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Laparoscopic and open surgery for pheochromocytoma

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Abstract

Backround: Laparoscopic adrenalectomy is a promising alternative to open surgery although concerns exist in regard to laparoscopic treatment of pheocromocytoma. This report compares the outcome of laparoscopic and conventional (open) resection for pheocromocytoma particular in regard to intraoperative hemodynamic stability and postoperative patient comfort.

Methods: Seven patients laparoscopically treated (1997–2000) and nine patients treated by open resection (1990–1996) at the National Hospital (Rikshospitalet), Oslo. Peroperative hemodynamic stability including need of vasoactive drugs was studied. Postoperative analgesic medication, complications and hospital stay were recorded.

Results: No laparoscopic resections were converted to open procedure. Patients laparoscopically treated had fewer hypertensive episodes (median 1 vs. 2) and less need of vasoactive drugs peroperatively than patients conventionally operated. There was no difference in operative time between the two groups (median 110 min vs. 125 min for adrenal pheochromocytoma and 235 vs. 210 min for paraganglioma). Postoperative need of analgesic medication (1 vs. 9 patients) and hospital stay (median 3 vs. 6 days) were significantly reduced in patients laparoscopically operated compared to patients treated by the open technique.

Conclusion: Surgery for pheochromocytoma can be performed laparoscopically with a safety comparable to open resection. However, improved hemodynamic stability peroperatively and less need of postoperative analgesics favour the laparoscopic approach. In experienced hands the laparoscopic technique is concluded to be the method of choice also for pheocromocytoma.

Introduction

Since the first laparoscopic cholecystectomy reported in 1987, laparoscopic surgery has become an excellent alternative to open procedure for an increasing number of indications. Several authors advocate laparoscopy as the preferred approach to adrenalectomy [1–6]. However, in patients with pheochromocytoma laparoscopic surgery may increase the risk of serious cardiovascular complica-

tions [7,8] as the induction of pneumoperitoneum may trigger adrenergic reactions [9,10]. On the other hand careful laparoscopic manipulation of the tumor may reduce the release of adrenergic substances achieving better cardiovascular stability.

In order to compare the frequency of hemodynamic complications, postoperative hospital stay and use of analgesics in laparoscopic and open adrenalectomy for pheochromocytoma, a retrospective study including all patients operated for pheochromocytoma the last 10 years at the National Hospital (Rikshospitalet), the University of Oslo, was carried out.

Materials and methods

Laparoscopic adrenalectomy for phechromocytoma was first carried out in June 1997 at our center. Since this a total of 7 patients have been laparoscopically treated for this disease. These patients were compared with all patients, total 9, undergoing traditional surgery for pheochromocytoma between 1990–1996. In the laparoscopy group (LG) 6 adrenal pheochromocytomas and 1 paraganglioma were included and in the open group (OG) 8 pheochromocytomas and 1 paraganglioma were included.

Median age of the patients and tumor localization is shown in Table 1. There was no statistical difference between the two groups in regard to age, sex, localization, clinical manifestation and preoperative endocrine parameters (Tables 1,2,3). All patients with pheochromocytoma were comprehensively examined including clinical investigation, biochemistry tests and ophthalmologic investigations to exclude MEN2 and Hippel-Lindau syndrome. Patients in both groups received preoperative α-blockade (phenoxybenzamin). In the OG all patients had epidural analgesia per- and postoperatively in addition to general anesthesia.

Table 1: Patient characteristics

	Laparoscopic surgery N = 7	Open surgery N = 9	P-value
Sex (male/female)	4/3	1/8	ns
Age (years)	52 (31–65)	45 (24–65)	ns
Localization:			
Left adrenal / right adrenal	5/1	4/4	ns
Paraganglioma	1 (left)	1 (left)	

Values expressed as median (range) ns – not significant.

Table 2: Clinical manifestation before surgery

	Laparoscopic surgery N = 7	Open surgery N = 9	P-value
Hypertensive crises	2	3	ns
Persistent hypertension	2	4	ns
Hypertensive crises + persistent hypertension	3	2	ns

ns – not significant.

Table 3: Preoperative endocrine parameters (24-hour hormones in urine)

Hormones	Laparoscopic surgery N = 7	Open surgery N = 9	P-value value
Noradrenalin (nmol)	2000 (444–3819)	1922 (579–7492)	ns
Adrenalin (nmol)	440 (75–870)	570 (180–1795)	ns
Vanillylmandelic acid (μmol)	86 (22–121)	72 (30–100)	ns

Values expressed as median (range) ns – not significant.

Laparoscopic surgery was performed with the patients placed in lateral position. Three trocars were used for left sided resections and 4 trocars for right sided resections. The trocars were inserted 3–5 cm below the costal margin lateral to the rectus abdominis muscle (linea semilunaris) and in dorsal direction. On the right side a 4^{th} trocar was inserted just below the costal margin lateral to the rectus abdominis muscle or medial to this. An open technique was used for placement of the first 12 mm trocar 4–5 cm just lateral to the rectus abdominis muscle and 3–5 cm below the costal margin. A 30° laparoscope was inserted and CO_2 gas insufflated until the intraabdominal pressure reached 8–9 mm Hg. For the other ports 11 mm trocars were used.

The adrenal vein was localized and secured before mobilizing the tumor. Dissection was performed using the Harmonic scalpel (Ethicon, Cincinnati, OH, USA) or AutoSonix (AutoSuture, Connecticut, USA). The specimen was removed in one peace using Endo-Catch (AutoSuture, Connecticut, USA).

Open surgery was performed throw transabdominal approach with using of transverse incision just bellow cos-

Table 4: Operative and postoperative data

	Laparoscopic surgery N = 7	Open surgery N = 9	P-value
Tumor size (histology), (cm)	6 (3–11)	6 (2,7–8)	ns
Operative time (min)			
1. Adrenalectomy (all procedures)	110 (90–165)	125 (105–195)	ns
Left side	125 (90–165)	125 (110–135)	ns
Right side	90	155 (105–195)	ns
2. Paraganglioma	235	210	-
Converted procedures	0	-	
Blood loss (ml)	200 (50–400)	300 (100–400)	ns
Patients requiring blood transfusions	0	0	-
Peroperative complications	0	0	-
Postoperative hospital stay	3 (2–4)	6 (5–15)	0.001
Postoperative complications	0	3*	ns
Patients requiring opoids	1	9	0.001

* 1 – pneumonia; 1 – bowel paralysis; – pain, damage to the ileoinguinal nerve Values expressed as median (range) ns – not significant.

tal margin. Patients were placed in back-lying position. In most cases the adrenal vein was localized and secured before mobilizing the tumor.

The following peroperative parameters were compared in the two groups: cardiovascular stability, operative time, blood loss, number of blood transfusions, peroperative complications and requirement of vasoactive medication. To evaluate cardiovascular stability during operation, an increase in systolic pressure of more than 33% within 10 minutes was considered as a hypertensive episode, and a heart rate of more than 100 per minute was defined as a tachycardic episode [11]. The requirement of vasoactive drugs was recorded in all patients.

Postoperative parameters analysed were: analgesic medication, postoperative hospital stay and complications. Postoperative analgesics were: nonsteroid anti-inflammatory drugs (NSAIDs)(ketorolac or diklofenac), paracetamol, combined analgesics (dextroproxyphen + paracetamol or kodeinofosfat + paracetamol), intravenous opoides (ketobemidol, petidin or morfin) and epidural opoides (fentanyl, bupvacaine, adrenalin). Opoid administration was recorded from the first postoperative day.

The data are presented as median and range. For comparison of frequencies the Fisher Exact Test and the Chi-square Test were performed. For analysis of the continuous variables the Mann-Whitney Rank Sum Test was used.

Results

All tumors were successfully removed. No laparoscopic procedures were converted to open procedures. Histological examination of resected specimens confirmed the diagnosis of pheochromocytoma in all patients. Median operative time did not differ between the two groups (Table 4). There were no peroperative complications and no patient required blood transfusion during or after operation. The groups did not differ in respect to blood loss (Table 4).

Table 5 shows intraoperative hemodynamic indices. In the LG there was significantly less hypertensive episodes than in the OG (P = 0.008, Table 5). There was no difference in intraoperative maximal systolic, mean systolic and diastolic pressures (Table 5). In the LG one patient required peroperatively vasoconstrictive drugs (metaraminol, efedrin) and two patients vasodilatatory drugs (fentolamin, nitroprussid, metoprolol). In the OG six patients required vasoconstrictive drugs and eight patients vasodilatatory drugs. The need for vasodilatatory drugs was significantly less in the laparoscopic group (P = 0.035). The groups did not differ in respect to the need of vasoconstrictive drugs, albeit a strong tendency for less drug requirement was found in the LG (P = 0.06, Table 5).

One out of seven patients in the LG required opoid administration. In six out of seven patients pain control was achieved by paracetamol, combined analgesic or NSAIDs. In the OG eight out of nine patients had epidural analgesia and six of these patients were treated with additional opoids intravenously. The ninth patient re-

Table 5: Intraoperative hemodynamic indices

	Laparoscopic surgery N = 7	Open surgery N = 9	P-value
Hypertensive episodes (per procedure)	1 (0–1)	2 (0–4)	0.008
Tachycardic episodes (per procedure)	0 (0–1)	1 (0–3)	ns
Maximal systolic blood pressure (nun Hg)	170 (150–230)	200 (130–270)	ns
Mean systolic blood pressure (nun Hg)	127,4 (117,7–146,9)	136,9 (110,7–163,3)	ns
Mean diastolic blood pressure (nun Hg)	74,3 (55,8–78,6)	76,4 (57,3–85,4)	ns
Patients requiring vasoconstrictive drugs	1	6	ns
Patients requiring vasodilatatory drugs	2	8	0.035

Values expressed as median (range) ns – not significant.

ceived a Patient Control Analgesia (PCA) pump (morfin), thus all nine patients in the OG required opoids. Statistical difference was found concerning postoperative opoid medication ($P < 0.001$, Table 4).

There were no postoperative complications in the LG. In the OG one patient developed pneumonia, one lesion of the ileo-inguinal nerve and one patient had postoperative bowel paralysis (postoperative stay 12 days). Median postoperative hospital stay was significantly shorter in the LG compared to the OG ($P = 0.001$, Table 4).

Discussion

Since the first report of laparoscopic adrenalectomy by Gagner M. et al in 1992 [12], the laparoscopic approach has become the treatment of choice for benign adrenal tumors [1,4,6]. However, in spite of successful laparoscopic resections of pheochromocytoma [12–14], the benefits of this procedure have been questioned. Intraoperative hypertensive crises are supposed to be more severe as a result of the increase in intraabdominal pressure due to CO_2 gas insufflation [10].

In this study patients laparascopically operated experienced less hemodynamic instability than patients operated by the open approach as documented by intraoperative hemodynamic indices including hyper- and hypotensive episodes in demand of medical treatment. The laparoscopic technique gives excellent anatomic exposure of the anatomic region of interest during surgery. The adrenal vein can therefore be safely dissected and ligated before dissection of the adrenal gland, preventing significant intraoperative oscillation of blood pressure. In our opinion dissection and occlusion of the adrenal vein should be performed before the manipulation of the gland.

CO_2 pneumo peritoneum has been claimed to produce hypercapnia, respiratory acidosis, increase in the systemic vascular resistance, decreased cardiac index and increased mean arterial pressure [9,10]. These problems may be managed by careful anesthetic maintenance including increased minute ventilation. Low pressure pneumoperitoneum (8–9 mm Hg) was used in all our patients. This may contribute to improved hemodynamic stability during the laparoscopic procedure. The use of Helium gas instead of CO_2 has been argued to prevent some of CO_2 side effects [15], but increases the cost of the procedure.

An important characteristic of pheochromocytomas is that they may be multifocal and even bilaterally positioned. Standard trocar placement, however, allows only unilateral abdominal examinations. Due to this all patients in our report were preoperatively examined for synchronous tumors by CT and in some cases MR-scan. These examinations will, in most cases, reveal the occurrence of any bilateral pheochromocytoma [16].

There was no difference in operating time between the two groups examined. Five of the laparoscopic adrenalectomies were performed on the left side, which is normally more time consuming than the right sided resections due to more extensive dissection. Adrenalectomia for pheochromytoma can thus be performed laparoscopically with similar operating time as during open procedures depending on the experience of the surgical team.

Our study was not randomised and the open procedures were performed by a number of surgeons. In most cases the team consisted of three surgeons. An identical surgical team consisting of two surgeons experienced in laparoscopy and open adrenalectomy, performed all

laparoscopic adrenalectomies. The laparoscopic approach may thus be cost effective in that less manpower is needed.

In both the LG and the OG one patient had a paraganglioma. Although successfully treated in both patients, these procedures were most time consuming. By accurate preoperative identification and localization of the paragangliomas on CT or MR scan, these patients may also be safely resected by the laparoscopic approach.

Adrenal sparing surgery is an excellent option to avoid life-long steroid dependency after bilateral adrenalectomy [17,18]. In context to pheochromocytoma some authors advocate using preoperative moleculargenetic evaluation to improve diagnostics of hereditary pheochromocytoma (multiple endocrine neoplasia type 2 and Von Hippel-Lindau disease) [17,19] and in that way to optimise the laparoscopic pheochromocytoma surgery including adrenal sparing modification [18].

In conclusion we consider the safety of laparoscopic resection of pheochromocytoma similar to that of open surgery. The laparoscopic approach, however, facilitates hemodynamic stability and postoperative patient comfort including reduced hospital stay. In experienced hands, therefore, the laparoscopic technique is in our opinion the method of choice for resection of pheocromocytoma.

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