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Body Mass Index and Postoperative Outcomes of Patients with Laparoscopic Adrenalectomy. A Single Center Experience

Flaviu Ionut Faur[1,2*], Ionel Nati[4], Laurian Stoica[1,2], Cristi Tarta[1,2], Alexandru Piraianu[2,3] and Amadeus Dobrescu[1,2]

[1]IInd Surgery Clinic, Timisoara Emergency County Hospital, Romania

[2]"Victor Babes" University of Medicine and Pharmacy Timisoara, Romania

[3]Anesthesiology and Intensive Care Department, "Victor Babeş" University of Medicine and Pharmacy, Timişoara, Romania

[4]Iuliu Hatieganu University of Medicine and Pharmacy Cluj-Napoca, Romania

[*]Corresponding author:

Flaviu Ionut Faur,
IInd Surgery Clinic, Timisoara Emergency County Hospital, Romania,
E-mail: faurflaviuionut@gmail.com

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1. Abstract

1.1. Objectives

Laparoscopic adrenalectomy has become the standard of care for resection of adrenal masses with extremely low morbidity and mortality. This study investigates the difference in outcomes in patients who underwent laparoscopic adrenalectomy, comparing obese with non-obese patients.

1.2. Methods

This is a prospective study between 01.01.2017 - 31.12.2019. Setting: Pius Brinzeu Clinical Hospital Timisoara, Romania that includes 69 laparoscopic adrenalectomies. Selection criteria: Minimally invasive adrenalectomy (tumor size bellow 10 cm). All patients were managed by a constant surgical team, in the General II nd Department of Surgery of the Pius Brinzeu Clinical Hospital Timisoara, Romania. The preoperative workup and postoperative follow-up was performed in over 96% of cases in our department and in the endocrinology department of our hospital. In this article all values are presented as mean±standard deviation for continuous variables, or percentages for categorical variables.

1.3. Results

The mean age of the patients population was 53.2±9 years old. The mean diameter of adrenal glands resected was 5.2±3.4 cm with a higher proportion of masses resected were left sided 53.62 %, 46.37 % right sided. The largest percentage of these lesions were adenoma (44.92 %), aldosteronoma (20.28%), pheocromocythoma (13.04 %), angiomyolipoma (17.39 %) and ganglioneuroma (4.3 %). Median operative time for our patient population was 123.5 minutes (range 96-165minutes), while median estimated blood loss (EBL) was 52 ml (range 30-350 ml). The median length of stay (LOS) was 2 days (range 1-5). Adjusting for sex, the final logistic regression model predicting 30-day complications found obese patients were significantly (P=0.036) more likely to have complications compared to non-obese patients. Women were significantly (P=0.042) more likely to have 30-day complication (OR=3.91, 95% CI=1.32 11.47). The final regression model for LOS had no significant predictors. Obesity status was significant in predicting major postoperative complications (n= 8, 19.04 %).

1.4. Conclusions

Laparoscopic adrenalectomy can be performed in non-obese as well in obese patients. Although there is a statistically increase in intraoperative and major postoperative complications for obese patients undergoing laparoscopic adrenalectomy, the clinical significance seems less obvious as it was shown that the laparoscopic approach has fewer complications than open surgery has. These results should rather challenge physicians to optimize obese patients prior to surgical intervention to avoid such complications.

2. Introduction

Laparoscopic resection of adrenal masses was first reported in

1992 by Gagner [1-2]. Laparoscopic adrenalectomy (LA) has gained acceptance due to the size of the typical adrenal mass as well as the retroperitoneal location, making laparoscopic surgery technically less challenging than open surgery [3-5]. Since first reported in 1992 laparoscopic adrenalectomy has become the standard care for most benign and some malignant adrenal masses and its advantages has been well proven in a large number of large studies within the last 2 decades. The laparoscopic approach for adrenalectomy has been proven to lower morbidity, shorten length of stay (LOS) and shorten period of disability for the patient [6-9]. Discharge from the hospital is usually within 1 day to 2 days after surgery and full recovery requires 10 days to 14 days. Time to first oral intake and first ambulation are shorten with LA versus open adrenalectomy.

Over the past several decades, there has been an increase in patients who are obese. Obesity has previously not been shown to increase morbidity or mortality in patients who undergo laparoscopic colorectal surgery, appendectomy, paraesophageal hernia repair and cholecystectomy [10]. However, obesity had lead to higher conversion rates in patients undergoing laparoscopic colorectal surgery and a trend toward more postoperative complication without reaching statistical significance. We are comparing intra- and postoperative morbidity and mortality in obese and healthy weight patients undergoing laparoscopic adrenalectomy with the hypothesis that obesity would not increase the complication rate.

3. Material and Methods

The main objectives of this study is to define the early morbidity and mortality in obese patients with laparoscopic adrenalectomies. The cutoff value used to define obesity was 30 kg/m2. This is a prospective study between 01.01.2017-01.01.2019. Setting: Pius Brinzeu Clinical Hospital Timisoara, Romania that includes 69 laparoscopic adrenalectomies. Selection criteria: Minimally invasive adrenalectomy (tumor size bellow 10 cm). All patients were managed by a constant surgical team, in the General II nd Department of Surgery of the Pius Brinzeu Clinical Hospital Timisoara, Romania. The preoperative workup and postoperative follow-up was performed in over 96% of cases in our department and in the endocrinology department of our hospital. In this article all values are presented as mean±standard deviation for continuous variables, or percentages for categorical variables. Categorical variables were tested using chi-square or Fisher's exact tests and continuous variables (such as age) were tested using 2-sample *t* test or Wilcoxon's rank sum test. Logistic regression models were fit predicting complications, with the main predictor being obesity group status. Obesity status was kept in the model regardless of significance. Significant covariates were then adjusted for the model. Results are reported in terms of odds ratios with 95% confidence intervals. Another regression model was fit predicting LOS, where the primary predictor variable was obesity group status; significant covariates were adjusted for the final model. SAS statistical software was used for all analysis, and P values of <0.05 were considered statistically significant.

4. Patients Preparation

All patients completed a standard hormonal evaluation by the endocrinologist. Computed tomography (CT) adrenal protocol including a washout study was the first choice of diagnostic imaging. Patients contraindicated to a CT scan were examined by magnetic resonance imaging (MRI) instead. An additional CT chest was performed in patients suspected of adrenocortical carcinoma (ACC) and malignant pheochromocytoma. In functioning adrenal tumors, the blood pressure was controlled with antihypertensive medication before surgery. Serum potassium level was normalized by potassium replacement in aldosterone-producing adenoma patients. Hydrocortisone replacement was given on the day of surgery in Cushing syndrome patients.

In pheochromocytoma patients, the alpha-adrenergic blockade was titratable to control the blood pressure and heart rate at least 14 days before surgery.

5. Surgical Techniques

All LA were performed by a standard lateral transperitoneal approach with patient in the lateral decubitus position. In brief, four trocars were used for right adrenalectomy and three for a left adrenalectomy. An additional retracting trocar may be needed in patients with a large adrenal tumor. For a right adrenalectomy, the right lobe of the liver was mobilized upwards. The peritoneum lateral to inferior vena cava was then opened longitudinally and the adrenal gland was dissected from the medial to lateral direction and from the inferior to superior direction. For a left adrenalectomy the descending colon was mobilized medially to expose the upper pole of the kidney. Then, the tail of the pancreas and spleen were rotated medially. The left adrenal vein was controlled, and the adrenal gland was dissected from the medial to the lateral direction. Lastly, the adrenal gland was dissected from the upper pole of the kidney.

Adrenal arteries and small adrenal veins were controlled using Ligasure, a vessel sealing device, Covidien-Medtronic (clipless adrenalectomy). The large adrenal vein was controlled with Titanium clip or Hemo-lock clip. A close-suction drain was not routinely used, but it was placed only in patients with blood oozing from the surgical bed.

6. Results

Sixty-nine patients (41 women and 28 men) underwent laparoscopic adrenalectomy between January 2017-January 2020 in Surgical Clinic II of the „Pius Brinzeu" County Emergency Hospital Timisoara by the same operative team. All operation were performed by transperitoneal approach.

Tabel 1 summarizes patients demographics. The mean age of the

patients population was 53.2±9 years old. The mean diameter of adrenal glands resected was 5.2±3.4 cm with a higher proportion of masses resected were left sided 53.62 %, 46.37 % right sided. The largest percentage of these lesions were adenoma (44.92 %), aldosteronoma (20.28%), pheocromocythoma (13.04 %), angiomyolipoma (17.39 %) and ganglioneuroma (4.3 %). Median operative time for our patient population was 123.5 minutes (range 96-165minutes), while median estimated blood loss (EBL) was 52 ml (range 30-350 ml). The median length of stay (LOS) was 2 days (range 1-5). 42 patients (60.86%) were obese by study criteria, with the mean BMI for our patients being 32.6±6 kg/m². The pathological reports are summarized in Table 3. 40 (57.97 %) patients have had adrenal tumors bellow 6 cm and 29 (42.03%) have had adrenal tumor over 6 cm diameter. Most of the patients with a small adrenal tumor was cortical adenoma (n=19, 47.5%) and also in large adrenal tumor the most common was cortical adenoma (n=12, 41.37%). Pheocromocytoma was present in 6 (20.68%) patients with adrenal tumor over 6 cm and only in 3 (7.5%) patients with adrenal tumor bellow 6 cm.

There was no 30-day mortality in the population. For classification, complication were divided into intraoperative and postoperative. Postoperative complications where further classified as major (pneumonia, deep wound infection, abdominal hematoma, renal vein injury, deep vein thrombosis) and minor (ileus, anemia not requiring blood transfusion, superficial wound infection).

As shown in Table 4 there were 8 (19.04%) significant complication in the obese patients and no similar complications in the non-obese patients (P<0.01). 3 (7.14%) obese patients had intraoperative complications including 1 inferior vena cava injury, 1 splenic laceration and 1 right renal vein injury.

Injuries occurred 2 on the right and 1 on left side. 5 (11.9 %) obese patients had significant postoperative morbidity, including 3 infectious complications and 2 intraabdominal hematoma. There was one conversion to open adrenalectomy that occurred in a obese patients due to bleeding from a iatrogenic lesion on right renal vein that could not be managed laparoscopically. An unadjusted logistic regression model predicting all postoperative 30-day complications (n= 21, %) was fit with the obesity status. The unadjusted odds ratio for obese compared to non-obese patients is 2.41 (95 %, CI= 0.81, P< 0.95) same as the Fisher's exact test. A multivariate logistic regression model was fit with possible covariates of sex, age, tabacco use, diabetes indicator and history of cardiac disease. Using a step-wise model selection technique, the final multivariate logistic regression model for 30-day complication included obesity and sex as predictors. Adjusting for sex, the final logistic regression model predicting 30-day complications found obese patients were significantly (P=0.036) more likely to have complications compared to non-obese patients. Women were significantly (P=0.042) more likely to have 30-day complication (OR=3.91, 95% CI=1.32 11.47). The final regression model for LOS had no significant predictors. Obesity status was significant in predicting major postoperative complications (n= 8, 19.04 %).

Tabel 1: compares the 2 cohorts of patients. Patients characteristics for the 2 groups are well matched. There was a trend towards older patients, patients who used tobacco and patients with cardiac disease in the obese group, but operative time, EBL and LOS did not differ significantly between the 2 cohorts.

Characteristics	n	%
Sex		4
Male	28	40.57
Female	41	59.42
Mean age (years)	53.2±9	
Mean mass size (cm)	5.2±3.4	
Location		
Right	32	46.37
Left	37	53.62
Pathology		
Cortical adenoma	31	44.92
Aldosteronoma	14	20.28
Pheocromocytoma	9	13.04
Angiomyolipoma	12	17.39
Ganglioneuroma	3	4.3
Mean BMI (kg/m²)	**32.6±6**	
Median OR time (min)	**123.5 (Min=96; Max=165)**	
Median EBL (mL)	**52 (Min=35 ml; Max=350 ml)**	

Table 2: Patients characteristics by Obesity status (n=69).

	BMI≤30 kg/m² (n=27)	BMI≥30 kg/m² (n=42)	P-Value
Sex			
Male	**17 (62.96 %)**	**13 (30.95%)**	**0.114**
Female	**10 (37.03%)**	**29 (69.04%)**	
Mean age (years)	**51.1±8**	**48.2±7**	**0.052**
Mean mass size (cm)	**4.3±1.2**	**5.6±2.9**	**0.05**
Location			
Right	**9 (33.33%)**	**15 (35.71%)**	
Left	**18 (66.66%)**	**27(64.28%)**	
Median OR time (min)	**128 (Min=96; Max=142)**	**126 (Min=107; Max=165)**	**0.47**
Median EBL (mL)	**50 (Min=35; Max=180)**	**70 (Min 50; Max=350)**	**0.397**
Median LOS (days)	**2**	**3**	**0.542**
Comorbidities			
Tabacco use	**11 (40.74%)**	**23 (54.76%)**	**0.05**
DM	**3 (11.11%)**	**19 (45.23%)**	**0.04**
Cardiac disease	**4 (14.81%)**	**17 (40.47%)**	**0.05**
Respiratory disease	**7 (25.92%)**	**18 (42.85%)**	**0.05**

Table 3: Pathological reports.

Pathology	<6 cm (n=40)- 57.97%	>6 cm (n=29)- 42.03%
Cortical adenoma	**19 (47.5%)**	**12 (41.37%)**
Aldosteronoma	**11 (27.5%)**	**3 (10.34%)**
Pheocromocytoma	**3 (7.5%)**	**6 (20.68%)**
Angiomyolipoma	**4 (10%)**	**7 (24.13%)**
Ganglioneuroma	**3 (7.5%)**	**0**

Table 4: Complications after Laparoscopic Adrenalectomy.

	BMI≤30 kg/m²	BMI≥30 kg/m²	P-Value*
Early (in hospital) and late (post discharge) 30-day complications			
Total	**4 (14.81%)**	**17 (35.71%)**	**0.95**
Intraoperative or major early postoperative complications			
Intraoperative	**0**	**3 (7.14%)**	
Early postoperative	**0**	**5 (11.9%)**	
Total	**0**	**8 (19.04%)**	**0.01**
*Calculated using Fischer's exact test			

7. Discussion

With an increase in obesity over the last several decades surgeons are facing new challenges. The purpose of this study was to evaluate results of laparoscopic adrenalectomy, comparing obese and non-obese patients. The advantages of LA compare to open procedure are well documented by numerous studies within the last decade. A recent study by Erbil et al in 51 consecutive patients showed a positive correlation between BMI and operating time, postoperative complications and hospital stay, suggesting that increased amount of retroperitoneal fat mass is responsible for these findings [11-14].

Previous studies in the literature have shown comparable intraoperative and postoperative complication rates in obese and non-obese patients after laparoscopic procedures [15]. It is unclear why complication rates differ in LA but may be a result of specific organs that are manipulated during operation. Specifically left sided LA required splenic colon mobilization and also mobilization of the greater omentum of the spleen, which can lead to splenic laceration (a major cause of intraoperative complication in this patients) [16]. Obese patients have a more significant burden of omentum making this maneuver more difficult. This may also attribute to the higher risk of complications in men versus women in this study because men typically have a higher amount of intraabdominal fat and omentum fat compared with women. Size of the adrenal mass was not a risk factor for complications in this patients cohort [17-18].

Increased intraoperative complication rates in obese patients may also be the result of suboptimal visualization in the context of increased amount of intraperitoneal fat [19]. Surgeon experience may also affect complication rates, as all intraoperative complications occurred within the first 30 procedures performed by the respective surgeon.

Conversion rates seem to increase in obese patients according to some studies. The only conversion in this group occurred in an obese patient with uncontrollably bleeding after iatrogenic renal vein injury. According to the literature, bleeding is the most common intraoperative complication of LA and also the most common reason for conversion [20].

8. Conclusion

Laparoscopic adrenalectomy can be performed in non-obese as well in obese patients. Although there is a statistically increase in intraoperative and major postoperative complications for obese patients undergoing laparoscopic adrenalectomy, the clinical significance seems less obvious as it was shown that the laparoscopic approach has fewer complications than open surgery has. These results should rather challenge physicians to optimize obese patients prior to surgical intervention to avoid such complications. The results should amend the consent process in the preoperative period and will allow physicians to predict possible complications in this patient population but does not preclude the use of LA in obese patients.

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