

Obesity as a risk factor of in-hospital outcomes in patients with endometrial cancer treated with traditional surgical mode

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ABSTRACT

Objectives: Abdominal obesity is a risk factor for endometrial cancer. The negative impact of individual parameters of obesity on the procedural effects of endometrial cancer surgical treatment has been suggested. The aim of the current study was to estimate the relationship of particular parameters of obesity and in-hospital outcomes in patients treated surgically due to endometrial cancer.

Material and methods: The study included 70 women treated surgically for endometrial cancer. Pre-operatively, mass, body mass index (BMI), waist circumference, waist-hip ratio and selected anatomical indices were measured. The duration of surgery, hospitalisation, and the loss of haemoglobin served as parameters of in-hospital procedure success. Also, procedural-related complications were estimated.

Results: There were 37 (52.8%) obese females in the current study. They were obese patients presenting more advanced clinical stages of endometrial cancer before operation. The duration of operation (94.9 ± 21.6 min. vs. 76.1 ± 13.5 min., $p < 0.0001$), hospitalisation (12.4 ± 3.4 days vs. 10 ± 2.3 days, $p = 0.0009$) and haemoglobin loss (2.5 ± 0.9 g/dL vs. 1.9 ± 0.8 g/dL, $p = 0.004$) were significantly greater in obese patients. Multivariate analysis, among the independent predictors of the duration of operation, has confirmed the correlation between BMI, waist circumference and weight and the duration of hospitalisation. Waist and hip circumference and BMI coupled with external conjugate dimension and intertrochanteric distance have been linked with haemoglobin loss. The strongest correlation for the duration of operation, hospitalisation and haemoglobin loss was noticed for waist circumference ($r = 0.7$, $r = 0.57$ and $r = 0.59$).

Conclusions: Waist circumference and BMI are strong predictors of in-hospital outcomes among patients with endometrial cancer treated via traditional surgical operation.

Key words: abdominal obesity; BMI; cancer of endometrium; operative time; perioperative outcomes

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INTRODUCTION

Endometrial cancer is the most common cancer of the female reproductive organs. It is ranked fourth in terms of the incidence of malignant tumours. In the years 1963–2008, a significant increase in the incidence of malignant neoplasms of endometrial cancer was observed (1,023 and 4,820 cases, respectively, in 1963 and 2008) [1]. There was also an increase in the percentage of malignant tumours in this organ among all malignancies in women from 5.3% to 7.4%. The standardised incidence rate in 1963 and 2008 was 5.9 and 14.4 per 100,000 women, respectively. According to Bidziński, it is likely that the growing trend in the incidence of malignant neoplasms

of the uterus will persist [1]. On the other hand, mortality from endometrial malignancies in the last decades has significantly decreased. Standard mortality rates in 1963 and 2003 were 9.1 and 2.2, respectively [1]. The occurrence of endometrial cancer is associated with economic and cultural fluctuations in developed countries that bring about lifestyle changes, which, among others, involve obesity, diabetes, hypertension, metabolic syndrome, multiparity, treatment with exogenous oestrogens unbalanced with gestagens or treatment with tamoxifen [2, 3]. The prolonged life expectancy in women in Poland and other European countries also contributes to an increase in the incidence of endometrial cancer. Most cases occur

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in postmenopausal women (75%) [1]. Obesity in women aged 50–59 is the most important risk factor for the development of endometrial cancer [2]. It was estimated that an increase in body mass by 10 kg in women in this age range results in a threefold higher risk of disease, an increase in mass above 20 kg increases the likelihood of the disease even tenfold [4]. In a meta-analysis of 19 reviews and prospective studies, Renehan et al. [5] also found that each increase in BMI by 5 kg/m² significantly increased a woman's risk of developing endometrial cancer (RR 1.59, 95% CI 1.50–1.68). Not only does obesity have impact on cancer-related death, but through its association with co-morbidities (diabetes mellitus and hypertension), it significantly affects all-cause mortality. The Gynaecologic Oncology Group, in a review among 380 patients with endometrial cancer, found that morbid obesity was associated with higher mortality (HR 2.77, 95% CI 1.21–6.36) from causes other than endometrial cancer or disease recurrence [6]. Endometrial cancer is not a homogeneous tumour, both in terms of histological structure or clinical exponents. Classically, according to Bokhman, two types of histopathology are distinguished: Type 1 — more frequent, endometriotic cancer, Type 2 — less frequent, non-endometrioid cancer. Non-endometrioid carcinomas include serous and clear cell carcinomas. The second type of endometrial tumours has a vague etiology and worse prognostics [7, 8]. Type 1 is etiopathogenetically associated with excessive oestrogen stimulation and obesity [9]. We assume that in about 80% of endometrial cancers, it is reasonable to find these compounds. According to the World Cancer Report, obesity accounts for 40% of all endometrial cancer cases [2]. Obesity is an important social and health problem. It is estimated that the issue of overweight and obesity affects 50–65% of the European population. In summary, there are discrepancies in the assessment of the influence of obesity regarding the course of surgically treating endometrial cancer due to the use of various parameters of obesity in the literature.

The aim of the current study was to assess the relationship between obesity parameters and procedural indices with emphasis on the duration of operation, hospitalisation and haemoglobin loss after the operation.

MATERIAL AND METHODS

70 patients treated at the Clinical Department of Gynaecology of the Provincial Specialist Hospital due to endometrial cancer in the period from February to August 2011. The study included patients qualified for transabdominal hysterectomy with diagnosed endometrial cancer based on histopathological examination of uterine scrapings. The research project was an observational prospective study of standard treatment. Before the operation, a clinical

interview was performed. This included age, births, education in years, prior abdominal surgeries and comorbidities. In the preoperative study, the following parameters were determined: height, weight, waist and hip circumference in cm with a measuring tape, pelvic bone dimensions using a pelvis meter. Also, body mass index (BMI) and waist-hip ratio (WHR) were calculated in the study group. According to the World Health Organization, overweight and individual degrees of obesity are determined by defined ranges of BMI. Overweight was defined as BMI in the range 25–30 kg/m². Class I obesity is within the range 30–35 kg/m², while class II obesity is within the range of 35–40 and class III obesity values are > 40 kg/m². Patients were qualified for the hysterectomy procedure according to the current Polish guidelines [10]. In the current study obesity was defined as the BMI ≥ 30 kg/m². The surgery treatment included: removal of the uterus with adnexal tracts, systemic pelvic and para-aortic lymphadenectomy (FIGO I–G1/G2 and myometrium invasion > 50%, G3) removal of the greater omentum (Excision of the greater omentum in serous endometrial carcinoma and sarcomatous) [11]. In the perioperative period, selected parameters were monitored and they were recognised as indicators of in-hospital outcome of operational treatment: the duration of surgery (minutes), the loss of haemoglobin — the difference in the serum concentration before surgery and on the second day after surgery (g/dL), the occurrence of procedural-related complications, and the duration of hospitalisation (days).

The study has been approved by the local University of Rzeszów ethics committee. The protocol complied with the Declaration of Helsinki, and all participants provided written informed consent before enrolment.

Statistical analysis

Continuous variables are expressed as mean ± standard deviation. Categorical variables are introduced as numbers and percentages. Normality was assessed with the Shapiro-Wilk test. The Mann-Whitney U test was used for non-normally distributed continuous variables. Univariate and multivariate regression analysis were used to find significant predictors of in-hospital outcomes. The analysed procedural indices (duration of operation, duration of hospitalization and the extent of hemoglobin loss) were assessed as continuous variables. Also predictors of clinical outcomes were assessed as continuous variables or dichotomic when appropriate. Multifactorial analysis was performed by backward elimination. Also, Spearman's correlations were calculated for possible relationships between selected factors and pre-specified indicators of in-hospital outcomes. The p-value < 0.05 was considered statistically significant. All analyses were performed with JMP®, Version 13.1.0 (SAS Institute INC., Cary, NC, USA).

RESULTS

General characteristics

The patients' epidemiology and tumour characteristics are presented in Table 1. In the studied group, 81.43% presented a BMI > 25 kg/m² (Fig. 1). While 37 patients presented with BMI > 30 kg/m² (52.8%). Most often, the patients were diagnosed and operated in stage I of the cancer according to FIGO — Table 2. In the preliminary analysis of the results of surgical treatment, we observed that the average duration of abdominal hysterectomy due to endometrial cancer was 86 ± 20.4 minutes, the average duration of hospitalisation was 11.3 ± 3.1 days, the average loss of haemoglobin

measured as a difference measured in g/dL before surgery and on the second day after surgery was 2.2 ± 0.9 (Tab. 3).

The duration of the operation

The duration of the operation was significantly longer in patients with BMI value ≥ 30 kg/m² compared patients with BMI value < 30 kg/m² (94.9 ± 21.6 vs. 76.1 ± 13.5 days, p < 0.0001). The duration of operation time correlated positively with body mass, BMI value, hip circumference, WHR, intertrochanteric distance, interspinous distance, intercrystal distance, external conjugate and prior abdominal surgery, while a negative correlation was found with

Table 1. Patients epidemiology and tumour characteristics

| Variable | | Overall group N = 70 (%) | |
|--|---------------------------------------|--------------------------|-----------|
| Place of residence | Rural region | 26 (37.2) | |
| | Urban region | 24 (34.3) | |
| | Town > 50,000 residents | 20 (28.5) | |
| Menstrual status | Before menopause | 61 (87.1) | |
| | After menopause | 9 (12.9) | |
| Parity | Nulliparous | 14 (20.1) | |
| | Uniparous | 16 (22.8) | |
| | Multiparous | 40 (57.1) | |
| Histopathological type | Endometrioid | G1 | 36 (51.4) |
| | | G2 | 24 (34.2) |
| | | G3 | 5 (7.1) |
| | Clear-cell | 1 (1.4) | |
| | Serous | 2 (2.8) | |
| | Adenosquamous | 1 (1.4) | |
| | Non-epithelial | 1 (1.4) | |
| Staging according to FIGO classification | I | 52 (74.3) | |
| | II | 11 (14.3) | |
| | III | 5 (7.1) | |
| | IV | 2 (2.8) | |
| Co-morbidities | Diabetes mellitus | 17 (24.8) | |
| | Hypertension | 32 (54.8) | |
| | Coronary artery disease | 5 (7) | |
| | History of venous occlusive disease | 3 (5.2) | |
| | Arrhythmias | 6 (8.4) | |
| | Priorcerebral stroke | 2 (2.8) | |
| | Chronic heart failure | 4 (5.6) | |
| | Bronchial asthma | 5 (7) | |
| | Chronic pulmonary obstructive disease | 3 (4.2) | |
| | Hyperthyroidism | 4 (5.6) | |
| | Hypothyroidism | 3 (4.2) | |
| | Cholelithiasis | 6 (8.4) | |
| | Diathesisurica | 2 (2.8) | |
| | Osteoarthritis | 9 (12.6) | |

the number of births. This is presented in Table 4. Univariate regression analysis confirmed significant relationships between operation duration and body mass, BMI, waist circumference, hip circumference, WHR, intertrochanteric

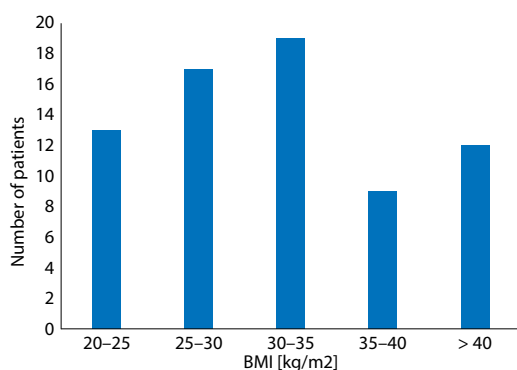


Figure 1. Patient distribution according to body mass index (BMI) value; BMI — body mass index

distance, interspinous distance, intercrystal distance, prior abdominal surgery, hypertension, diabetes, chronic obstructive pulmonary disease and hypothyroidism. This is presented in Table 5. Multivariate regression analysis among the above-mentioned factors confirmed significant relationships between the duration of the operation and waist circumference ($p < 0.0001$), body mass ($p < 0.0001$), chronic obstructive pulmonary disease ($p = 0.001$), BMI ($p = 0.0002$), intertrochanteric distance ($p = 0.01$) and hypothyroidism ($p = 0.02$).

The duration of hospitalisation

The mean duration of hospitalisation was significantly longer in patients with BMI value ≥ 30 kg/m² compared to those with BMI value < 30 kg/m² (12.4 ± 3.4 vs. 10 ± 2.3 days, $p = 0.0009$; Tab. 3). The duration of hospitalisation correlated significantly positively with body mass, BMI, waist circumference, hip circumference, WHR, , intertrochanteric distance, interspinous distance, intercrystal dimension, external con-

Table 2. Clinical stages according to International Federation of Gynaecology and Obstetrics (FIGO) 2008 — comparison of the number of patients in each stage of cervical cancer depending on the presence of obesity (Chi square test)

| Stages of severity | Overall group N = 70 | Obese (BMI ≥ 30 kg/m ²) N = 37 | Non-obese (BMI < 30 kg/m ²) N = 33 | p value |
|--------------------|-------------------------|---|--|---------|
| Stage I | | | | |
| A | 34 (51.4) | 15 (40.6) | 19 (57.4) | 0.15 |
| B | 16 (22.8) | 8 (21.6) | 9 (27.2) | 0.58 |
| Stage II | 11 (14.3) | 5 (13.5) | 5 (15.4) | 0.84 |
| Stage III | | | | |
| A | 5 (7.1) | 5 (13.5) | 0 | – |
| B | 1 (1.4) | 1 (2.7) | 0 | – |
| C1 | 1 (1.4) | 1 (2.7) | 0 | – |
| C2 | 0 | 0 | 0 | – |
| Stage IV | | | | |
| A | 0 | 0 | 0 | – |
| B | 2 (2.8) | 2 (5.4) | 0 | – |

BMI — body mass index

Table 3. Comparison of selected indices in obese and non-obese patients

| | Overall group | Obese (BMI ≥ 30 kg/m ²) | Non-obese (BMI < 30 kg/m ²) | p value |
|-----------------------------------|-----------------|--|---|------------|
| Age, years | 61.3 ± 10.4 | 63.3 ± 9 | 59.1 ± 11.5 | 0.09 |
| Intertrochanteric dimension, cm | 35.3 ± 2.1 | 36.2 ± 2 | 34.2 ± 1.8 | < 0.0001 |
| Intersubular dimension, cm | 26.9 ± 2 | 27.6 ± 2.1 | 26.2 ± 1.7 | 0.0006 |
| Intercrystal distance, cm | 32.3 ± 3 | 33.7 ± 2.5 | 30.7 ± 2.7 | < 0.0001 |
| External conjugate, cm | 22.2 ± 1.5 | 22.8 ± 1.4 | 21.5 ± 1.4 | 0.0002 |
| Duration of operation, minutes | 86 ± 20.4 | 94.9 ± 21.6 | 76.1 ± 13.5 | < 0.0001 |
| Duration of hospitalisation, days | 11.3 ± 3.1 | 12.4 ± 3.4 | 10 ± 2.3 | 0.0009 |
| Loss of haemoglobin, g/dL | 2.2 ± 0.9 | 2.5 ± 0.9 | 1.9 ± 0.8 | 0.004 |

BMI — body mass index

jugate, prior abdominal surgery, clinical stages according to FIGO classification and histopathological grading. This is presented in Table 4. Univariate regression analysis also revealed significant relationships between the duration of hospitalisation and body mass, BMI, waist circumference, hip circumference, WHR, intertrochanteric distance, interspinous distance, external conjugate prior abdominal

surgery, hypertension, diabetes, chronic obstructive pulmonary disease, hypothyroidism and heart failure. This is presented in Table 5. Multivariate regression analysis among the above-mentioned factors confirmed that the duration of hospitalisation was significantly associated with waist circumference, hip circumference, prior abdominal surgery hypothyroidism and BMI.

Table 4. Significant correlations between selected indices and haemoglobin loss during operation, duration of operation and hospitalisation

| Predictors | Δ Hb before and two days after operation [g/dL] | | Duration of operation [min.] | | Duration of hospitalisation [days] | |
|------------------------------------|---|----------|------------------------------|----------|------------------------------------|----------|
| | R coefficient | p value | R coefficient | p value | R coefficient | p value |
| Weight, kg | 0.54 | < 0.0001 | 0.59 | < 0.0001 | 0.48 | < 0.0001 |
| Body-mass index, kg/m ² | 0.55 | < 0.0001 | 0.57 | < 0.0001 | 0.48 | < 0.0001 |
| Waist circumference, cm | 0.57 | < 0.0001 | 0.7 | < 0.0001 | 0.59 | < 0.0001 |
| Hip circumference, cm | 0.46 | < 0.0001 | 0.57 | < 0.0001 | 0.43 | 0.0002 |
| Waist-hip ratio | 0.42 | 0.0003 | 0.36 | 0.002 | 0.35 | 0.003 |
| Intertrochanteric dimension, cm | 0.33 | 0.004 | 0.45 | 0.001 | 0.25 | 0.03 |
| Intersubular dimension, cm | – | – | 0.36 | 0.002 | 0.31 | 0.008 |
| Intercristal distance, cm | 0.43 | 0.0002 | 0.39 | 0.0007 | 0.25 | 0.03 |
| External conjugate, cm | 0.48 | < 0.0001 | 0.28 | 0.02 | 0.33 | 0.004 |
| Prior abdominal surgery | 0.42 | 0.0003 | 0.29 | 0.014 | 0.41 | 0.0005 |
| Number of births | – | – | –0.28 | 0.017 | – | – |
| Clinical stages, FIGO | 0.29 | 0.01 | – | – | 0.24 | 0.04 |
| Histopathology, grading | – | – | – | – | 0.25 | 0.04 |

Δ Hb — the difference in the serum concentration before surgery and on the second day after surgery

Table 5. Predictors of blood loss, duration of operation and hospitalisation assessed by univariate regression analysis

| Predictors | Δ Hb before and two days after operation [g/dL] | | Duration of operation [min.] | | Duration of hospitalisation [days] | |
|------------------------------------|---|----------|------------------------------|----------|------------------------------------|----------|
| | β (95% CI) | p value | β (95% CI) | p value | β (95% CI) | p value |
| Weight, kg | 0.018 (0.008–0.028) | 0.00006 | 0.641 (0.439–0.842) | < 0.0001 | 0.081 (0.048–0.115) | < 0.0001 |
| Body-mass index, kg/m ² | 0.043 (0.018–0.068) | 0.001 | 1.554 (1.061–2.048) | < 0.0001 | 0.205 (0.124–0.286) | 0.0009 |
| Waist circumference, cm | 0.02 (0.01–0.031) | 0.0002 | 0.759 (0.564–0.955) | < 0.0001 | 0.102 (0.069–0.135) | < 0.0001 |
| Hip circumference, cm | 0.018 (0.005–0.032) | 0.005 | 0.681 (0.408–0.954) | < 0.0001 | 0.082 (0.037–0.126) | 0.0005 |
| Waist-hip ratio | 4.123 (1.605–6.64) | 0.002 | 102.39 (45.27–159.5) | 0.0006 | 15.55 (6.784–24.33) | 0.0007 |
| Intertrochanteric dimension, cm | – | – | 3.929 (1.833–6.024) | 0.0004 | 0.424 (0.086–0.761) | 0.014 |
| Intersubular dimension, cm | – | – | – | – | 0.397 (0.042–0.753) | 0.028 |
| Intercristal distance, cm | 0.082 (0.013–0.151) | 0.02 | 2.341 (0.793–3.89) | 0.004 | – | – |
| External conjugate, cm | 0.273 (0.15–0.396) | < 0.0001 | – | – | 0.534 (0.059–1.009) | 0.028 |
| Prior abdominal surgery | 0.361 (0.109–0.614) | 0.006 | 7.016 (1.128–12.904) | 0.02 | 1.461 (0.615–2.306) | 0.001 |
| Hypertension | 0.246 (0.041–0.451) | 0.019 | 7.857 (3.328–12.38) | 0.0009 | 1.033 (0.322–1.743) | 0.005 |
| Diabetes mellitus | – | – | 4.955 (0.192–9.718) | 0.04 | 1.059 (0.351–1.767) | 0.004 |
| COPD | – | – | 8.647 (1.23–16.063) | 0.023 | 1.258 (0.116–2.399) | 0.031 |
| Hypothyroidism | – | – | 11.86 (5.475–18.257) | 0.0004 | 1.708 (0.716–2.7) | 0.001 |
| Heart failure | – | – | – | – | 1.684 (0.282–3.086) | 0.02 |

Δ Hb — the difference in the serum concentration before surgery and on the second day after surgery; β — coefficient beta; CI — confidence interval; COPD — chronic obstructive pulmonary disease

Procedure-related haemoglobin loss

The mean haemoglobin loss during periprocedural time was significantly higher in patients with BMI value ≥ 30 kg/m² compared to patients with BMI value < 30 kg/m² (2.5 ± 0.9 vs. 1.9 ± 0.8 g/dL, $p = 0.004$; Tab. 3). The degree of haemoglobin loss at the periprocedural time correlated significantly and positively with body mass, BMI, waist circumference, hip circumference, WHR, intertrochanteric distance, intercrystal distance, external conjugate, prior abdominal surgery and clinical stages according to FIGO classification. This is presented in Table 4. Univariate regression analysis revealed significant relationships between periprocedural degree of haemoglobin loss and body mass, BMI, waist circumference, hip circumference, WHR, intercrystal distance, external conjugate, prior abdominal surgery and hypertension. This is presented in Table 5. Multivariate regression analysis among the above-mentioned factors confirmed a significant relationship between the degree of haemoglobin loss during periprocedural time and external conjugate ($p = 0.0002$) and prior abdominal surgery ($p = 0.001$).

Anatomical parameters

Anatomical indices were significantly higher in patients with BMI value ≥ 30 kg/m² compared to patients with BMI < 30 kg/m², and they included intertrochanteric distance (36.2 ± 2 vs. 34.2 ± 1.8 cm, $p < 0.0001$), interspinous distance (27.6 ± 2.1 vs. 26.2 ± 1.7 cm, $p = 0.0006$), intercrystal distance (33.7 ± 2.5 vs. 30.7 ± 2.7 cm, $p < 0.0001$) and external conjugate (22.8 ± 1.4 vs. 21.5 ± 1.4 cm, $p = 0.0002$). This is presented in Table 3.

Procedure-related complications

There were 5 perioperative complications: infection of the postoperative wound with impaired healing in 2 patients, intraoperative bladder injury in one patient, gastrointestinal obstruction in 1 case and intraoperative bleeding with the need to ligate the internal iliac artery in another patient. On average, patients with procedure-related complications showed higher obesity parameters: BMI (38 vs. 31.7 kg/m², $p = 0.88$) and waist circumference (119.6 vs. 103.7 cm, $p = 0.54$), compared to patients who had no procedure-related complications, however, those differences did not reach statistical significance.

DISCUSSION

The main findings of the current study are that patients with the mean BMI value > 30 kg/m² demonstrated longer duration of hospitalisation and operation, as well as greater haemoglobin loss during the periprocedural period. The second observation worth mentioning is that patients with obesity were diagnosed with endometrial cancer at more

advanced stages according to the FIGO classification before the surgical treatment in comparison to non-obese patients. Thirdly, among predictors of the longer duration of operation we confirmed greater BMI, greater waist circumference and body mass. While among predictors of the duration of hospitalisation there were greater waist and hip circumference and greater BMI value. The external conjugate and intertrochanteric dimensions were found to be predictors of greater haemoglobin loss related to the procedure. The strongest correlation for the duration of operation, hospitalisation and haemoglobin loss was noticed for waist circumference. Moreover, patients with procedure-related complications were characterised by greater BMI value and waist circumference. The percentage distribution of obesity parameters showed that a significant percentage of patients with normal BMI presented abdominal obesity in the study group according to IDF criteria. Similar results were obtained in a study on the prevalence of metabolic syndrome in the population of the Tarnawa Dolna commune (70% of patients with abdominal obesity) [12]. The results of the study in the population of women treated for endometrial cancer show a higher incidence of this type of obesity than in the general population ($> 90\%$). Most often, the patients' operations were diagnosed at stage I according to the FIGO classification. The average duration of surgery in the study group operated on for endometrial cancer is comparable to the results obtained at other centres [13, 14]. This study, however, used other parameters of blood loss (blood volume), and the average length of stay in hospital was much shorter. The effect of visceral obesity on the results of surgical treatment has not been studied. However, the influence of obesity measured by the BMI parameter on the duration of surgery and blood loss was demonstrated, which was also confirmed in the presented study for both the BMI parameter and waist circumference. In the current study, the greater waist circumference value is related to longer duration of the operation and hospitalisation, and among other natural explanations of that relationship are greater extent, incision and more complicated surgical procedure in obese compared to non-obese patients. This also definitely reflects directly greater haemoglobin loss during the procedure and remains in close relation to the more advanced disease in this particular group of patients. Interesting data were presented by Kerimoglu et al. [15]. Their study evaluated the effect of the percentage of body fat on surgical outcomes in women with endometrial cancer. In the group patients with an elevated % of body fat, a longer mean operation time was noted than in those with a % of body fat less than 32% (138.2 ± 27.1 vs. 119.3 ± 34.8 min, $p = 0.043$). Nonetheless, there were no differences between patient groups regarding rates of intraoperative complications, mean duration of hospital stay and postoperative

complications [15]. However, in a cohort of 192 patients with differing BMI, Jan et al. showed that surgical operative time and mean length of hospitalisation in days were not significantly different among the 4 groups. In the obese group, there was significantly higher perioperative blood loss ($p = 0.01$), more wound abscess ($p = 0.05$) and more reinterventions for complications ($p = 0.03$) [16]. The incidence of postoperative complications in developed countries is estimated at 3–22% after surgical operations [11, 13, 15, 17]. Postoperative complications can be divided into early and late. The most common early complications in surgical gynaecology are: bleeding, bladder damage, ureters, intestinal perforation. The most frequent postoperative complications include infections, wound healing disorders, thromboembolic complications, cardiovascular complications, respiratory failure, gastrointestinal obstruction, renal failure, urination disorders, urogenital fistulas, intestinal fistulas. Co-morbidity of obesity and endometrial cancer may be associated with the increased rate of procedure-related complications. It has long been assumed that obesity can hinder the course of surgery. Some studies have shown that obesity is an obstacle to cancer staging in endometrial cancer [13], breast cancer [18] and gastric cancer [19]. A recent study identified EC patients with a body mass index (BMI) of $\geq 40 \text{ kg/m}^2$ at increased risk of developing surgical complications compared to their non-obese counterparts [20]. However, among 514 women with endometrial cancer, Bouwman et al. noted that obese and morbidly obese women experienced significantly more surgical complications than non-obese women ($p = 0.010$) [21]. This was confirmed in the present study.

In a prospective study conducted on a group of 233 patients operated on due to endometrial cancer, it was shown that the BMI value significantly and positively correlates with the duration of the surgery and the loss of haemoglobin during the periprocedural period. However, no relationships were found between obesity, the duration of hospitalisation and the occurrence of postoperative complications [14]. However, a study conducted in Turkey suggests that obesity in this group of patients does not significantly affect the number of acquired lymph nodes, the duration of hospitalisation or the number of procedure-related complications. However, this study was conducted on a relatively small group of 48 patients [22]. There are discrepancies in the literature regarding the influence of obesity on the occurrence of post-operative complications such as: infections, wound healing disorders, pulmonary embolism, and venous thromboembolism. Some authors mention visceral obesity as potentially crucial in understanding the real impact of obesity on the incidence of postoperative complications [22, 23]. On the basis of the conducted study, it could not be unequivocally determined whether there is a relationship

between obesity and the occurrence of perioperative complications. The comparative group of patients with complications (5 patients), despite clear differences in parameters, did not demonstrate statistical significance. In the current study, there is no consensus in the assessment of the relationship between obesity and specific postoperative complications. Probably, chronic inflammation and metabolic disturbances observed in abdominal obesity contribute to postoperative complications such as: infections, wound healing disorders, circulatory and respiratory disorders [14]. In our study the highest predictive value for analysed parameters in-hospital outcomes among patients with endometrial cancer were BMI value and waist circumference.

CONCLUSIONS

Obesity predisposes to the later diagnosis of endometrial cancer at a more advanced stage, which may contribute to worse treatment results both in terms of the effectiveness of the procedure and mortality in the follow-up period. Waist circumference seems to be the most sensitive marker, indicating the possibility of extending the duration of the procedure and hospitalization, which is also associated with increased blood loss associated with the procedure. Therefore, waist circumference could serve as a tool for operational risk stratification. Further research will help determine a more accurate relationship between obesity and the occurrence of specific perioperative complications.

Limitations

This study can be referred to as a developmental study because it was conducted on a small group of patients. Also due to the relatively small group of patients studied, in the analysis we conducted, we focused on assessing trends and the relationship of individual indicators with treatment results. However, we have not attempted to isolate cut-off points for individual data above which the risk of losing large amounts of hemoglobin increases significantly.

REFERENCES

- Zwierko M, Bidziński M. Nowotwory trzonu macicy. Centrum Medyczne Kształcenia Podyplomowego, Warszawa 2011: 5–27.
- Stewart B. World Cancer Report © International Agency for Research on Cancer. 2008; 5: 428–430.
- Abacjew-Chmyłk AO, Chmyłko Ł, Wydra DG, et al. Multiple multiparity is a negative prognostic factor for endometrial cancer in Poland. *Ginekol Pol.* 2016; 87(3): 178–182, doi: [10.17772/gp/60071](https://doi.org/10.17772/gp/60071), indexed in Pubmed: [27306125](https://pubmed.ncbi.nlm.nih.gov/27306125/).
- Bręborowicz GH. Położnictwo i Ginekologia. Wydawnictwo Lekarskie PZWL Warszawa 2007: 833–842.
- Renehan AG, Tyson M, Egger M, et al. Body-mass index and incidence of cancer: a systematic review and meta-analysis of prospective observational studies. *Lancet.* 2008; 371(9612): 569–578, doi: [10.1016/S0140-6736\(08\)60269-X](https://doi.org/10.1016/S0140-6736(08)60269-X), indexed in Pubmed: [18280327](https://pubmed.ncbi.nlm.nih.gov/18280327/).
- von Gruenigen VE, Tian C, Frasure H, et al. Treatment effects, disease recurrence, and survival in obese women with early endometrial carcinoma: a Gynecologic Oncology Group study. *Cancer.* 2006; 107(12): 2786–2791, doi: [10.1002/cncr.22351](https://doi.org/10.1002/cncr.22351), indexed in Pubmed: [17096437](https://pubmed.ncbi.nlm.nih.gov/17096437/).

7. Bokhman JV. Two pathogenetic types of endometrial carcinoma. *Gynecol Oncol.* 1983; 15(1): 10–17, doi: 10.1016/0090-8258(83)90111-7, indexed in Pubmed: 6822361.
8. Roguz S, Krowiranda KW, Michalski T, et al. [Histological grading of endometrial carcinoma. Clinical and patomorphological analysis]. *Ginekol Pol.* 2015; 86(5): 340–345, indexed in Pubmed: 26117970.
9. Möllerström G, Carlström K, Lagrelius A, et al. Is there an altered steroid profile in patients with endometrial carcinoma? *Cancer.* 1993; 72(1): 173–181, doi: 10.1002/1097-0142(19930701)72:1<173::aid-cnrcr2820720132>3.0.co;2-x, indexed in Pubmed: 8508403.
10. Sznurkowski J, Knapp P, Bodnar L, et al. Recommendations of the Polish Gynecological Oncology Society for the diagnosis and treatment of endometrial cancer. *Current Gynecologic Oncology.* 2017; 15(1): 34–44, doi: 10.15557/cgo.2017.0003.
11. Krzakowski M, Herman K, Jassem J. Zalecenia postępowania diagnostyczno–terapeutycznego w nowotworach złośliwych, cz. 2. *Via Medica, Gdańsk* 2019: 243–247.
12. Żyła ZG, Kinalska I. Ocena częstości występowania zespołu metabolicznego w populacji dorosłych mieszkańców gminy Tarnawa Dolna. *Przegląd Kardiologiczny.* 2010; 5(2): 93–97.
13. Orekoya O, Samson ME, Trivedi T, et al. The Impact of Obesity on Surgical Outcome in Endometrial Cancer Patients: A Systematic Review. *J Gynecol Surg.* 2016; 32(3): 149–157, doi: 10.1089/gyn.2015.0114, indexed in Pubmed: 27274182.
14. Santoso JT, Barton G, Riedley-Malone S, et al. Obesity and perioperative outcomes in endometrial cancer surgery. *Arch Gynecol Obstet.* 2012; 285(4): 1139–1144, doi: 10.1007/s00404-011-2116-2, indexed in Pubmed: 22020677.
15. Kerimoglu OS, Pekin A, Yilmaz SA, et al. Effect of the percentage of body fat on surgical, clinical and pathological outcomes in women with endometrial cancer. *J Obstet Gynaecol Res.* 2015; 41(3): 449–455, doi: 10.1111/jog.12554, indexed in Pubmed: 25330937.
16. Jan S, Duquesne M, Marret H, et al. [Influence of Body Mass Index on management and prognosis of women with endometrial cancer]. *Gynecol Obstet Fertil.* 2014; 42(11): 766–771, doi: 10.1016/j.gyobfe.2014.07.034, indexed in Pubmed: 25153444.
17. Eisenhauer EL, Wypych KA, Mehrara BJ, et al. Comparing surgical outcomes in obese women undergoing laparotomy, laparoscopy, or laparotomy with panniculectomy for the staging of uterine malignancy. *Ann Surg Oncol.* 2007; 14(8): 2384–2391, doi: 10.1245/s10434-007-9440-6, indexed in Pubmed: 17522943.
18. Derossis AM, Fey JV, Cody HS, et al. Obesity influences outcome of sentinel lymph node biopsy in early-stage breast cancer. *J Am Coll Surg.* 2003; 197(6): 896–901, doi: 10.1016/j.jamcollsurg.2003.08.005, indexed in Pubmed: 14644276.
19. Li Sk, Zhou Yb, Zhou Cf, et al. [Influence of obesity on short-term surgical outcome in patients with gastric cancer]. *Zhonghua Wei Chang Wai Ke Za Zhi.* 2010; 13(2): 133–136, indexed in Pubmed: 20186625.
20. Gunderson CC, Java J, Moore KN, et al. The impact of obesity on surgical staging, complications, and survival with uterine cancer: a Gynecologic Oncology Group LAP2 ancillary data study. *Gynecol Oncol.* 2014; 133(1): 23–27, doi: 10.1016/j.ygyno.2014.01.041, indexed in Pubmed: 24680587.
21. Bouwman F, Smits A, Lopes A, et al. The impact of BMI on surgical complications and outcomes in endometrial cancer surgery—an institutional study and systematic review of the literature. *Gynecol Oncol.* 2015; 139(2): 369–376, doi: 10.1016/j.ygyno.2015.09.020, indexed in Pubmed: 26407479.
22. Erkanli S, Kayaselçuk F, Bagis T, et al. Impact of morbid obesity in surgical management of endometrial cancer: surgical morbidity, clinical and pathological aspects. *Eur J Gynaecol Oncol.* 2006; 27(4): 401–404, indexed in Pubmed: 17009636.
23. Doyle SL, Lysaght J, Reynolds JV. Obesity and post-operative complications in patients undergoing non-bariatric surgery. *Obes Rev.* 2010; 11(12): 875–886, doi: 10.1111/j.1467-789X.2009.00700.x, indexed in Pubmed: 20025695.