The role of hand-assisted laparoscopy in urology: a critical appraisal

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INTRODUCTION

Laparoscopic techniques are now part of the standard armoury for extirpative and reconstructive urological procedures. Hand-assisted laparoscopy (HAL) is a variant of laparoscopy; a pneumoperitoneum is created, a laparoscope inserted and laparoscopic instruments used for the surgery, with the only difference between standard laparoscopy and HAL being that the surgeon is able to introduce a hand into the operative field.

The objective of this review is to examine the advantages and disadvantages of the selective use of hand-assistance in laparoscopic urology, and the evidence comparing its efficacy with standard laparoscopic techniques.

HISTORY OF HAL IN UROLOGY

HAL surgery is being widely used in general surgery and gynaecology for colon resections, splenectomy, distal pancreatectomy, partial hepatectomy and hysterectomy [1–4]. In urology, HAL was first introduced in 1996 when Bannenberg *et al.* [5] performed the first HAL nephrectomy in a pig. They reported that HAL nephrectomy was quick and easy, and compared with conventional laparoscopic nephrectomy, the surgery was quicker (30–45 vs 90–120 min). In 1997, Nakada *et al.* [6] performed the first HAL nephrectomy in a human for a chronically infected kidney from stone disease. Since 1997 many investigators have reported their experience with HAL for complex laparoscopic urological procedures, including radical nephrectomy (RN), nephroureterectomy (NU), donor nephrectomy (DN), partial nephrectomy (PN) and cystectomy.

HAND-ASSISTANCE DEVICES

Several devices are commercially manufactured which allow the hand to be introduced into an insufflated abdomen while maintaining the pneumoperitoneum. The Pneumosleeve® (Dexterity Inc., Atlanta, USA) was the first device, introduced in 1997. The Intromit® (Applied Medical, Rancho Santa Margarita, USA) and the HandPort® (Smith and Nephew, Huntingdon, UK) followed shortly thereafter, but all have been discontinued in favour of the three superior 'second-generation' products currently available.

The GelPort® (Applied Medical), based on coaptative gel, is snapped onto an abdominal ring. The LapDisc® (Hakko Ltd, Tokyo, Japan, marketed by Ethicon Endo-Surgery, Bracknell, UK) is based on an the principle of an iris valve creating an airtight seal for the surgeon's hand. Finally, the Omniport® (ASC Limited, Wicklow, Ireland, marketed by TYCO, Gosport, UK) is inflated with air to fix it into place and maintain pneumoperitoneum. All of these devices are effective (Fig. 1), and selection depends on surgeon preference, the patient's habitus and history of previous abdominal surgery.

TECHNIQUE

The patient is placed supine or in a partial (not complete) flank position, and secured to the table by several cloth tapes; the table is then rotated laterally allowing the viscera to fall away inferiorly. One common port configuration for left-sided renal surgery is shown in Fig. 2, and is similar to that used by both the present authors. An assisting port is sometimes placed caudal and well lateral to the camera port. The figure assumes the surgeon is right-handed; for a left-handed surgeon, or for procedures on the right-side, various port-placement schemes are in use [7]. If the surgeon rather than the assistant uses the HAL device, as is most common, then one hand is placed into the operative field and the other used to work the laparoscopic instruments. Some choose to always use the subordinate hand intra-abdominally, freeing up the dominant hand to manipulate laparoscopic instruments, while others vary the inserted hand depending on the operated side. An assistant (or robotic arm) operates the laparoscope. Whatever port configuration is chosen, general principles dictate that the hand should have easy access to the renal hilum while maintaining full flexion/extension at the wrist, and avoid clashing with the laparoscope and/or laparoscopic instruments.

DISCUSSION

Since the first reports of HAL nephrectomy by Nakada *et al.* there have been numerous publications explaining the efficacy and efficiency of the technique. Several comparative studies have been reported, where HAL has been compared with open surgery, standard laparoscopy and retroperitoneoscopy for RN, radical NU and DN.

SIMPLE AND RADICAL NEPHRECTOMY

Nakada *et al.* [8] compared a group of 18 patients who underwent HAL RN with a contemporary cohort who had an open surgical RN. Patients were matched for age, body mass index and American Society of Anesthesiology score. In the HAL group, the mean operating-room time was 220.5 min, the length of stay 3.9 days, the time to return to normal activity 15.8 days, and the time taken to return to work 26.8 days. The median time taken to return to completely normal was 28.0 days. In the open group, the corresponding times were 117.8 min, 5.1 days, 23.5 days, 52.2 days and 150 days; three patients never recovered normal activity. The authors concluded that HAL nephrectomy offers considerable benefits for patient

recovery, at the expense of longer surgery.

Comparing 22 HAL and 16 standard laparoscopic RNs, Nelson and Wolf [9] noted significantly faster surgery with the HAL approach, at 4.5 v 3.4 h. There were no significant differences in analgesic use, time to oral intake, duration of hospital stay or time to full recovery. Three other studies [10–12] comparing HAL and standard transperitoneal laparoscopic RN found no significant improvement in operative time with HAL; however, the comparisons were confounded by issues with case order and previous experience.

Rehman *et al.* [13] reported a series of three patients who had simultaneous HAL bilateral nephrectomy for end-stage renal disease and symptoms resulting from autosomal dominant polycystic kidney disease. The mean operative duration was 5.5 h and mean estimated blood loss 200 mL. Patients resumed oral intake on the first day after surgery, had a mean hospital stay of 4.3 days and returned to normal activity after a mean of 2 weeks. Similar results were reported by Troxel *et al.* [14] for bilateral nephrectomy before renal transplantation.

There is only one reported comparison of the HAL vs the retroperitoneoscopic route for RN, wherein data by Batler *et al.* [15] showed that the HAL approach did not result in a longer time to oral intake or longer hospital stay; in addition, there was no significant difference in narcotic usage or time to normal activity in both groups. The same group published an elegant small study suggesting that HAL RN may be safe when used by urologists with minimal laparoscopic experience [16].

NU

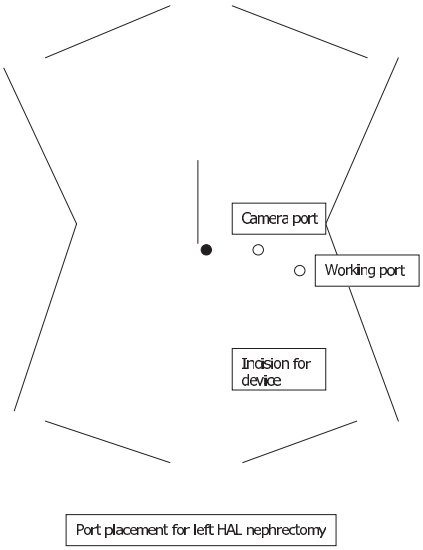
Stifelman *et al.* [17] compared their results of HAL NU in 11 patients with a matched group of contemporary open NUs. The surgery was slower with the HAL approach (mean 291 min for vs 232 min for the open procedure), but the mean blood loss was 144 vs 311 mL, oral narcotic requirement 5.8 vs 16 tablets, and length of stay 4.6 vs 6.1 days for the HAL NU and open groups, respectively.

Seifman *et al.* [18] reported similar results comparing 16 patients who underwent HAL NU with 11 contemporary patients undergoing open surgery. The surgery was slower with the laparoscopic approach (320 vs 199 min) but the hospital stay was 3.9 vs 5.2 days, time taken to resume driving 17.1 vs 37.7 days, and time to achieve normal light activity 18.2 vs 38.1 days, in the HAL NU and open groups, respectively. Minor complications occurred in 19% of laparoscopic and 27% of open surgical procedures. Cancer control was similar in both groups.

In a comparison of 11 standard and 16 HAL NUs performed at the same institution, Landman *et al.* [19] found the latter speeded the surgery by 72 min. Convalescence measures were similar in the two groups, except that the hospital stay was longer after HAL NU (3.3 vs 4.5 days).

FIG. 1. Currently available HAL surgery devices (from top to bottom): GelPort, LapDisc and OmniPort.

FIG. 2. A common port-placement scheme for left HAL nephrectomy by a right-handed surgeon.



DN

Wolf *et al.* [20] performed a randomized controlled trial between HAL DN and open DN, with 50 patients randomly assigned to undergo each (live DN). This trial showed that in the HAL group there was 47% less analgesic use, 35% decrease in inpatient hospital stay, 33% faster return to light activity and 73% less pain at 6 weeks after surgery than in the open group. The HAL DN patients had complete recovery sooner and had fewer long-term residual effects. There were no significant differences in graft function.

Stifelman *et al.* [21] compared 60 patients who had undergone HAL DN with 31 who had had open surgery. The time to patient recovery, blood loss, analgesic use and hospital stay were all less in the HAL DN group, while operative times and complication rates were similar. Again, there were no significant differences in graft function.

Ruiz-Deya *et al.* [22] compared patients who had undergone open surgery, laparoscopic surgery and HAL DN, noting that HAL DN was faster than a conventional laparoscopic

TABLE 1 Published series comparing standard transperitoneal laparoscopic with HALS donor nephrectomy

Ref	N patients, route	Operative duration, min	Warm ischaemia, min	Complications (N)	Conversion (N)	Hospital stay (days)
[22]	11 standard	215	3.9	1/1	0	1.6
	23 HAL	165	1.6	2/0	1	2.0
[23]	11 standard	270	5.0	3/0	0	6.5
	11 HAL	197	3.6	0/0	0	6.2
[24]	40 standard	255	–	–	3	3.2
	60 HAL	260	–	–	1	2.6
[25]	15 standard	276	3.8	1/0	0	2.0
	29 HAL	205	2.4	2/0	1	2.3
[26]	29 standard	311	3.7	5/2	4	4.1
	18 HAL	269	3.4	2/1	1	4.1
[27]	28 standard	306	3.0	0/0	0	2.0
	17 HAL	249	2.0	1/0	0	2.0
Total	134 standard	278*	3.7*	14.2%†	5.2%†	3.1*
	158 HAL	232*	2.5*	8.1%†	2.5%†	2.8*

**weighted mean; †% occurrence of summed totals.*

approach and offered significantly shorter warm-ischaemia times. There were no differences in long-term graft function.

Table 1 summarizes six published comparisons of HAL and standard laparoscopic DN [22–27]. HAL is faster, associated with a shorter warm-ischaemia time, less frequently required conversion to open surgery, had fewer complications, and is followed by a shorter hospital stay. However, in the studies that assessed narcotic use, there tended to be somewhat more postoperative narcotic use or longer duration of convalescence after HAL.

PN

Several centres have reported that HAL PN is safe and reproducible. Stifelman *et al.* [28] performed HAL PN in 11 patients, nine of whom had suspicious lesions and two of whom had duplex systems with nonfunctioning upper moieties. The harmonic scalpel (Ethicon, Cincinnati, Ohio, USA) was used to excise tissue; haemostasis was aided with gel-foam and the argon beam coagulator. The mean operative duration was 273 min and the estimated blood loss 319 mL. Patients resumed oral intake at a mean of 1.7 days and were discharged home in 3.3 days. There was one conversion; no major complications were reported. The average tumour diameter was 1.9 cm and there were no positive surgical margins.

In another study, Wolf *et al.* [29] compared 10 laparoscopic PNs (eight with hand assistance) to a contemporary cohort of 10 who had open PN. Most tumours were peripheral, exophytic and of a similar size (mean 2.4 cm in both groups) Data on patient satisfaction and recovery were obtained via self-administered questionnaires. The mean operative time was 24% longer in the laparoscopic group. However, in the HAL group, there was 62% reduction in parenteral narcotic use, 43% reduction in hospital stay, 64% more rapid return to normal light activity, and improved pain and physical health scores taken at 2 and 6 weeks.

CONTRAINDICATIONS

HAL does not seem to have a niche for any reconstructive procedure. e.g. pyeloplasty or cyst decortication, which can be performed safely and effectively with standard laparoscopic techniques. In young children, during deep pelvic surgery and during retroperitoneoscopy, the hand in the operative field takes up too much working space, making visualization and exposure difficult. Adrenal surgery, and small/hydronephrotic nonfunctioning kidneys, are more effectively addressed by conventional laparoscopic techniques. The main disadvantages of hand-assistance include the reduced working space taken up by the hand, the potential for loss of pneumoperitoneum because of a leaking hand-assistance device, and the cosmetic issues associated with an upper abdominal incision (for left nephrectomy).

CONCLUSION

HAL surgery offers clear advantages over traditional open surgery, including decreased blood loss, pain medication requirement, hospital stay and convalescence. It appears to be at least as effective as conventional laparoscopic techniques, and offers the benefits of proprioception and three-dimensional spatial orientation. In summary, HAL surgery appears to be a safe, reproducible and minimally invasive technique to perform extirpative renal surgery.

CONFLICT OF INTEREST

None declared.

REFERENCES

1 **Pelosi MA, Pelosi MA III.** Hand-assisted laparoscopy for complex hysterectomy. *J Am Assoc Gynecol Laparosc* 1999; **6**: 183–8

2 **Sjoerdsma W, Meijer DW, Jansen A, den Boer KT, Grimbergen CA.** Comparison of efficiencies of three techniques for colon surgery. *J Lap Adv Surg Tech* 2000; **10**: 47–53

3 **Mooney MJ, Elliott PL, Galapon DB, James LK, Lilac LJ, O'Reilly MJ.** Hand-assisted laparoscopic sigmoidectomy for diverticulitis. *Dis Colon Rectum* 1998; **41**: 630–5

4 **Ballaux KE, Himpens JM, Leman G, Van den Bossche MR.** Hand-assisted laparoscopic splenectomy for hydatid cyst. *Surg Endosc* 1997; **11**: 942–3

5 **Bannenberg JJG, Meijer DW, Bannenberg JH, Hodde KC.** Hand-assisted laparoscopic nephrectomy in the pig: initial report. *Minim Invasive Ther Allied Technol* 1996; **5**: 483–7

6 **Nakada SY, Moon TD, Gist M, Mahvi D.** Use of the Pneumo Sleeve as an adjunct in laparoscopic nephrectomy. *Urology* 1997; **49**: 612–3

7 **Lopez-Pujals A, Leveillee RJ.** Trocar

arrangement for HALS. *J Endourol* 2004; **18**: 319–25
8 **Nakada SY, Fadden P, Jarrard DF, Moon TD.** Hand-assisted laparoscopic radical nephrectomy: comparison to open radical nephrectomy. *Urology* 2001; **58**: 517–20
9 **Nelson CP, Wolf JS Jr.** Comparison of hand-assisted versus standard laparoscopic radical nephrectomy for suspected renal cell carcinoma. *J Urol* 2002; **167**: 1989–94
10 **Baldwin DD, Dunbar JA, Parekh DJ *et al.*** Single-center comparison of purely laparoscopic. hand-assisted laparoscopic, and open radical nephrectomy in patients at high anesthetic risk. *J Endourol* 2003; **17**: 161–7
11 **Hayakawa K, Aoyagi T, Ohashi M, Hata M.** Comparison of gas-less laparoscopy-assisted surgery, hand-assisted laparoscopic surgery and pure laparoscopic surgery for radical nephrectomy. *Int J Urol* 2004; **11**: 142–7
12 **Okeke AA, Timoney AG, Keeley FX.** Hand-assisted laparoscopic nephrectomy: complications related to the hand-port site. *BJU Int* 2002; **90**: 364–7
13 **Rehman J, Landman J, Andreoni C *et al.*** Laparoscopic bilateral hand assisted nephrectomy for autosomal dominant polycystic kidney disease: initial experience. *J Urol* 2001; **166**: 42–7
14 **Troxel S, Das S.** Hand-assisted laparoscopic approach to multiple-organ removal. *J Endourol* 2001; **15**: 895–7
15 **Batler RA, Campbell SC, Funk JT, Gonzalez CM, Nadler RB.** Hand assisted versus retroperitoneal laparoscopic nephrectomy. *J Endourol* 2001; **15**: 899–902
16 **Batler RA, Schoor RA, Gonzalez CM, Engel JD, Nadler RB.** Hand assisted radical nephrectomy. the experience of the inexperienced. *J Endourol* 2001; **15**: 513–5
17 **Stifelman MD, Hyman MJ, Shichman S, Sosa RE.** Hand-assisted nephroureterectomy versus open nephroureterectomy for the treatment of transitional cell carcinoma of the upper tract. *J Endourol* 2001; **15**: 391–5
18 **Seifman BD, Montie JE, Wolf JS.** Prospective comparison between hand-assisted laparoscopic and open surgical nephroureterectomy for urothelial cell carcinoma. *Urology* 2001; **57**: 133–7
19 **Landman J, Lev R, Bhayani S *et al.*** Comparison of hand assisted and standard laparoscopic radical nephroureterectomy for the management of localized transitional cell carcinoma. *J Urol* 2002; **167**: 2387–91
20 **Wolf JS Jr, Merion RM, Leitchman AB *et al.*** Randomized controlled trial of hand-assisted laparoscopic versus open surgical live donor nephrectomy. *Transplantation* 2001; **72**: 284–90
21 **Stifelman MD, Hull D, Sosa E *et al.*** Hand assisted laparoscopic donor nephrectomy: a comparison with the open approach. *J Urol* 2001; **166**: 444–8
22 **Ruiz-Deya G, Cheng S, Palmer E, Thomas R, Slakey D.** Open donor, laparoscopic donor and hand assisted laparoscopic donor nephrectomy: a comparison of outcomes. *J Urol* 2001; **166**: 1270–4
23 **Lindstrom P, Haggman M, Wadstrom J.** Hand-assisted laparoscopic surgery (HALS) for live donor nephrectomy is more time- and cost-effective than standard laparoscopic nephrectomy. *Surg Endoscopy* 2002; **16**: 422–5
24 **Velidedeoglu E, Williams N, Brayman KL *et al.*** Comparison of open, laparoscopic, and hand-assisted approaches to live-donor nephrectomy. *Transplantation* 2002; **174**: 169–72
25 **Gershbein AB, Fuchs GJ.** Hand-assisted and conventional laparoscopic live donor nephrectomy: a comparison of two contemporary techniques. *J Endourol* 2002; **16**: 509–13
26 **Mateo RB, Sher L, Jabbour N *et al.*** Comparison of outcomes in noncomplicated and in higher-risk donors after standard versus hand-assisted laparoscopic nephrectomy. *Am Surg* 2003; **69**: 771–8
27 **El-Galley R, Hood N, Young CJ, Deierhoi M, Urban DA.** Donor nephrectomy. A comparison of techniques and results of open, hand assisted and full laparoscopic nephrectomy. *J Urol* 2004; **171**: 40–3
28 **Stifelman MD, Sosa RE, Nakada SY, Shichman SJ.** Hand assisted laparoscopic partial nephrectomy. *J Endourol* 2001; **15**: 161–4
29 **Wolf JS, Seifman BD, Montie JE.** Nephron sparing surgery for suspected malignancy. Open surgery compared to laparoscopy with selective use of hand assistance. *J Urol* 2000; **163**: 1659–64

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Abbreviations: **HAL**, hand-assisted laparoscopy; **NU**, nephroureterectomy; **RN**, **DN**, **PN**, radical, donor, partial nephrectomy.