Anesthesia and Laparoscopic Adrenalectomy for Primary Aldosteronism

NARONG LERTAKYAMANEE, M.D., F.R.C.S. (GLAS), M.P.H.*,
PRADIT SOMPRAKIT, M.D., F.R.C.A., M.Sc.**,
PEERA BURANAKIJAROEN, M.D.***,
JARIYA LERTAKYAMANEE, M.D., F.R.C.A., M.P.H.**,
THANYADEJ NIMMANWUDIPONG, M.D., F.R.C.S.T.*,
SUTIN SRIUSSADAPORN, M.D.***

Abstract

Adrenalectomy is the curative treatment of primary aldosteronism or Conn's syndrome. Laparoscopic adrenalectomy, a new method, should result in less pain and shorter hospitalization. We reported 25 patients who received anesthesia and laparoscopic adrenalectomy from 1995-1999. There were 17 females and 8 males. The mean age was 41.9 years (range 25-59). Ninety-six per cent had hypertension, 76 per cent had weakness of the extremities. When these patients sought medical care, their serum potassium and bicarbonate were 2.4 and 30.9 mEq/l respectively. Before operation, after treatment with spinorolactone, they were 4.3 and 24.4 mEq/l respectively. Associated diseases and cardiovascular abnormalities were reported. General anesthesia was the anesthetic technique of choice. Laparoscopic adrenalectomy was described in detail. Sixteen patients had adenomas on the left adrenal gland, 9 were on the right. Twenty-four patients had unilateral adrenalectomy, one had enucleation of the tumor. The size of the adenoma was 1.8 cm (range 1-3). There was no morbidity or mortality. All patients were discharged on the third postoperative day.

Key word : Laparoscopic Adrenalectomy, Primary Aldosteronism

LERTAKYAMANEE N, LERTAKYAMANEE J, SOMPRAKIT P NIMMANWUDIPONG T, BURANAKIJAROEN P, SRIUSSADAPORN S
J Med Assoc Thai 2001; 84: 798-803

Patients with primary aldosteronism (or Conn's syndrome) are referred to an anesthesiologist and a surgeon for their adrenalectomy. The syndrome occurs from the action of mineralocorticoid, released from the tumor in zona glomerulosa of the adrenal cortex. The success of management

* Department of Surgery,
** Department of Anesthesiology,
*** Department of Medicine, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok 10700, Thailand.

lies in multidisciplinary co-operation. Since the introduction of laparoscopic surgery, the procedure has been applied to many fields of surgery(1). In this paper, we report anesthesia and laparoscopic adrenalectomy for patients with primary aldosteronism.

METHOD

This is a case series of 25 patients who were operated on in Siriraj Hospital Medical School, Mahidol University from 1995-1999. Patients were first admitted to the Department of Medicine or Surgery, most with the diagnosis of "hypertension in the young". Adrenal cortical adenoma was suspected when weakness of extremities and/or hypokalemia was found.

Preoperative diagnosis and localization

The aims of preoperative treatment were to control hypertension and restore body potassium. Diuretic was stopped and potassium chloride replacement was given for ten days. Plasma renin activity was studied when hypokalemia persisted, low activity was suggestive of primary mineralocorticoid syndrome. Serum and urine potassium levels were compared and high urine level supported the diagnosis. At the same time, other causes of "hypertension in the young" were investigated: renal artery stenosis (by captopril renogram, saline loading test), pheochromocytoma (catecholamines and their metabolites in serum and urine), and Cushing's syndrome (dexamethasone test). Ultrasonography, computerized tomography, or magnetic resonance imaging was used to localize the tumor. Spinorolactone was the antihypertensive drug of choice.

Anesthesia

An anesthesiologist evaluated the patient before agreeing to administer anesthesia for the surgery. The treatment was reviewed to ascertain that the patient had received spinorolactone for at least 2-3 weeks, the serum potassium had risen to normal limit, and blood pressure had come down. Metabolic alkalosis should have disappeared and the acid-base value returned to normal. Sometimes the patients also received other antihypertensive agents, such as nifedipine, but spinorolactone was mandatory since it controlled hypertension while preserving potassium. Some patients have had hypertension for years and the adverse effects on the hearts should be diagnosed and treated.

On the day of operation, the patient was given the morning drugs with a small amount of water. We premedicated with oral benzodiazepine, such as midazolam. General anesthesia with endotracheal intubation and controlled ventilation was the technique of choice, with thiopentone, succinyl choline, nitrous oxide and oxygen, isoflurane, pancuronium or atracurium, and fentanyl. The standard monitoring was automated blood pressure, heart rate, oximetry and electrocardiography. We have not found intra-arterial pressure or central venous pressure monitoring necessary. Because this was a laparoscopic surgery, the end tidal carbondioxide level was monitored to detect the increase in blood carbondioxide; and airway pressure was monitored to look out for pneumothorax. When the end tidal carbondioxide level rose, alveolar ventilation would be increased. Muscle relaxation should be adequately provided because the surgeon worked near the diaphragm.

Surgery

The adrenal imaging must be shown in the operating room and the site of the adenoma confirmed before incision. The patient lay in the kidney position, with the side of the tumor up, and the abdomen close to the edge of the table. The operating table was tilted in a reverse Trendelenberg position. All patients were operated on by using zero degree laparoscopy. We used the harmonic scalpel in the last 17 cases. The first port was normally inserted by using the open technique, at the paramedian line. The site of this first port was crucial. We had to be certain that the tip of the camera could reach the dome of the diaphragm especially for the left adrenalectomy. Pneumoperitoneum was raised up to 15 mmHg, using carbondioxide.

Right adrenalectomy

After the pneumoperitoneum, three more trocars were inserted. Two 5-mm trocars were placed along the anterior axillary line and epigastric area. Another 10-mm port was placed in the midclavicular line. All three ports were placed at about one inch below the costal margin.

The operation started by using the liver retractor through the epigastric port to retract the liver upward and medially. The dissection started from the peritoneal attachment of the inferior surface of the right lobe. Harmonic scalpel was used throughout the operation. Then the right adrenal

Table 1. Age, weight and preoperative treatment of patients.

	Mean	SD	Range	N
Age (year)	41.9	8.8	25 - 59	25
Weight (kg)	62.4	16.8	36 - 110	22
Duration of hypertension (month)	47.9	61.4	1 - 240	21
Spinorolactone given (month)	6.5	12.6	0.5 - 66	21

Table 2. Potassium and bicarbonate levels before and after spinorolactone treatment.

	Mean	SD	Range	N
Serurfi potassium				
Before	2.4	0.5	1.6 - 3.2	20
After	4.3	0.4	3.6 - 5.6	25
Serum bicarbonate				
Before	30.9	3.5	25 - 38	16
After	24.4	2.0	20 - 28	21

gland was identified in the suprarenal space. The inferior vena cava was also identified. The inferior border of the gland was dissected from the kidney medially until the inferior vena cava was clearly seen. We dissected along the lateral aspect of the inferior vena cava superiorly until we could identify the adrenal vein. Using the dissecting grasper to get around the vein, the adrenal vein was clipped and divided, 2 clips were left on the proximal side. Then the gland was lifted upward and laterally and was easily dissected from the adjacent tissue. The harmonic scalpel easily controlled the bleeding and blood transfusion was not required in this series. The gland was removed in a bag through the paramedian port. The patient had to starve postoperatively, until bowel movement returned to normal, which was not more than 24 hours.

Left adrenalectomy

Only three trocars were inserted. The camera port was also in the paramedian area. The point of trocar insertion was a little more cephalad to the umbilicus and had to be certain that the tip of the camera could reach the dome of the left diaphragm. A 5-mm trocar was inserted at the midclavicular line and a 10-mm one at the anterior axillary line. The dissection started from the mobilization of the splenic flexure of colon until the kidney and the tail of the pancreas could be seen. The latter and the spleen were dissected from the retroperitoneum until they were freely folded medially. The superiomedial aspect of the kidney was dissected to identify the adrenal gland in the retroperitoneal fat. This step could be difficult due to the limitation of the camera to differentiate the colors between the adrenal gland and the surrounding fat. The gland was identified from its lateral aspect. The dissection was continued along the inferior border of the gland medially. The left adrenal vein was easily identified and clipped. The gland was lifted upward and dissection carried out carefully along the medial side. The small adrenal arteries were controlled easily by using the harmonic scalpel. The gland was totally dissected from the retroperitoneum.

RESULTS

We prospectively studied the 25 patients. There were 17 females and 8 males. Table 1 shows their mean age, weight and preoperative treatment. The symptoms that brought them to seek medical care were: hypertension and/or headache in 12 patients (48%), weakness in 7 patients (28%), chest pain in 2 patients (8%), congestive heart failure in 1 patient (4%), hemiplegia in 1 patient (4%), severe pre-eclampsia in 1 patient (4%) and inquinal hernia in 1 patient (4%). All except this last patient (96%) were found to have hypertension when their blood pressure was measured. Nineteen patients (76%) developed weakness of the extremities before Conn's syndrome was diagnosed. The serum potassium and bicarbonate when the patients were diagnosed as haveing hypokalemia and metabolic alkalosis are shown in Table 2, compared with the levels before surgery.

Associated diseases were found in 5 patients: thyrotoxicosis (1 patient), diabetes (1), Bell's palsy (2), and chronic renal failure (2). Associated cardiovascular abnormality was found in 11 patients (44%). They were congestive heart failure (1 patient), his-

tory of cerebrovascular accident (2), cardiomegaly (3), concentric hypertrophy (1), myocardial infarction post coronary artery bypass graft (1), mitral regurgitation (2) and ischemia by electrocardiography (1).

Preoperative management was cooperated well among surgeons, internists, and anesthesiologists to correct the patients' pathophysiology. There was no perioperative mortality or morbidity. All laparoscopic patients were discharged on the third postoperative day.

Of the 25 cases, 16 adenomas were on the left adrenal gland and 9 were on the right. Twenty-four patients had unilateral adrenalectomy and one had enucleation of the tumor. The mean size of the adenoma was 1.8 cm (SD 0.5, range 1-3 cm). All were confirmed postoperatively by pathological section to be cortical adenomas.

DISCUSSION

The tumor of the adrenal cortex is probably found in less than 1 per cent of unselected hypertension patients, although reported figures varied from 0.5 to 12 per cent[2,3]. The annual incidence was 0.8 per million inhabitants in Denmark[4]. It is usually unilateral, small in size, and rarely malignant. Our finding is similar to other epidemiologic reports : the ratio between females and males is 2 to 1[5] and the common age is between 30-50 years, with a mean age of 46.6 years[6]. Toxemia of pregnancy has been reported to occur in female patients with primary aldosteronism[7]. A study reported that an adenoma affected the left gland four times more often than the right[8].

Increased sodium reabsorption and extracellular volume expansion result in diastolic hypertension. Potassium depletion results in muscle weakness, cramping, intermittent paralysis, headache, polydipsia, polyuria, nocturia, and fatigue[6]. Because many patients were initially treated for hypertension before the diagnosis could be made, the incidence of symptoms that were specific to primary aldosteronism was difficult to determine. The patients were found to have impaired ability to concentrate urine, hypokelemia, hypernatremia and metabolic alkalosis. The size of the adenoma in our series was 1.8 cm, which is consistent with previous reports[6,9].

Primary aldosteronism is diagnosed when a hypertensive patient has suppressed plasma renin activity (PRA) (below 0.2-0.5 ng/mL/h), specifically one who demonstrates hypokalemia (serum potassium less than 3.4 mEq/L). If the radioimmunoassays are available, increased plasma aldosterone concentration (PAC) (normal, 2.2- 15 ng/dL) confirms the diagnosis. An elevated basal PAC and a PAC-PRA ratio (calculated as picograms per milliliter/nanograms per milliliter per hour) greater than 400:1 are also reliable criteria for the diagnosis [10]. The diagnosis in a suspected case can be confirmed by demonstrating inability to stimulate PRA on a low-sodium diet or inability to suppress PAC with intravenous salt loading. Captopril, an angiotensin-converting enzyme inhibitor, has also been used to demonstrate the lack of suppressibility of aldosterone[11].

To differentiate between an aldosterone-producing adenoma and idiopathic hyperaldosteronism from bilateral hyperplasia is also critical for selecting cases for surgery. A postural decrease in PAC and a plasma 18-hydrocorticosterone level greater than 100 ng/dL is characteristic of an aldosterone-producing adenoma.

Localization of the adenoma by CT scan has a sensitivity of 82-90 per cent. If the CT scan shows that a patient has bilateral nodules or bilateral normal glands, then further localization studies are required, using isotope adrenal scanning (iodine-131-6B-iodomethylnorcholesrerol or NP-59) or selective adrenal venous sampling.

Since 1976, 66 cases of adrenalectomy for Conn's syndrome have been performed in our hospital; 41 were open laparotomy (posterior approach) and 25 were laparoscopic surgery. Laparoscopic procedure has been used since 1992[12]. This procedure has several advantages over open surgery: less postoperative pain, fewer adverse effects on pulmonary mechanics, and shorter hospitalization days. In our experience, laparoscopic adrenalectomy is feasible and safe.

During the learning stage of surgery, we did not succeed in two patients. In the first patient, we used the extraperitoneal approach and could not identify structures in the retroperitoneal space. The limitation of the color differentiation of the camera made it difficult to differentiate the adrenal gland from the retroperitoneal fat. The second failure was due to an obese patient and the procedure was converted to open surgery when bleeding from the adrenal gland started. Use of the harmonic scalpel reduced the operative time and bleeding by making

the dissection plane clearer and the gland was easily identified. The camera port at the paramedian area gave a wide operative field.

Previous experience using the posterior approach, open laparotomy resulted in a median postoperative hospital stay of 8 days (range 5-21) (13), whereas, all patients in our present series went home on the third postoperative day. Some investigator have reported a mean hospital stay after laparoscopic approach of 5.3 days (range 1-12)(1). In one study, the transabdominal approach resulted in a 30 per cent incidental splenectomy rate(14). There was no need for steroid or other hormone therapy postoperatively since primary aldosteronism does not produce excess steroid and bilateral adrenalectomy was not done.

The long term cure rate of hypertension by unilateral adrenalectomy for patients with primary aldosteronism averages 69 per cent in reported series(2). However, those who remained hypertensive were reported to have improved markedly. Normalization of blood pressure does not always occur immediately after the operation. Older patients and male patients are at higher risk of having persistent hypertension after the operation.

SUMMARY

Our series confirmed as reported from previous studies(15,16) that anesthesia and laparoscopic adrenalectomy are safe and laparoscopic adrenalectomy should be the standard surgery for primary aldosteronism.

(Received for publication on February 30, 2000)

REFERENCES

1. Walmsley D, McIntyre R, Sawers HA, et al. Laparoscopic trans-perineal adrenalectomy: a preliminary report of 14 adrenalectomies. Clin Endocrinol (Oxford) 1996; 42: 141-5.
2. Young WF Jr, Hogan MJ, Klee GG, et al. Primary aldosteronism: Diagnosis and treatment. Mayo Clin Proc 1990; 65: 96.
3. Gordon RD, Ziesak MD, Tunny TJ, et al. Evidence that primary aldosteronism may not be uncommon: 12 per cent incidence among antihypertensive drug trial volunteers. Clin Exp Pharmacol Physiol 1993; 20: 296.
4. Anderson GS, Toftdahl DB, Lund JO, et al. The incidence rate of pheochromocytoma and Conn's syndrome in Denmark, 1977-1981. J Hum Hypertens 1988; 2: 187-9.
5. Favia G, Lumachi F, Scapa V, et al. Adrenalectomy in primary aldosteronism: Along-term follow-up study in 52 patients. World J Surg 1992; 16: 680.
6. Obara T, Ito Y, Fugimoto Y. Hyperaldosteronism. In: Endocrine Surgery. Clark OH, Duh Q (eds). Pennsylvania: WB Saunders: 1997: 483-9.
7. Lins PE, Adamson U. Primary aldosteronism: A follow-up study of 28 cases of surgically treated aldosterone-producing adenomas. Acta Med Scand 1987; 221: 275.
8. Meah FA, Abdullah T, Jasmi AY, et al. The surgical treatment of adrenal diseases. Ann Acad Med Sibgapore 1996; 25: 251-4.
9. Grant C, Carpenter P, van Heerden JA, et al. Primary aldosteronism: Clinical management. Arch Surg 1984; 119: 585.
10. Hiramatsu K, Yamada T, Yukimura Y, et al. A screening test to identify aldosterone-producing adenoma by measuring plasma renin activity. Arch Intern Med 1981; 141: 1589.
11. Lyon DF, Kem DC, Brown RD, et al. Single dose captopril as a diagnostic test for primary aldosteronism. J Clin Endocrinol Metab 1983; 57: 892.
12. Obara T, Ito Y, Okamoto T, et al. Risk factors associated with postoperative persistent hypertension in patients with primary aldosteronism. Surgery 1992; 112: 987.
13. Sand J, Saaristo J, Nordback I, Auvinen O. Posterior approach for adrenal surgery: experiences with 59 patients. Ann Chir Gynaecol 1997; 86: 234-7.
14. Weigel RJ, Wells SA, Gunnells JC, et al. Surgical treatment of primary hyperaldosteronism. Ann Surg 1994; 219: 347.
15. De Canniere L, Michel L, Hamoir E, et al. Multicentric experience of the Belgian Group for Endoscopic Surgery (BGES) with endoscopic adrenalectomy. Surgical Endoscopy 1997; 11: 1065-7.
16. Lo CY, van Heerden JA, Grant CS, et al. Adrenal surgery in the elderly, too risky? World J Surg 1996; 20: 368-73.

การระงับความรู้สึกและการผ่าตัดต่อมหมวกไตโดยใช้กล้องสำหรับผู้ป่วย Primary aldosteronism

ณรงค์ เลิศอรรฆยมณี, พ.บ., F.R.C.S., M.P.H., จริยา เลิศอรรฆยมณี, พ.บ., F.R.C.A., M.P.H.**, ประดิษฐ์ สมประกิจ, พ.บ., F.R.C.A., M.Sc.**, ธัญเดช นิมมานวุฒิพงศ์, พ.บ., F.R.C.S.T.*, พีระ บูรณกิจเจริญ, พ.บ., ว.ว. (อายุร)***, สุทิน ศรีอัษฎาพร, พ.บ., ว.ว. (อายุร)****

การตัดต่อมหมวกไตเป็นการผ่าตัดรักษาโรค Primary aldosteronism หรือ Conn's syndrome การตัดต่อมหมวกไตโดยการส่องกล้อง (Laparoscopic adrenalectomy) เป็นวิธีใหม่ที่น่าจะช่วยลดความปวดและระยะเวลาอยู่ในโรงพยาบาล ผู้รายงานได้ทำการศึกษาผู้ป่วยที่มารับการระงับความรู้สึกและผ่าตัด Laparoscopic adrenalectomy จำนวน 25 รายในภาควิชาวิสัญญีวิทยาและศัลยศาสตร์ในระหว่างปี 2538–2542 เป็นผู้หญิง 17 รายและผู้ชาย 8 ราย อายุเฉลี่ย 41.9 ปี (ช่วง 25–59 ปี) ผู้ป่วยร้อยละ 96 มีความดันเลือดสูง ร้อยละ 96 มีแขนขาอ่อนแรง เมื่อแรกรับผู้ป่วยมีระดับโปแตสเซียม และไบคาบอนเนตในเลือด 2.4 และ 30.9 mEq/l ตามลำดับ หลังจากได้รับการรักษาด้วยยา aldactone แล้ว ระดับโปแตสเซียมและไบคาบอนเนตในเลือดก่อนผ่าตัดเป็น 4.3 และ 24.4 mEq/l ตามลำดับ ได้รายงานโรคอื่น ๆ และความผิดปกติทางระบบหัวใจและหลอดเลือด การระงับความรู้สึกแบบทั้งตัว (General anesthesia) เป็นวิธีที่เหมาะสมที่สุด และรายงานขั้นตอนการผ่าตัดโดยการส่องกล้องอย่างละเอียด ผู้ป่วย 16 รายมีก้อนเนื้องอกที่ต่อมหมวกไตข้างซ้าย และ 9 รายมีก้อนเนื้องอกที่ต่อมหมวกไตข้างขวา ผู้ป่วย 24 รายได้รับการตัดต่อมหมวกไตออกหนึ่งข้าง ส่วนอีก 1 รายเป็นการเจาะก้อนเนื้องอกออก ขนาดเฉลี่ยของก้อนเนื้องอก 1.8 ซม. (ช่วง 1–3 ซม.) ไม่พบว่ามีอาการแทรกซ้อนหรือการเสียชีวิต ผู้ป่วยทุกรายกลับบ้านได้ในวันที่ 3 หลังผ่าตัด

คำสำคัญ : การผ่าตัดต่อมหมวกไตโดยใช้กล้อง, Primary aldosteronism

ณรงค์ เลิศอรรฆยมณี, จริยา เลิศอรรฆยมณี, ประดิษฐ์ สมประกิจ, ธัญเดช นิมมานวุฒิพงศ์, พีระ บูรณกิจเจริญ, สุทิน ศรีอัษฎาพร
จดหมายเหตุทางแพทย์ ฯ 2544; 84: 798–803

* ภาควิชาศัลยศาสตร์,
** ภาควิชาวิสัญญีวิทยา,
*** ภาควิชาอายุรศาสตร์, คณะแพทยศาสตร์ศิริราชพยาบาล, มหาวิทยาลัยมหิดล, กรุงเทพ ฯ 10700