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Influence of adrenal pathology on perioperative outcomes: a multi-institutional analysis

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Abstract

BACKGROUND: Endoscopic or open adrenalectomies are performed for variable pathologies. We investigated if adrenal pathology affects perioperative outcomes independent of operative approach.

METHODS: A multi-institutional retrospective review of 345 adrenalectomies was performed. A multivariate analysis was utilized.

RESULTS: Pathology groups included benign non-pheochromocytoma tumors (50.4%), pheochromocytomas (41%), adrenocortical carcinomas (5.2%), and metastatic tumors (3.4%). Controlling for age, body mass index, tumor size, procedure type, and pathology, pheochromocytomas exhibited greater blood loss (92 mL more, $P = .007$) and operative times (33 min more, $P < .001$) than benign non-pheochromocytoma tumors. Metastatic tumors demonstrated longer operative times (53 min more, $P = .013$). Open adrenalectomy was associated with greater blood loss (396 mL more, $P = .001$), transfusion requirement ($P = .021$), operative times (79 min more, $P < .001$), hospital stay (6.6 days more, $P < .001$) and complications ($P < .001$) when compared with endoscopic adrenalectomy.

CONCLUSIONS: The type of adrenal pathology appears to influence blood loss and operative time but not complications in patients undergoing adrenalectomy. Open adrenalectomy remains a major driver of adverse perioperative outcomes.

With the improvement and frequency of imaging methods, an increasing number of adrenal lesions of all types are being detected and resected. The number of adrenalectomy procedures performed in the United States from 1998 to 2006 increased significantly from 3,241 to 5,232.[1] Since Gagner's report on the first endoscopic adrenalectomy,[2] several single-institution retrospective studies[3–7] and large registry database studies[1,8] have compared surgical outcomes according to whether the procedure was performed open or endoscopic. However, very few have compared outcomes according to adrenal pathology.

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Today, adrenalectomy remains the definitive therapy for a variety of adrenal pathologies, and endoscopic adrenalectomy has become the preferred operative approach for most. The benefits of endoscopic adrenalectomy when compared with open adrenalectomy include decreased operative times, blood loss, duration of hospital stay, and complications.[3–7] However, some studies suggest that certain pathologies (ie, pheochromocytoma and adrenocortical carcinoma) are more likely to have adverse operative outcomes regardless of operative approach.[9–11] A retrospective review of the Nationwide Inpatient Sample that included 40,353 patients who underwent adrenalectomy over an 8-year period (1998 to 2006) showed that patients with benign adrenal pathology (adrenal-based hypercortisolism, hyperaldosteronism, pheochromocytoma, adrenogenital disorders, and benign adenomas) were more likely to experience major complications when compared with malignant pathology (primary and metastatic).[1] Despite these results, to our knowledge, there has not been a more comprehensive study of the influence of adrenal pathology on operative blood loss, transfusion requirement, procedure time, duration of hospital stay, and postoperative complications. We therefore sought to determine the effect of adrenal pathology on intraoperative and postoperative outcomes while controlling for operative approach.

Methods

After obtaining institutional review board approval, a multi-institutional retrospective review of the medical records of 345 patients undergoing adrenalectomy between 2002 and 2013 was performed. The participating institutions included the following: The University of Miami (2007 to 2009), The University of Puerto Rico (2007 to 2012), and Vanderbilt University (2002 to 2013). Demographic data recorded included sex, age, race, body mass index, and presence of a familial syndrome. Familial syndromes included multiple endocrine neoplasia type 2, von Hippel–Lindau syndrome, and neurofibromatosis type 1. Tumor size and functional status were recorded. A tumor was considered to be functional if it produced a clinical syndrome and/or released excess aldosterone, cortisol, or catecholamines.

Operative and postoperative data recorded included operative approach, operative time (skin incision to closure), estimated blood loss, transfusion requirement, length of stay, and complications. Procedure type was defined as either endoscopic adrenalectomy or open adrenalectomy. Endoscopic adrenalectomy ($n = 274$) included the anterior transperitoneal laparoscopic ($n = 188$), posterior retroperitoneoscopic ($n = 80$), and endoscopic converted to open approach ($n = 6$).

Final pathology was grouped into benign non-pheochromocytoma tumors, pheochromocytomas, adrenocortical carcinoma, and metastatic tumors. Benign non-pheochromocytoma tumors included adenomas ($n = 149$), ganglioneuromas ($n = 12$), hyperplasia ($n = 6$), myelolipomas ($n = 4$), and cysts ($n = 3$).

Statistical analysis was performed using STATA version 13.0. (StataCorp, College Station, TX). Patient demographics, tumor characteristics, procedure type, and perioperative variables were compared using chi-square, Fisher's exact, Kruskal–Wallis, and Wilcoxon rank-sum tests. Intraoperative and perioperative outcome variables were analyzed using multivariate linear regression and logistic regression controlling for age, body mass index, tumor size, procedure type, and pathology. The coefficient reported for the multivariate linear regression for continuous outcome variables, blood loss, procedure time, and length of stay is the β coefficient of the regression and is therefore interpreted as the expected increase in the value of the outcome variable with one unit increase in the independent variable holding all other variables constant. Statistical significance was defined as a P value of less than .05. Missing data were excluded from the analysis.

Results

Demographics and perioperative data are presented in Table 1. Overall, the median patient age was 52 years, 60% were women, 85% were white, and 7% had a familial syndrome. The majority of tumors were functional (75%); forty tumors (12%) secreted cortisol, 75 (22%) aldosterone, and 145 (42%) catecholamines. As expected, open adrenalectomy was associated with larger tumors and blood loss, longer procedure times and length of stay, and more complications. Non-functional tumors and familial disease were more frequent in the open adrenalectomy group.

On unadjusted analysis and according to adrenal pathology (Table 2), there were no significant differences in sex or race. Patients with metastatic tumors were significantly older than patients with other pathologies (63 years, $P = .04$). Patients with pheochromocytomas had a significantly lower body mass index when compared with patients with benign non-pheochromocytoma tumors (27 vs 30 kg/m^2, $P < .001$). Pheochromocytomas were larger (4.0 vs 2.5 cm, $P < .001$), more likely to be removed using an open approach (29% vs 7%, $P < .001$), had greater blood loss (100 vs 30 mL, $P < .001$), and a longer procedure time (150 vs 110 min, $P < .001$) when compared with benign non-pheochromocytoma tumors. Adrenocortical carcinomas were larger when compared with all other pathologies (8.8 cm vs others, $P < .001$) and open adrenalectomy was the preferred surgical approach (83% vs others, $P < .001$). Metastatic tumors were larger (4.6 vs 2.5 cm, $P = .02$), more likely to be removed utilizing an open approach (25% vs 7%, $P = .017$), and associated with longer procedure times (143 vs 110 min, $P < .001$) when compared with benign non-pheochromocytoma tumors. Other significant findings in the univariate analysis were no longer significant in the multivariate analysis discussed below.