80, and 6 were aged between 81 and 90.

A hip endoprosthesis for fracture was performed on 52 (38.2%) out of the 136 patients, while the indication in 84 patients (61.8%) was coxarthrosis. 4 patients whose BMI was between 25 and 29.9 had Garden Type III fractures, while 9 had Garden Type IV. 12 patients whose BMI was over 30 had Garden Type III fractures, while 27 had

Garden Type IV. Out of the 84 patients (100%) who had an endoprosthesis implanted for coxarthrosis 22 (26.19%) had a BMI between 25 and 29.9, and 62 (73.81%) had a BMI over 30.

The distribution of patients by their BMI in relation to secondary illnesses is shown in Table 1. Patients suffered from chronic illnesses for which they had already been treated. Table 1 shows that the results of the t-test according to which, with a 5% risk, an alternative hypothesis is accepted whereby there is a significant statistical difference between chronic illnesses of patients with a BMI between 25 and 29.99 and those with a BMI over 29.99, and it amounts to $p = 0.000521$.

The Austin-Moore surgical access was used on all patients. The surgical access in patients with a BMI between 25 and 29.9 was 15cm long, while it amounted to 24cm in patients with a BMI over 30. The lead surgeon always had three assistants, irrespective of the patient's BMI. The duration of surgery in patients whose BMI ranged between 25 and 29.9 was 90 minutes, and

Body mass index	Amount of blood used (ml)										Total	
	0		320		640		960		1280			
	f	%	f	%	f	%	F	%	f	%	f	%
25-29.9	5	55.56	13	30.95	11	26.83	6	16.67	0	0.00	35	25.74
> 29.9	4	44.44	29	69.05	30	73.17	30	83.33	8	100.00	101	74.26
Total	9	100.00	42	100.00	41	100.00	36	100.00	8	100.00	136	100.00

Table 2. Distribution of patients by body mass index in relation to amount of blood used (ml)

Body mass index	Post-operative complications										Total	
	Infection		Haemorrhage		Vein thrombosis		Dislocation		No post-operative complications			
	f	%	f	%	f	%	f	%	F	%	f	%
25-29.99	1	12.50	1	33.33	4	30.77	2	33.33	27	25.47	35	25.74
> 29.9	7	87.50	2	66.67	9	69.23	4	66.67	79	74.53	101	74.26
Total	8	100.00	3	100.00	13	100.00	6	100.00	106	100.00	136	100.00

Table 3. Distribution of patients by body mass index in relation to post-operative complications

Body mass index	Quality score with weight coefficients of variables										Total	
	Inpatient length of stay (days)		Amount of blood used (ml)		Incision area size (cm)		Number of assistants		Duration of surgery (min)			
	f	%	f	%	f	%	f	%	f	%	f	%
25-29.9	5.7	28.79	17.4	29.59	10.1	34.36	10.7	35.68	21	28.57	65	30.68
> 29.9	14.1	71.21	41.4	70.41	19.2	65.64	19.2	64.32	53	71.43	146	69.32
Total	19.8	100.00	58.8	100.00	29.3	100.00	29.9	100.00	74	100.00	211	100.00

Table 4. Distribution of patients by body mass index in relation to quality (with different weight coefficients for variables)

in those whose BMI was over 30 the surgery took 120 minutes on average. BMI did not affect the waiting time for surgeries. BMI had a significant effect on the use of blood when implanting endoprostheses (Table 2).

BMI had a significant effect on the selection of anaesthesia for surgery. Thus, general anaesthesia was used for 24 patients with a BMI between 25.00 and 29.99 and spinal anaesthesia for 11. In order to implant an endoprosthesis in patients with a BMI over 30, general anaesthesia was used on 44, and spinal on 57 patients.

We had 23 patients with a BMI between 25 and 29.9 whose physical therapy started the first day, for 8 patients it started on the second day, and for 4 on the third. As for patients with a BMI over 30, 35 of them started their physical therapy on the first day, 35 on the second, 27 on the third and 4 on the twelfth. With 10 patients whose BMI was between 25 and 29.9 we achieved full-weight bearing on their operated leg on the first day, with 14 it was on the second, with 6 on the third, with 2 on the fourth, and with 3 patients it was on the fifth day. With 5 patients whose BMI was over 30 we achieved full-weight bearing on their operated leg on the first day, with 15 it was on the second, with 23 on the third, with 20 on the fourth, and with 9 patients it was on the fifth day.

4 patients with a BMI between 25 and 29.9 spent up to 6 days in hospital, 14 spent 10 days, 16 up to 15 days and 1 patient spent over 15 days in hospital. 3 patients with a BMI over 30 spent up to 6 days in hospital, 35 spent up to 10 days in hospital, 56 up to 15 days and 7 patients spent over 15 days in hospital.

Early post-operative complications were as follows: infection, haemorrhage (post-operative haematoma), vein thrombosis, dislocations (Table 3).

We obtained the Chi-square test value (54.84) > (5.99) ($p < 0.05$) according to which, with a 5% risk, a hypothesis is accepted whereby there is a significant statistical difference between patients with a BMI of up to 29.9 and those with a BMI over 30 (Table 3).

There is a significant statistical difference between patients with a BMI of up to 29.99 and those with a BMI over 30.00. Distribution of patients by body mass index in relation to the quality score with weight coefficients of the variables is best shown in Table 4. It is obvious from Table 4 that the results of the t-test according to which, with a 5% risk, an alternative hypothesis is accepted whereby there is a significant statistical difference between the quality score with weight coefficients of the variables of patients with a BMI between 25 and 29.99 and those whose BMI was higher than 29.99, and it amounts to $p = 0.000521$.

5. DISCUSSION

A suitable hip joint endoprosthesis is the greatest modern achievement in orthopaedics(5,8,9). A number of factors influence a more long-term proper functioning of an endoprosthesis and better movement of persons with an artificial joint. In simple terms, we talk about three most important factors: properties of the endoprosthesis, the orthopaedic surgeon's skill and experience, and individual characteristics of the patient, i.e. age, sex, health condition, body weight or BMI, and physical activity(8,9). The effect that body weight has on the musculoskeletal system and damages that occur are well known, and we have been telling patients for a long time about the value of controlling and reducing their body weight, which is very important in endoprosthetics(9). Due to the build and biomechanical relationships, the body weight at one stage

of movement eccentrically loads the weight-bearing hip joint, and a muscle force that is approximately three times greater than the weight is required for balancing the pelvis, which results in the load-bearing force being three-four times greater than the weight(9). A weight gain of only 1kg results in a load increase of approximately four times in the hip with an endoprosthesis (9).

While monitoring long-term function of endoprostheses, Cooper and the group of authors do not indicate any significant statistical differences in the number of complications between normal weight and obese patients (10). They infrequently implant endoprostheses in obese persons (10), which would definitely be recommendable here too.

In a prospective clinical trial, Slavica Jandric *et. al.*, using a randomised method on 394 patients diagnosed with coxarthrosis, concluded that the average BMI value was 30.61 kg/m². In men, the average BMI value was at the overweight level (28.66 kg/m²), and in women it was at the obesity level (31.49 kg/m²) (11). The statistical difference between the BMI for women and the BMI for men was significant ($p = 0.016802$, $p < 0.05$). BMI was at the obesity level in 27 or 60% of patients with coxarthrosis, at the overweight level in 11 or 24.4% of patients, and only 15.5% of patients had normal weight. 91.11% or 41 patients with symptomatic coxarthrosis were aged over 50. The statistical correlation between BMI and age was not significant in the total sample of patients suffering from coxarthrosis ($r = -0.32799$). The correlation between ages was significant ($r = -0.34745$, $p > 0.05$) (11). The results showed that there was a difference in the connection between age and BMI in patients with symptomatic coxarthrosis in relation to sex. The younger the men suffering from coxarthrosis were, the higher their BMI was (11).

Carrying a few extra kilograms may pose a health risk, while morbid obesity may cause serious health problems. The studies conducted by Natvig (12) have shown that patients with a BMI over 30.00 suffer 3.3 times more often from infections as a complication following endoprosthesis implantation, have a loosened endoprosthesis 1.5 times more

often and experience thromboembolic complications 0.7 times more often (12). A number of orthopaedic surgeons suggest implanting a hip endoprosthesis in patients suffering from obesity with a BMI over 35.00 (13). In the USA, the increase in obesity has triggered the need for many more endoprostheses and thus increased the risk of lifelong complications (12,13). One group of authors, in extreme cases when endoprosthesis implantation is the only solution, are adamant that the patient should be requested to lose weight (minimum to obesity Class I) before the endoprosthesis can be implanted, in order to reduce the risk of complications(14).

Andrew *et. al* (15) conducted a prospective study on 1421 patients who had an endoprosthesis implanted for coxarthrosis in the period between January 1999 and 2007 (15). They examined whether and to what extent obesity had an effect on the clinical outcome(15). The patients were classified into three groups: non-obese patients with a BMI less than 30 kg/m², obese patients with a BMI between 30 and 40 kg/m², and morbidly obese patients with a BMI over 40 kg/m² (15). The study showed a significant statistical difference in increased haemorrhage, infections, deep vein thromboses and pulmonary embolism, and duration of hospital treatment between morbidly obese and non-obese patients (15). Radiological analyses of heterotopic ossification of the femur were statistically significantly increased in the morbidly obese (15). The morbidly obese group was considerably younger and they required a longer surgical work(15).

Obesity has reached epidemic proportions in the USA, and it is expected that the rest of the developed world will follow in their wake. As obesity is a well documented risk factor for developing osteoarthritis(16), what can be expected is the increased need for joint arthroplasty in obese people(16,17). Surgeries alone take longer time on obese patients (17), the rates are higher and complications during hospital stay last longer, and some authors have even suggested refusing to implant endoprostheses in obese patients(17).

Todkar *et. al* (18) established that having a higher BMI is related to less

physical activity, which in turn resulted in less wear and tear of the endoprosthesis(18). On the other hand, there was a greater force affecting the prosthesis of obese patients and led to early loosening of the prosthesis (18).

Walter *et. al* (19) in their study state that patients with a BMI over 25.00 had early complications such as infection, post-operative haematoma, deep vein thrombosis and pulmonary embolism, and endoprosthesis dislocation 3, 4, 2 and 0.5 times more often (19).

Most authors in their work mention the BMI cut-off point(4,9,12,19,20) on which they base their consensus BMI for implanting a hip endoprosthesis. They believe that a BMI of up to 30 is the cut-off point between obesity and non-obesity(20) and patients with their BMI over 30 do not need endoprosthesis implantation until they have reached a BMI of up to 30 [20]. Another group of authors do not recommend endoprosthesis implantation when the BMI is over 35(21).

6. CONCLUSION

Obesity is a factor in developing coxarthrosis early, especially in women. A decrease in the number of people who are overweight would certainly result in fewer joint damages and endoprosthetic indication. Surgical implantation of endoprostheses in obese persons is technically more difficult and it is related to more complications than in case of normal weight patients. Both objective and subjective results in obese patients are less successful.

The examined sample has therefore led us to believe that the implantation of a hip endoprosthesis should be postponed for patients with a BMI exceeding 29.99. Such patients should receive endocrine treatment, they should undergo a weight loss programme in order to reduce their body weight and in order to reduce their BMI to under 29.99.

CONFLICT OF INTEREST: NONE DECLARED.

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