Selective strategy for intensive monitoring after pheochromocytoma resection

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Background. *Guidelines recommend 24–48 hours of intensive monitoring after resection of pheochromocytoma. However, many patients do not require it. The objective of this study is to identify preoperative risk factors associated with postoperative hemodynamic instability (HDI) so as to select patients who may not require intensive postoperative monitoring.*

Methods. *Medical records of patients undergoing pheochromocytoma resection over a 12-year period were reviewed. Postoperative HDI was defined as systolic blood pressure of >200 or <90, heart rate >110 or <50 or needing active resuscitation.*

Results. *We included 41 patients; 49% had postoperative HDI but only 34% had HDI > 6 hours. Risk factors for HDI were preoperative mean arterial pressure (MAP) > 100 mm Hg (14% vs 45%), norepinephrine/normetanephrine levels >3x normal (44 vs 82%), and resection of another solid organ (0 vs 20%). Avoidance of planned postoperative monitoring for low-risk patients would have reduced estimated costs by 34%.*

Conclusion. *Fewer than one-half of patients undergoing resection for pheochromocytoma benefit from intensive monitoring. High preoperative MAP, high norepinephrine/normetanephrine levels, and concomitant resection of another organ are risk factors for postoperative HDI. After a 6-hour interval of postoperative stability, selective rather than routine use of intensive monitoring may be an efficient strategy for monitoring lower risk patients. (Surgery 2016;159:275-83.)*

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The treatment of pheochromocytoma has evolved substantially since its first successful resection in 1926.[1] Over the years, there has been a progressive decrease in the morbidity and mortality after surgical removal of these catecholamine-secreting tumors. Improvements in diagnostic imaging and biochemical assays, as well as in preoperative and surgical management, have contributed to improved outcomes and accelerated postoperative recovery.[2]

Derangements in hemodynamics remain the major contributor to morbidity and mortality after surgery for pheochromocytoma. The tumor size, catecholamine type, optimal preoperative mean arterial pressure (MAP), operative approach, and presence of multiple tumors/genetic syndromes have all been identified as risk factors for intraoperative hemodynamic abnormalities.[3-6]

However, little evidence is available to predict hemodynamic instability (HDI) in the immediate postoperative period. The current guidelines recommend 24–48 hours of continuous monitoring after resection of pheochromocytoma to diagnose and treat postoperative hypertension, hypotension, and hypoglycemia.[7,8] Presently, many patients do not experience these complications and, if they do occur, they generally resolve within a few hours postoperatively.[9] Preoperative selection and avoidance of routine intensive

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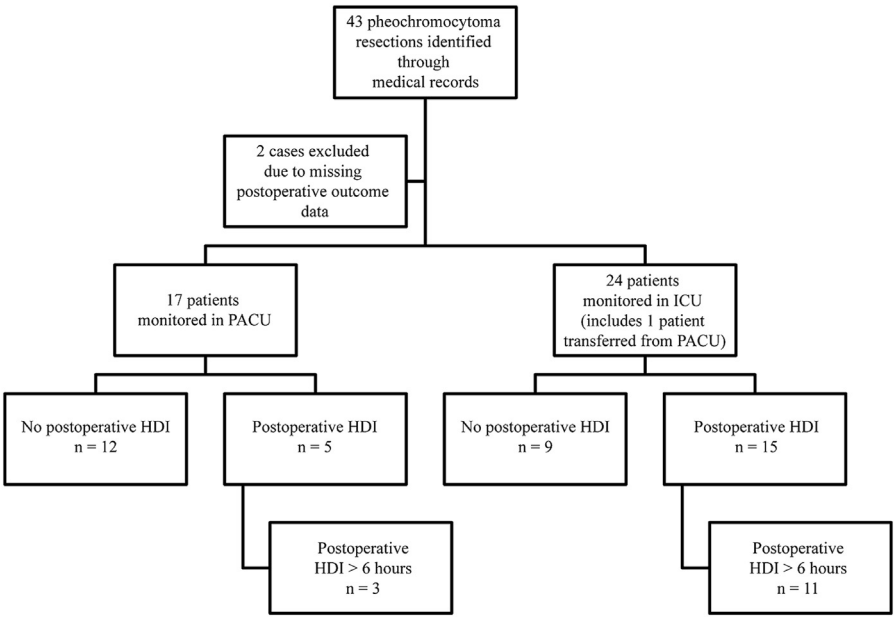

Fig 1. Patient selection.

monitoring of patients for whom there is no benefit would facilitate management and may decrease resource use, potentially translating into lower health care costs.

Therefore, the main objective of this study was to identify predictors of postoperative HDI in patients undergoing adrenalectomy for pheochromocytoma, and to develop an algorithm to select patients who do not require intensive postoperative monitoring and treatment.

METHODS

We performed a retrospective chart review of all adult patients undergoing adrenalectomy for pathologically confirmed pheochromocytoma or paraganglioma between 2003 and 2014 at a single university-affiliated referral center (Fig 1). The institutional review board approved this study. Patients with metastatic pheochromocytoma were excluded. As per local institutional protocol, all patients were scheduled for routine postoperative intensive care unit (ICU) monitoring. If ICU monitoring was not available immediately after surgery, patients were transferred to the postanesthesia care unit (PACU) for hemodynamic monitoring.

Patient and tumor characteristics were recorded. Preoperative hemodynamic parameters were measured 1 week before surgery. All patients were prepared with preoperative antihypertensive medications (α-blockers, β-blockers, calcium channel blockers). Preoperative urine catecholamine and metanephrine levels were presented as normalized values (calculated by dividing the absolute value by the upper limit of the normal reference range) with the result being recorded as multiples of normal, using the highest normalized value for analysis.[4] Intraoperative data included operative approach (laparoscopic vs open), operative time, and intraoperative hemodynamic parameters. The presence of intraoperative HDI (defined as a systolic blood pressure of >200 or <90, or a heart rate of >10 or <50, or requiring any of the after supportive treatment including intravenous fluid resuscitation, blood transfusion, vasopressors or vasodilators) and estimated blood loss were recorded. Postoperative hemodynamic parameters, duration of stay in the PACU/ICU, and postoperative HDI treatment were recorded as well.

Statistical analysis, HDI predictor model, and cost estimate. Preoperative and intraoperative variables were compared between patients with and without postoperative HDI using the Student's t test or Chi-square test. The Pearson correlation coefficient was used to evaluate the correlation between normalized norepinephrine and normetanephrine levels with preoperative MAP. Data are expressed as mean values ± standard deviation or n (%). Patients with missing end point variables were excluded from the analysis (2/43).

Significant variables based on univariate analysis were used to construct a selective strategy that allowed patients to be stratified as having a low or high risk of developing postoperative HDI. Low

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