

# Laparoscopic hand-assisted adrenalectomy for tumours larger than 5 cm

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## Abstract

**Objective:** Adrenal surgery remains a distinct surgical challenge. Technical challenges associated with laparoscopic adrenalectomy are tumour size, haemorrhage control and oncological compromise. Hand-assisted laparoscopic (HAL) adrenalectomy, utilizing a hand-port device, offers minimally invasive surgery with the advantages and safety of tactile feedback. We aimed to assess the efficacy of HAL for patients requiring adrenalectomy for tumours over 5 cm in size.

**Context:** Hand-assisted laparoscopic surgery is used in several surgical specialities over totally laparoscopic surgery to manage sizeable pathology, reduce operating time and conversion rates. HAL adrenalectomy is demonstrated in this series as a safe alternative to laparoscopic adrenalectomy for large adrenal tumours.

**Design:** A retrospective analysis of all HAL adrenalectomies performed over 8 years (October 2006-May 2015) by a single surgeon was performed. This case series is the largest study of this technique.

**Patients:** All patients who were fit for surgery with adrenal tumours (over 5 cm) were included.

**Analysis:** Primary endpoints were overall mortality, operating time, hospital stay, complications and conversion to open surgery.

**Results:** A total of 56 patients underwent the procedure. A total of 43 had unilateral and 13 bilateral lesions. Most lesions (45) were histologically benign. These included functioning and non-functioning tumours. Median tumour size was 8 cm (range 5-19 cm). There was one (1.8%) intra-operative conversion and no peri-operative mortality. Postoperative complications occurred in 8 (14%) patients, all self-limiting. The median length of stay was 6 days (range 2-21). There was one recurrence of pathology with repeat surgery.

**Conclusion:** Hand-assisted laparoscopic surgery offers a safe reproducible approach to adrenal surgery combining minimally invasive surgery with tactile integration. Although previously described in small numbers, this represents the largest case series to date. HAL is a safe minimally invasive surgical option for larger tumours, including malignancies. The HAL technique may additionally offer a shorter learning curve for trainee adrenal surgeons.

**KEYWORDS**

adrenal tumours, adrenalectomy, hand assisted, hand port, laparoscopic, minimally invasive, port site seeding

## 1 | INTRODUCTION

Hand-assisted laparoscopic (HAL) adrenalectomy was first reported by Bennett and Ray in 2002.<sup>1</sup> Since then, only individual case reports and case series on the use of hand assistance for laparoscopic adrenalectomy have been reported. The well-documented advantages of minimally invasive surgery over open surgery include decreased wound morbidity, improved cosmesis and shorter hospital stay with earlier return to normal activity.<sup>2</sup> While totally laparoscopic adrenalectomy is the gold standard surgical technique for smaller adrenal lesions, there is still some reluctance for the use of the laparoscopic approach in adrenal surgery with larger lesions (>5 cm), bilateral lesions, malignant lesions and pheochromocytomas. This is based on anxiety regarding prompt haemorrhage control (warranting open conversion), difficulty in the extraction of large lesions, oncological compromise and hypertensive crises in pheochromocytomas. Large adrenal tumours may need to be morcellated for their removal or require a larger incision to be made to deliver them intact for histological analysis, thus obviating some of the potential advantages of minimally invasive surgery. An additional crucial consideration in the context of malignant adrenal tumours with minimally invasive techniques is damage to the capsule (tumour spillage) with the additional risk of port site seeding at the time of removal.<sup>3</sup> While some series at experienced centres have shown no port site seeding, the aggressive nature of primary adrenal carcinomas is evident in later metastases in operative wounds in previous studies of open surgery.<sup>4,5</sup> Laparoscopic surgery is now becoming increasingly established for primary adrenal malignancy and adrenal metastases. However, its efficacy has yet to be proven in any large scale studies.<sup>6,7</sup>

Hand-assisted laparoscopic adrenalectomy potentially addresses and minimizes all of these concerns. The HAL technique provides tactile feedback for large tumours and allows dissection to be kept outside the capsule of the tumour without disruption. The plane of dissection can be visualized very clearly in a magnified fashion on screen. This allows meticulous dissection and the use of laparoscopic energy devices for haemostasis. The hand port also provides the ideal conduit for delivering the adrenal tumour from the abdominal compartment minimizing the risk of tumour spillage and port site seeding. Larger tumours are easier to manipulate providing tactile feedback to ensuring safe dissection and control of larger blood vessels and reducing the need for conversion to open surgery. Finally, the surgeon's fingers and hand can be used to great advantage for retraction, traction and counter traction, without the insertion of additional ports or retractors.

This series aims to demonstrate that hand-assisted laparoscopic adrenalectomy is a safe method for adrenalectomy for large adrenal tumours. HAL is a robust technique to facilitate removal of larger (>5 cm) lesions without risk to the patient and with significant benefits in terms of recovery and has potential oncological benefit as lesions are removed intact.

## 2 | MATERIALS AND METHODS

A single consultant surgeon performed all adrenalectomies in this case series over an 8 year period. All HAL adrenalectomies were performed via a trans peritoneal approach. A total of 13 patients with bilateral lesions were removed through one midline (hand port) incision without conversion. All patients were included and analysed retrospectively. The primary endpoints were efficacy of the procedure, patient outcomes including morbidity and mortality, conversion to open surgery and hospital stay.

All patients with lesions larger than 5 cm were included in the analysis for this study. There were 12 patients with tumours smaller than 5 cm who had adrenalectomy in this time period that were excluded after histology results confirmed lesions smaller than 5 cm. Prior to the procedure, all patients had comprehensive pre-operative general and endocrine secretory assessment to determine whether lesions were functionally active. Radiological imaging in the form of either computed tomography or magnetic resonance imaging was carried out on all patients.

In all patients with a suspected pheochromocytoma, an iodine-123-meta-iodobenzylguanidine (MIBG) scan was performed to localize these lesions and excluded multifocality. Patients with pheochromocytomas were commenced on alpha-adrenergic blockade using oral phenoxybenzamine, and if necessary, additional beta-adrenergic blockade for a minimum of 3 weeks with satisfactory blockade achieved before surgery as per unit protocol. Patient demographics, clinical characteristics and histologically confirmed tumour size were retrospectively collated from a contemporaneously maintained database. Operative time (minutes) was calculated as the start and completion of surgery. In cases with bilateral lesions, patient positioning to allow access to the contralateral lesion was included.

Postoperative complications collated included wound morbidity, infections, hospital acquired pneumonia and an incisional hernia. Wound infections were defined as the development of localized inflammation that required antibiotics between the peri-operative period and at clinic review at 6 weeks.

### 2.1 | Statistical analysis

The data were compiled and analysed using EXCEL 2007. (Microsoft, Richmond, CA, USA). All values are expressed as medians (range) unless otherwise specified. Full institutional permission was obtained for this retrospective study.

### 2.2 | Surgical technique

In all cases, standard laparoscopy was performed and the abdomen was insufflated with CO<sub>2</sub> to a pressure of 12 mm of mercury

(increased to 14 mm in situations where there is difficulty in visualization or in patients with a larger body habitus; Figure 1).

After general laparoscopy to ensure no other undiagnosed co-existent pathology, the technique of dissection is similar to the well-described technique of totally laparoscopic adrenalectomy. In the hand-assisted technique, however, the operator's non-dominant hand is utilized to maximum advantage, to identify the lesion, gauge its characteristics and to aid in tissue dissection and retraction.

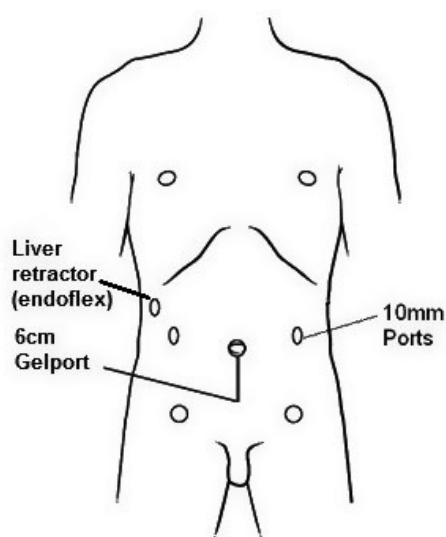
On the left side, the hand is used to retract the splenic flexure of the colon and the spleen during dissection with the Harmonic™ scalpel or Ligasure™. Once the splenic flexure and the spleen are mobilized, the intra-abdominal hand is positioned so that there is a working space within the palm and fingers in which dissection can be safely carried out at the same time digitally identifying the adrenal lesion, defining margins and assisting in the dissection. The plane between the upper pole of the kidney and the adrenal is easily identified using tactile feedback.

On the right side, the hand initially guides the positioning of the liver retractor and the operator's fingers aids in the dissection, particularly in the plane between the inferior vena cava (IVC) and the adrenal lesion. The most crucial area is the apex of the adrenal, which lies on the crus of the diaphragm. The HAL method facilitates retraction of the tumour for complete dissection of the lesion from the IVC and crus of the diaphragm safely, providing tactile benefit over a purely laparoscopic approach (Figure 2).

### 3 | RESULTS

A total of 56 patients with 69 lesions (43 unilateral, 13 bilateral) were included and analysed in this study. All patients with adrenal lesions

#### Position of Hand Ports for Right/Left sided and Bilateral Lesions



Right sided port placement = red  
Left sided port placement = blue

**FIGURE 1** Position of hand ports

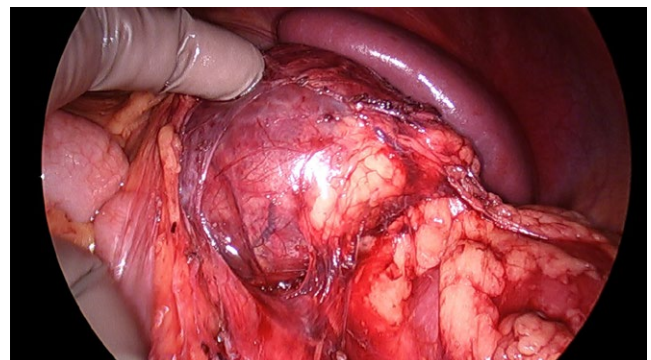
larger than 5 cm on removal were included in this analysis. One patient with recurrent Cushing's disease and bilateral lesions was operated on as a staged procedure with a single side done at six-week intervals due to morbid obesity and significant underlying cardiovascular morbidity. In the group of unilateral lesions, there were 25 left- and 18 right-sided lesions. There were 33 female and 23 male patients. The median age of the group was 52 years (range 17-82).

Histologically, 45 of the 56 patients had benign adrenal tumours. (Table 1). A total of 29 of the benign group were secreting endocrine tumours (15 pheochromocytomas, 10 Cushing's hyperplasia (seven adrenal and three pituitary), two Conn's tumour's, one virilizing tumour and one congenital adrenal hyperplasia).

The other tumours included 16 benign tumours of varied pathology including adenomas (8), paragangliomas (2), a gastro-intestinal stromal tumour (1), adrenal cysts (2), myelolipomas (2) and a focally organized haematoma (1). There were eleven malignant tumours which included 4 primary adrenal cortical carcinomas and 7 secondary metastatic malignancies (6 lung primaries and 1 metastasis from a clear cell renal cancer).

The average length of time for surgery for unilateral lesions was 144 minutes (range 69-287 minutes). For bilateral lesions, the operative time was 258 minutes (range 140-439 minutes) which included patient repositioning (median 30 minutes). This is notable shorter to mean operating time for laparoscopic and open adrenalectomies which are averaged at 189 and 219 minutes, respectively, in retrospective reviews.<sup>8,9</sup> The median tumour size was 8 cm (range 5-19 cm). There was one (1.8%) intra-operative conversion to open surgery due to persistent bleeding in an adrenocortical carcinoma tumour bed after successful HAL removal of the tumour. Open conversion for laparoscopic adrenalectomy also remains low with retrospective reviews averaging 3%-5%.<sup>10,11</sup> The average length of stay was on 6 days (range 2-21 days) which is comparable to a recent evaluation with the National Surgical Quality Improvement Program (NSQIP).<sup>12</sup> Longer patients stay (>10 days) were invariably associated with post-operative complications.

Post operatively, eight (14%) patients had complications. (seven early and one late). This figure is higher than the rate for laparoscopic adrenalectomies (10%) but lower than open adrenalectomies (27%).<sup>13</sup> Early complications included three patients with



**FIGURE 2** Left-sided adrenal tumour below spleen being dissected [Colour figure can be viewed at [wileyonlinelibrary.com](http://wileyonlinelibrary.com)]

**TABLE 1** Pathology results for tumours 5 cm. Pathology results: Number of patients = 56

Adrenal tumours (56)	
Benign (45)	
Functional (29)	
Phaeochromocytoma	15
Cushing	10
Pituitary	(3)
Adrenal	(7)
Conn's	2
Virilizing tumour	1
CAH	1
Non functional (27)	
Adenoma	8
Cyst	2
Myelolipoma	2
Haematoma	1
Paraganglioma	2
GIST	1
Malignant (11)	
Primary	4
Secondary	7

hospital acquired pneumonia (HAP), two patients were treated for intra-abdominal sepsis (based on inflammatory marker rise post-surgery), all of which were successfully treated with antibiotics and did not require further surgical intervention. There were two wound infections during the peri-operative period at the hand port site that again were treated successfully with antibiotics and did not require surgical debridement. Patient follow-up was excellent with 54 (96%) of patients seen. All had made a good recovery although one late complication of a small incisional hernia was noted, which has been managed conservatively at the patients request.

## 4 | DISCUSSION

Experience with adrenalectomy among surgeons in the UK varies with most surgeons dealing with a small number of cases. There are a low number of specialist endocrine referral centres performing higher volumes. The BAETS national audit in 2017 shows 34 surgeons undertaking adrenal surgery with numbers ranging from 1 to 39 cases in 2017. This captures a snapshot of the national profile of adrenal surgery but is not exhaustive. Surgical details cover open or laparoscopic surgery, and if laparoscopic, trans peritoneal or posterior. The postoperative factors considered are reoperation for haemorrhage and complications, namely MI, CVA, respiratory, DVT/PE or other.<sup>14</sup> It is limited by being a non-mandatory reporting process used mainly by endocrine and thyroid surgeons. Adrenal surgery, in contrast, is carried out by a spectrum of subspecialists,

including urologists, and reporting may therefore be variable. This approach to data collation creates challenges in both monitoring of performance and outcomes but also in identifying and providing reproducible training programmes for trainee surgeons. It also provides challenges in establishing a robust and standardized outcome measure.

Due to this relatively sparse and irregular distribution by multi-specialty surgeons, the opportunity to achieve technical competence with a purely laparoscopic approach to adrenalectomy, which has historically been described as the "gold standard" surgical procedure, can be difficult for aspiring adrenal surgeons and surgical trainees except in high volume endocrine surgeons dealing with endocrine surgery. Hand-assisted laparoscopic surgery is a well described and safe laparoscopic access technique used for various procedures but has primarily gained favour in laparoscopic donor nephrectomy for kidney transplantation. The merits of the procedure are minimal access surgery combined with the tactile advantages of the operator's hands in helping with dissection and traction and retraction of the tissue planes, speed of dissection and the ability to exert haemostatic compression in the event of bleeds. In the context of adrenal surgery, it most importantly provides an ability to deal with large lesions that may provide a challenge utilizing a purely laparoscopic approach, particularly in the context of malignant disease processes. The largest lesion in this series was 19 cm in maximum dimension. Removal was achieved without the need for morcellation or reduction in size, but only with an extension of the hand port incision to accommodate the smallest transverse dimension of the tumour. This is facilitated with good anaesthetic relaxation and the fact that the large tumours will mould through smaller extraction incisions. Another advantage is the management of intraoperative haemorrhage with digital pressure, with the reduction of blood loss, while the bleeding point is managed.

A disadvantage with this technique may be the need to reposition the patient in the case of bilateral lesions. However, in this series, there were 13 bilateral lesions with an acceptable time taken for repositioning.

Our series shows that HAL adrenalectomy is a safe and easily reproducible approach that provides significant benefit particularly in the resection of large and malignant adrenal tumours. Our average tumour size (8 cm) is larger than previous laparoscopic studies with most cut-offs at 6 cm.<sup>15-17</sup> This technique therefore provides the opportunity to provide a laparoscopic approach in situations that may not have been previously been widely reported, thereby providing a beneficial surgical technique in these situations. We concur with other authors that it is not the size of the tumour that prohibits safe resection but the adherence to strict oncological surgical principles that is important. However, tumours greater than 6 cm will require a larger incision to extract them, losing the advantage of the pure laparoscopic approach. HAL therefore provides an excellent compromise.

Of the 56 HAL adrenalectomies performed, there have been only one conversion (1.8%) and one recurrence of the original disease to

date. This is comparable to other large laparoscopic studies, some converting to open or hand-assisted techniques due to large sized, malignant tumours or haemorrhage.<sup>18,19</sup> Our one conversion was a right-sided adrenal cortical carcinoma due to haemorrhage from a superior adrenal vein. This patient is currently disease-free three years after surgery after adjuvant chemotherapy.

Our post-operative complication rate was 14% (8), which were all self-limiting. While the early postoperative complications affected patient discharge, most of the patients in this series had significant co-morbidities and social requirements associated with advanced age. This included 4 of the 5 patients treated as post-operative infections (HAP/intraabdominal sepsis). Tumour size is also an independent factor for increased complication rate and thus longer hospital stay.<sup>20</sup>

This paper is limited by its retrospective nature. It is not possible to draw a scientific conclusion on the superiority of this technique over totally laparoscopic or retroperitoneal adrenalectomy without comparative trials. However, the low conversion rate and satisfactory patient outcomes for lesions over 5 cm suggest this is an eminently suitable technique in adrenal surgery.

Hand-assisted laparoscopic adrenalectomy may also offer a shorter learning curve as it offers tactile integration with minimally invasive surgery. This is the largest case series to date on HAL adrenalectomies. HAL offers the benefits of minimally invasive surgery and tactile feedback for the removal of all adrenal tumours including large tumours and those with malignant pathology.

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## CONFLICT OF INTEREST

The authors have stated explicitly that there are no conflict of interests in connection with this article.

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