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Defining the role for robotics in endocrine surgery – benefits and challenges

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Robotic surgery has become an integral tool in many surgical specialties and may soon become the standard for minimally invasive surgery. Despite the lack of clear level 1 evidence supporting robotic surgery as the first line approach, and the associated costs, there is significant evidence reporting on the perceived benefits of robotics including three-dimensional vision, stable platform and increased precision.[1] The benefits to the patients include shorter length of stay, less blood loss, and fewer complications; with surgeon reported benefits of less musculoskeletal injury providing further support for the role of robotic surgery. These findings are consistent across many surgical specialties.[2, 3] In the United Kingdom, compared to the exponential adoption in other surgical specialties, the uptake of robotics in endocrine surgery is poor.

Endocrine surgery was one of the first surgical specialties to embrace minimally invasive surgery with the first laparoscopic adrenalectomy performed by Michel Gagner over 30 years ago.[4] In his early experience, Gagner reported that patients experienced less postoperative pain and quicker return to normal activities. More recently, minimally invasive approaches have been described for thyroid surgery. These approaches performed either through the axilla or through the mouth have similar outcomes compared to traditional thyroid surgery without the cosmetic issues of a scar on the neck. With robotic surgery supplanting laparoscopy in most surgical specialties, what is the role for robotics in endocrine surgery?

Robotic adrenal surgery

Several authors have reported the benefits of robotics in adrenal surgery. Gan *et al* in their systematic review of 11 studies reported that robotic adrenal surgery resulted in less blood loss, reduced length of stay, and lower risk of conversion to open surgery, with similar operative times. Robotic surgery was better than laparoscopy for patients with phaeochromocytomas.[5] Similar to laparoscopic adrenalectomy, robotic approaches to the adrenal gland are safe with low conversion rates and complications.[6, 7] Data extracted from a large European database also found that robotic adrenalectomy resulted in lower complication rates and shorter length of stay.[8] Obese patients benefit from a robotic approach with Brunaud et al[9] reporting shorter operative times in patients with BMI >30kg/m2. However, others have reported no difference in complications, conversions or blood loss.[10]

Other advantages to patients include those with large tumours who have shorter operating times and lower rates of conversion, with a particular benefit in tumours greater than 8cm in diameter. [11] The above advantages are likely due to the magnified view but also the articulated instruments that allow more precise and quicker dissection.[12] Robotic adrenal surgery used in combination with fluorescence techniques with inbuilt Firefly also facilitates partial adrenalectomy. Partial adrenalectomy is an approach used in patients with bilateral lesions where there is a desire to avoid steroid dependency. Using ICG which accumulates in the adrenal cortex, combined with the 3D view and precision of the robot, can facilitate partial adrenalectomy of medullary lesions particularly in patients with hereditary phaeochromocytomas.[13]

There are few endocrine surgeons in the UK performing robotic adrenalectomy, with most operations done by urological surgeons. The author of the present review started his robotic experience in 2022 and to date has performed over 50 robotic adrenalectomies. The evidence for the benefit of robotic over laparoscopic adrenal surgery as demonstrated in the literature has been replicated in the author's early experience, such as reduced risk of conversion, complications, and shorter length of stay for obese patients, large tumours and phaeochromocytomas. De Crea *et al* evaluated the cost effectiveness of robotic adrenal surgery in their single centre.[14] They reported that the procedure was more expensive than conventional laparoscopy, but this cost

was offset by the reduction in the length of stay. They also reported that the procedure was more cost effective in institutions performing more than 500 cases and the benefits were significant in obese patients, phaeochromocytomas and large tumours.

In the UK, adrenal surgery is offered not only by endocrine surgeons, but also by urologists and general surgeons. The British Association of Endocrine and Thyroid Surgeons recommends that surgeons performing adrenal surgery should perform a minimum of 6 operations per year.[15] Those performing surgery for phaeochromocytomas, and adrenal cancer should operate on at least 20 patients. In 2016, 795 adrenalectomies were performed by 222 surgeons with only 36 surgeons performed >6 adrenalectomies.[16] One of the barriers to the uptake of robotic adrenal surgery may be the low volume of operations performed by most surgeons. It is possible that with centralisation and increased volume of operations, adoption of robotics among endocrine surgeons will improve.

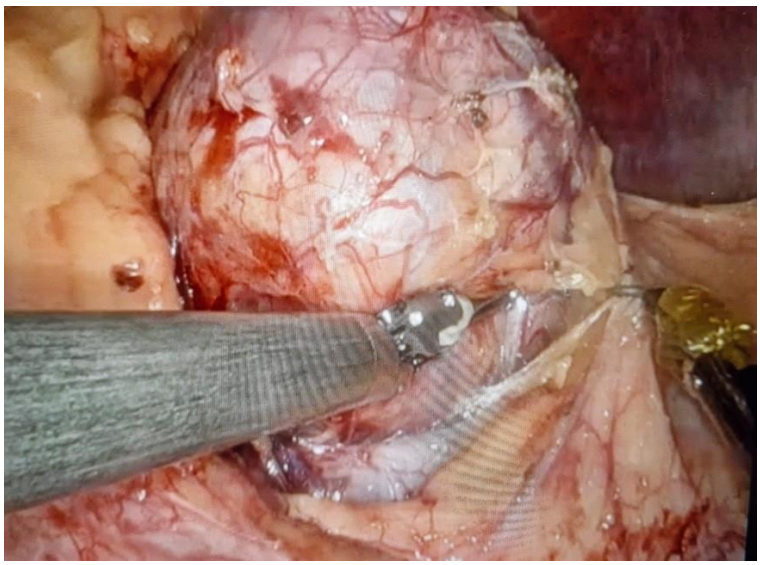

Figure 1. Robotic left adrenalectomy for 7cm phaeochromocytoma with left renal vein dissected at the inferior aspect

Robotic thyroid surgery

Robotic thyroid surgery has been pioneered in Asian countries where scars on the neck are a cultural taboo. Authors from these countries report on much higher cosmetic satisfaction scores compared to open thyroidectomy.[17-19] In Europe, robotic thyroid surgery is performed by endocrine surgeons in selected centres with the approach limited to slim patients with small unilateral nodules. Authors report that the approach is safe and feasible in these selected patients.[20] Again, the authors note similar outcomes without the need for a scar on the neck but at additional cost, and with some reporting on a longer operative time compared to conventional open thyroidectomy.[21] In the UK, patients infrequently complain of a scar on their neck and therefore the value of a robotic approach through the axilla or mouth is questionable.

One of the barriers to robotic approaches to thyroid gland include the steep learning curve required to perform the operation safely, and the cost. A study from Europe using cumulative sum analysis suggested a single surgeon without previous robotic experience required a learning curve of at least 66 procedures to become proficient.[22] It is possible that endocrine surgeons with prior robotic experience may require a shorter learning curve but will still require a large volume of cases to gain competency. With both endocrine and ENT surgeons performing thyroid surgery in the UK, combined with limited access to the robotic platform, the issues of who should be performing these operations will arise.

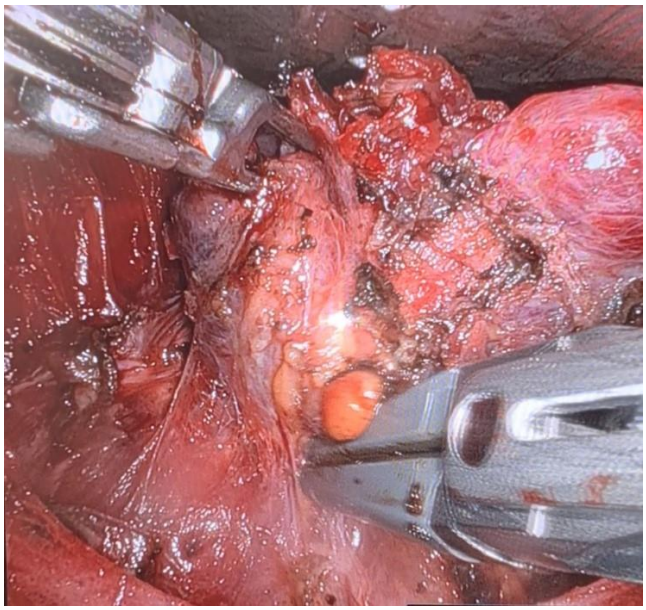

Figure 2: Robotic left thyroid lobectomy via the transaxillary approach. Superior view demonstrating easy identification of the parathyroid gland at the tip of the vessel sealer.

Robotic surgery is now the standard of care for many specialties in the United Kingdom with good outcomes for patients and surgeons. Surgical specialties such as colorectal and upper gastrointestinal surgery have well established programmes and training pathways that benefit experienced surgeons and trainees interested in robotics. These pathways are well supported by the robotic companies. There are challenges with access to the robot and endocrine surgeons will have to compete with other specialties to afford their patients the benefits of this new and innovative technology. Training in robotic surgery is also very limited for endocrine surgical trainees as there are a limited number of Trusts within the UK that offer robotic adrenal or thyroid surgery. Establishing robotic endocrine surgery units within tertiary level hospitals, combined with centralisation, can aid in the training of surgeons in robotics and ensure better outcomes for patients.

There is a promising role for robotics in endocrine surgery, however the evidence base and training pathways need to be clearly established. The role of robotic thyroid surgery in a UK is less defined. Regarding robotic adrenal surgery, there is evidence from the literature that obese patients, those with phaeochromocytomas and large tumours do benefit with fewer complications, reduced length of stay, and fewer conversions.

References

1. Ruiz MG, Escribano ML, Fernández CC, Poch LC, Martínez SS. Robotic surgery for colorectal cancer. Annals of Gastroenterological Surgery [Internet]. 2020 [cited 2021 Mar 11];4(6):646–51.

2. Sivathondan P, Jayne D. The role of robotics in colorectal surgery. Annals of The Royal College of Surgeons of England [Internet]. 2018 Sep 1;100(Suppl 7):42–53. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6216750/

3. Chaudhury M, Johnson J, Pursnani K, Turner P. P-OGC31 Robotic Upper GI Surgery: Is it Feasible, Safe and Can it Improve Patient Outcomes? British Journal of Surgery. 2021 Dec 1;108(Supplement_9).

4. Gagner M. Laparoscopic adrenalectomy in Cushing's syndrome and pheochromocytoma. N. Engl. J. Med.. 1992;327:1033.

5. Gan L, Peng L, Li J, Meng C, Li K, Wu J, et al. Comparison of the effectiveness and safety of robotic-assisted and laparoscopic in adrenalectomy: A systematic review and meta-analysis. International Journal of Surgery. 2022 Sep;105:106853.

6. Heger P, Probst P, Hüttner FJ, Gooßen K, Proctor T, Müller-Stich BP, et al. Evaluation of Open and Minimally Invasive Adrenalectomy: A Systematic Review and Network Meta-analysis. World Journal of Surgery. 2017 Jun 20;41(11):2746–57.

7. Tang K, Li H, Xia D, Yu G, Guo X, Guan W, et al. Robot-assisted versus laparoscopic adrenalectomy: a systematic review and meta-analysis. Journal of Laparoendoscopic & Advanced Surgical Techniques Part A [Internet]. 2015 Mar 1 [cited 2022 Mar 6];25(3):187–95. Available from: https://pubmed.ncbi.nlm.nih.gov/25763475/

8. Vatansever S, Nordenström E, Raffaelli M, Brunaud L, Makay Ö, EUROCRINE Council. Robot-assisted versus conventional laparoscopic adrenalectomy: Results from the EUROCRINE Surgical Registry. Surgery [Internet]. 2022 May 1 [cited 2023 Dec 18];171(5):1224–30. Available from: https://pubmed.ncbi.nlm.nih.gov/35027208/

9. Brunaud L, Bresler L, Ayav A, Zarnegar R, Raphoz AL, Levan T, et al. Robotic-assisted adrenalectomy: what advantages compared to lateral transperitoneal laparoscopic adrenalectomy? The American Journal of Surgery. 2008 Apr;195(4):433–8.

10. Agcaoglu O, Akbas M, Ozdemir M, Makay O. The Impact of Body Mass Index on Perioperative Outcomes of Robotic Adrenalectomy: An Update. Surgical Innovation. 2019 Jun 27;26(6):687–91.

11. Agcaoglu O, Aliyev S, Karabulut K, Mitchell J, Siperstein A, Berber E. Robotic versus laparoscopic resection of large adrenal tumors. Annals of Surgical Oncology [Internet]. 2012 Jul 1 [cited 2022 Aug 17];19(7):2288–94. Available from: https://pubmed.ncbi.nlm.nih.gov/22396002/

12. Teo XL, Lim SK. Robotic assisted adrenalectomy: Is it ready for prime time? Investigative and Clinical Urology. 2016;57(Suppl 2):S130.

13. Colvin J, Zaidi N, Berber E. The utility of indocyanine green fluorescence imaging during robotic adrenalectomy. Journal of Surgical Oncology. 2016 May 18;114(2):153–6.

14. De Crea C, Arcuri G, Pennestrì F, Paolantonio C, Bellantone R, Raffaelli M. Robotic adrenalectomy: evaluation of cost-effectiveness. Gland Surgery. 2020 Jun;9(3):831–9.

15. Palazzo F, Dickinson A, Phillips B, Sahdev A, Bliss R, Rasheed A, et al. Adrenal Surgery Practice Guidance for the UK [Internet]. Available from: https://www.baets.org.uk/wp-content/uploads/Adrenal-Surgery-Practice-Guidance-for-the-UK-2016.pdf

16. Palazzo F, Dickinson A, Phillips B, Sahdev A, Bliss R, Rasheed A, Krukowski Z, Newell-Price J. Adrenal surgery in England: better outcomes in high-volume practices. Clin Endocrinol (Oxf). 2016 Jul;85(1):17-20. doi: 10.1111/cen.13021. Epub 2016 Feb 15. PMID: 26776382.

17. Kang YJ, Cho JH, Stybayeva G, Hwang SH. Safety and Efficacy of Transoral Robotic Thyroidectomy for Thyroid Tumor: A Systematic Review and Meta-Analysis. Cancers [Internet]. 2022 Jan 1 [cited 2023 Aug 15];14(17):4230. Available from: https://www.mdpi.com/2072-6694/14/17/4230

18. Xing Z, Qiu Y, Abuduwaili M, Xia B, Fei Y, Zhu J, et al. Surgical outcomes of different approaches in robotic assisted thyroidectomy for thyroid cancer: A systematic review and Bayesian network meta-analysis. International Journal of Surgery (London, England) [Internet]. 2021 May 1 [cited 2023 Oct 1];89:105941. Available from: https://pubmed.ncbi.nlm.nih.gov/33864953/

19. Shen H, Shan C, Qiu M. Systematic Review and Meta-Analysis of Transaxillary Robotic Thyroidectomy Versus Open Thyroidectomy. Surgical Laparoscopy, Endoscopy & Percutaneous Techniques. 2014 Jun;24(3):199–206.

20. Piccoli M, Mullineris B, Santi D, Gozzo D. Advances in Robotic Transaxillary Thyroidectomy in Europe. Current Surgery Reports [Internet]. 2017 Jun 26;5(8). Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5488127/

21. Kandil E, Mohammed A, Walvekar RR, Hu T, Hammad Masoodi, Salah Eldin Mohamed, et al. Robotic Thyroidectomy Versus Nonrobotic Approaches. Surgical Innovation. 2015 Nov 2;23(3):317–25.

22. Materazzi G, Papini P, Fregoli L, Morganti R, Andrea De Palma, Carlo Enrico Ambrosini, et al. The learning curve on robot-assisted transaxillary thyroidectomy performed by a single endocrine surgeon in a third-level institution in Europe: a cumulative sum (CUSUM) analysis. Updates in Surgery. 2023 Aug 2;75(6):1653–60.