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What factors impact the treatment outcomes of laparoscopic adrenalectomy in patients with functioning adrenal gland tumors?

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ABSTRACT

Introduction: Laparoscopic adrenalectomy is currently considered a standard treatment for both functional and non-hormonal benign adrenal tumors. However, further studies are required to evaluate the factors that predict treatment outcomes in cases in which laparoscopic adrenalectomy is performed.
Materials and methods: This was a cross-sectional study conducted between 2011 and 2017. The inclusion criteria were a diagnosis of functioning adrenal gland tumors and having undergone transperitoneal laparoscopic adrenalectomy. Important factors affecting the outcomes of treatment were analyzed.
Results: There were 68 patients enrolled in this study. Participants were divided into two groups based on whether they had cured or uncured hypertension. The median ages in the cured and uncured groups were 41.0 and 54.0 years, respectively (p-value 0.001). The mean tumor size was 20 mm in the cured group and 15 mm in the uncured group. Patients in the cured group experienced a median of 20 ml of blood loss in both groups. Average operating times were 95 and 85 min, respectively. Only two factors were independently associated with uncured hypertension: age and preoperative systolic blood pressure, with adjusted odds ratios (95% confidence interval) of 1.11 (1.03, 1.17) and 1.03 (1.01, 1.07), respectively.
Conclusion: Predictors for unsuccessful of treatment in patients who underwent laparoscopic adrenalectomy were older age at the time of the operation and preoperative systemic blood pressure.

1. Introduction

Laparoscopic adrenalectomy was first reported by Gagner et al., in 1992 [1]. Currently, laparoscopic adrenalectomy is considered a standard treatment for both functional and non-hormonal benign adrenal tumors [2]. There are various surgical techniques by which laparoscopic adrenalectomy can be carried out including transperitoneal, retroperitoneal, and thoraco-abdominal approaches [3–5]. The method that is employed depends on the expertise the surgeon performing the operation.

Adrenal glands are hormonal organs that produce sex, glucocorticoid, and aldosterone hormones. Aldosterone is part of the renin angiotensin aldosterone system, which affects the kidney's ability to control blood pressure and water, sodium, and potassium levels. Functional adrenal tumors can cause problems for patients with high blood pressure or hypokalemia. Laparoscopic adrenalectomy plays a major role in the treatment of functioning adrenal gland tumors and can provide good treatment outcomes, including complete recovery in some cases. However, some patients who undergo laparoscopic adrenalectomy experience postoperative symptoms [6,7]. Further studies are required to evaluate the factors that predict the treatment outcomes of the procedure.

2. Methods

This was a cross-sectional study conducted at B (blind) Hospital. The study period was between 2011 and 2017. The inclusion criteria were a diagnosis of functioning adrenal gland tumors and having undergone transperitoneal laparoscopic adrenalectomy. The

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primary outcomes were patients having been cured of hypertension and having normal serum potassium levels without potassium supplements. We followed up on all patients for at least six months to determine their disease status. Baseline clinical features, medical treatment, and results of clinical, pathological, and operative reports were recorded. Laparoscopic adrenalectomy was conducted using the transperitoneal approach via the flank in the lateral decubitus in all patients.

2.1. Statistical analysis

The patients with functioning adrenal gland tumors were classified into two groups: those with cured (defined as the patient being completely free of symptoms after six months) hypertension and those with uncured (defined as persistence of symptoms after six months) hypertension. Important factors affecting on the outcomes of treatment were analyzed. Demographic data from these two groups were analyzed using descriptive statistics. Additionally, statistical analysis was performed to compare the data from both groups. Continuous data are presented as median plus interquartile range (IQR), whereas categorical data are presented as numbers and percentages. Either the Chi-squared test, Fisher exact test, Mann - Whitney *U* test, or the independent *t*-test was performed to examine statistical differences between two groups of patients where appropriate. Data were considered statistically significant when the p value was less than 0.05.

A univariate logistic analysis of odds ratio (OR) was performed to analyze the association of uncured hypertension with significant factors in both groups, the results of which are presented as an unadjusted odds ratios (OR). The Pearson correlation coefficient was used to determine the collinearity among the independent variables. Multivariate logistic regression analysis was subsequently performed to identify independent factors associated with uncured hypertension. The final model was tested for goodness of fit by using the Hosmer-Lemeshow method. The STATA version 10.1 software package (StataCorp, College Station, TX, USA) was used to analyze all statistical data in this study.

3. Results

There were 68 patients enrolled in this study, 24 of whom (35.3%) were determined to have uncured hypertension after surgery. Clinical features, operative findings, and lengths of hospital stay of both groups are summarized in Tables 1 and 2. There were three factors that were significantly higher in the uncured hypertension group than in the cured hypertension group: age, preoperative systolic blood pressure, and duration of hypertension treatment (Table 1). Both groups had a larger proportion of females than males (81.82% and 62.50% in the cured group and uncured group, respectively).

The majority of patients in both groups underwent left adrenalectomies (63.64% in the cured group and 66.67% for the uncured group). The median tumor size was 20 mm in the cured group and 15 mm in the uncured group. There were three patients (three in the cured group and one patient in the uncured group) who required conversion to open adrenalectomy. Blood loss and operation time were comparable between the two groups (Table 2). The overall conversion rate to open surgery was 5.88% (four patients). Those with uncured hypertension were taking fewer antihypertensive medications. All patients had normal potassium levels after surgery.

There were five factors in the final model associated with uncured hypertension (Table 3). Only two factors were independently associated with uncured hypertension: age and preoperative systolic blood pressure, with adjusted odds ratios (95% confidence interval) of 1.10 (1.03, 1.17) and 1.03 (1.01, 1.07), respectively. The Hosmer-Lemeshow chi square result was 5.74 with a p value of 0.68.

4. Discussion

Laparoscopic surgery is currently considered standard in the treatment of laparoscopic cholecystectomy, laparoscopic appendectomy, laparoscopic splenectomy, laparoscopic adrenalectomy and other minimally invasive procedures. Laparoscopic surgery has been increasing in popularity in the last two decades. Patients who undergo this treatment are able to recover more quickly and experience less pain and scarring than those who undergo open surgery with no difference in terms of treatment results. This treatment, however, requires an experienced surgeon and a qualified team. In B Hospital, laparoscopic adrenalectomy has come to replace open surgery as the standard form of treatment for benign adrenal tumors. Commonly used surgical techniques include transperitoneal [8–10] or retroperitoneal approaches [8,11,12]. Because the adrenal glands are bilateral organs with differences in organ orientation depending on the side, different surgical methods are required for each side. Previous research has shown

Table 1
Baseline characteristics of 70 patients with functioning adrenal gland tumors who underwent laparoscopic adrenalectomy categorized by type of hypertension after surgery.

Factors	Hypertension		p-value
	Cured (n = 44)	Uncured (n = 24)	
Age, years	41.0 (33.5–51.5)	54.0 (49.0–59.5)	<0.001
Male, n (%)	8 (18.18)	9 (37.50)	0.089
Body weight, kg	62.60 (56.5–70.5)	65.50 (57.3–74)	0.862
Height, cm	160 (156–165)	158 (155–168)	0.842
Body mass index, kg/m^2	24.4 (22.4–27.7)	24.5 (22.7–27.9)	0.959
Preoperative systolic blood pressure, mmHg[a]	135.5 (124.0–144.0)	146.0 (129.0–161.0)	0.023
Preoperative diastolic blood pressure, mmHg[a]	82.5 (73–92)	78.5 (74.5–91)	0.954
Preoperative duration of hypertensive treatment, months	24 (7–60)	96 (30–150)	0.005
Underlying disease, n (%)			
Diabetes Mellitus	8 (18.18)	2 (8.33)	0.475
Dyslipidemia	10 (22.73)	5 (20.83)	0.999
Chronic kidney disease	8 (18.18)	5 (20.83)	0.999
Ischemic heart disease	1 (2.27)	3 (12.50)	0.122
Others	7 (15.91)	6 (25.00)	0.520

Note. Data presented as median (interquartile range).
[a] After administration of antihypertensive medications.