Journal of Surgical Techniques and Procedures

Review Article
Published: 19 Feb, 2025

What are the Benefits and Costs of Current and Future Colorectal Surgery

Jose Manuel Devesa[1], Rosana Vicente[1], Araceli Ballestero[2] and Gervasio Salgado[1]*

[1]*Hospital Ruber Internacional, Madrid, Spain*

[2]*University Hospital Ramon y Cajal, Madrid, Spain*

Introduction

Partial or total proctocolectomy represents a particular standard for surgical intervention in specific colorectal disease. In this article we attempt to explore the cost-benefit relationship of these types of procedures from the 3 available perspectives of open, laparoscopic and robotic surgery.

The Hungarian physicist von Neumann once remarked, "For progress there is no cure [1]." In the field of colorectal surgery, technological advances have guided an increasing number of surgeons to adopt laparoscopic techniques giving way to robotic surgery [2-5]. As robots begin to incorporate artificial intelligence, the role of the surgeon may shift even further from a hands-on operator to a robotic technician, with expertise in abdominal and pelvic anatomy focusing on the design of procedures that primarily integrate 3D reconstructions.

This evolution-revolution has the potential to result in a significant diminution in the future operative skills. Many may find themselves completely ill-equipped for hands-on practice. Progress relies on technological innovation which demands a substantial financial investment and incentive. This reality has important implications for those burdening the healthcare system by imposing different demands on those countries with limited available resources [4-9].

In the United States, for example, the cost of open surgery ranges from between $6,500 to $20,000, whereas laparoscopic surgery may cost between $9,000 and $114,853. By contrast, robotic surgery generally escalates the overall costs depending on whether all charges such as the surgical fees, the location and specific characteristic features of the hospital, etc., are included in the estimates. The main factors influencing the costs of robotic surgery include the impact of the advanced technology itself along with the fees charged by hospitals and surgeons [4,5,7-9]. Excluding these fees, the average cost of uncomplicated open and laparoscopic colectomy in one of Spain's most prestigious private hospitals is around €17,450, with robotic surgery costing approximately €26,000 for the same procedure. This cost can vary considerably in the same country or even in the same region amongst the different hospital centers. In this regard, the pressing concern revolves around whether these expensive colorectal surgeries are justified and how best to balance the technological costs with the patient benefit, the expertise of the surgeon and the capacity of the particular healthcare system [6,10-13].

Currently, we lack comprehensive data from large-scale studies involving a single surgeon who performs a mix of open, laparoscopic and robotic surgeries for the same condition. Moreover, there is no documented experience of surgeries that have been conducted solely by robots. Consequently, we can only speculate as to the advantages of each technique over the others in colorectal resections.

In colectomy, the benefits of laparoscopic and robotic techniques primarily stem from their smaller incisions, which can decrease the risk of ventral hernias, reduce pain and minimize anastomotic leaks, which clearly result in a shorter hospital stay. The complication rates for both minimally invasive methods are generally comparable and the same for colon and rectum, with some reported evidence suggesting that a robotic colectomy has a slightly lower risk of anastomotic leak, when compared with either laparoscopic colectomy or open surgery [10-15]. That's probably because they are less invasive and surgeons have better technical skills. In turn, robotic colectomy has been shown to have certain advantages over conventional laparoscopy in terms of precision and control, with superior visualization making it easier to identify critical areas during surgery. But it's not a massive difference, and it would appear that the surgical expertise is paramount. Patients with pre-existing conditions, such as diabetes, bowel inflammation, or cancer, tend to experience more leaks irrespective of the method employed.

OPEN ACCESS

Correspondence:
José Manuel Devesa, Hospital Ruber International, Calle La Masó 38, 28034, Madrid, Spain, Tel: +34 609007348; E-mail: jmanueldevesa@telefonica.net

Received Date: *04 Feb 2025*
Accepted Date: *17 Feb 2025*
Published Date: *19 Feb 2025*

Citation:
Devesa JM, Vicente R, Ballestero A, Salgado G. What are the Benefits and Costs of Current and Future Colorectal Surgery. J Surg Tech Proced. 2025; 9(1): 1075.

When robots become fully integrated with artificial intelligence, the role of the surgeon may well evolve from a hands-on practitioner to one of a robotic technician. In the future, surgeons, although experts in abdominal and pelvic anatomy and in formulating the layouts of complex reconstructions, will not possess genuine operative skills since training in open and laparoscopic procedures could potentially be omitted from their standard education. This would lead to a critical decline in the number of colorectal surgeons capable of operating.

Progress in the field, evidently, stems from technological advances requiring complex and detailed financial backing incentives. This has profound implications that could overwhelm some countries, let alone regions and individual tertiary institutions. Concerning the regional variability in projected costs, the fundamental reason for higher expenses is the demand robotic surgery places upon high-tech resources.

If indeed we show that these additional economic outlays are worthwhile for individual healthcare systems, this will only be achieved by conducting formal cost-benefit analyses and more studies that assess individual surgical performance. A prospective analysis will need to be made of the effectiveness of robots capable of completing procedures after an initial surgical set-up with these new applications using computer algorithms and sensor systems to independently construct anastomoses. The cost of these autonomous robotic systems may presently appear prohibitive, however, with time, costs will reduce combined with the potential of reduced hospital stay and complications that might make these sorts of advances feasible in selected environments [10, 15]. In the context of public healthcare, in the coming future, despite the high cost of robotic technology, some of the expense outlay could be potentially mitigated by running a fully operational 24/7 system which will have a spin-off impact on savings around staffing and derivative costs, which could be obviated by reductions in morbidity and repeat interventions and hospital readmissions.

When examining anal surgery there is presently no justification for the use of sophisticated costly techniques for the management of haemorrhoids or anal fistulae for example. With these types of procedures there is currently no available evidence demonstrating superior outcomes using advanced technologies when compared with traditional techniques and simple comparatively inexpensive instruments. Rubber band ligation of haemorrhoids alleviates symptoms in a large proportion of patients at low cost. For those who need more aggressive treatment, the submucosal laser haemorrhoidectomy remains an optimal ambulatory procedure that is effectively painless and which achieves excellent results. Similar considerations are applicable to the management of anal fistulas, which can be successfully treated with an endofistular laser [16-18] A recent study (19) showed healing of fistulae with anti-inflammatory treatment.

We could consider an exception to this view applies in the surgery for functional disorders like anal incontinence. In this case sacral neuromodulation has consistently been shown to provide significantly better results than sphincter plication in patients with denervated sphincters, whilst sphincteroplasty remains the first-line treatment for anatomically damaged sphincters, allowing at least half of the patients to regain continence at a very low cost and with few complications. When sacral neuromodulation is unaffordable or when it fails, anal encirclement can be accomplished by reinforcing the damaged or absent sphincters with a simple elastic band. This procedure is currently under clinical evaluation; however, it permits the re-establishment of a good or very good continence status in a significant proportion of patients at low cost [20].

With the introduction of any new technology, on the matter of cost, important linked aspects need to be taken into account. These include the national economy, the caregiving characteristics and standards of specialist facilities within any given hospital and the place of an institution. Such a future might contain 4 distinct types of colorectal specialist surgeons including traditionalists, laparoscopists, robotic specialists and colorectal robots. Each of these will be aided by assistants who are trained in abdominopelvic anatomy and by others who could also engage in instrument and technological design geared to the operating room. Traditionalists will remain the fluent link to open surgery, with the laparoscopists mastering the gamut of laparoscopic techniques but who will also retain their ability to perform open surgery when necessary. Robotic surgeons will most likely perform the bulk of surgical coloproctology, conducting both laparoscopic and robotic procedures although they might on occasion need to defer to a traditionalist when indicated. The colorectal robot after initial set-up will function autonomously in the conduct of low anterior resections and anastomotic procedures. Even though they are surgically differentiated, each of these groups (apart from the robots themselves) maintains a common cause, to help patients in an holistic approach towards their care. This still remains in a sense *Deus ex machina* as something that robots are incapable of doing. For our patients, a colorectal tumour is much more than its mass. It is a disease that initiates a cascade of homeostatic alterations in many systems, beginning with a dysregulation of the local and then the systemic inflammatory and immune responses and extending to the other end of the reactive spectrum to influence the psychological receptiveness towards the disease itself [21].

The best possible allocation of the technological and instrumental tools available to the right hospital environment combined with a rational allotment of the different types of colorectal surgeons could make seemingly immense health care investments for the future not only affordable but equitable. Neumann's remarks on the lack of cure for progress still remain prescient. Only then will the colorectal surgery of the future become the art of the possible.

Acknowledgements

The authors wish to thank Andrew Zbar for a critical review of this manuscript.

References

1. Von Neumann J. "Can we survive technology?" Reprinted from John von Neumann Collected Works, ed. A. Taub, Vol. VI, pp. 504-519 (6 vols) 1963.
2. Trinh BB, Jackson NR, Hauch AT, Hu T, Kandil E. Robotic versus Laparoscopic Colorectal Surgery. JSLS. 2014;18(4):00187.
3. García-Granero A, Bravo-Salva A. *Cirugía robótica: cómo, cuándo y por qué*. Cir Andal. 2021;32(3):153-160.
4. Vasudevan V, Reusche R, Wallace H, Kaza S. Clinical outcomes and cost-benefit analisis comparing laparoscopic and robotic colorectal surgeries. Surg Endosc. 2016; 30(12): 5490-3.
5. Ielpo B, Duran H, Diaz E, Fabra I, Caruso R, Malavé LF, et al. Robotic versus laparoscopic surgery for rectal cancer: a comparative study of clinical outcomes and costs. Int J Colorectal Dis. 2017;32(10): 1423-9.
6. Zelhart M, Kaiser AM. Robotic versus laparoscopic versus open colorectal

surgery: towards defining criteria to the right choice. Surg Endosc. 2018;32(1):38.

7. Simianu VV, Gaertner WB, Kuntz K, Kwaan MR, Lowry AC, Madoff RD et al. Cost-effectiveness Evaluation of Laparoscopic Versus Robotic Minimally Invasive Colectomy. Ann Surg. 2020; 72(2): 333-41.
8. Ng AP, Sanaiha Y, Bakhtiyar SS, Ebrahimian S, Branche C, Benharash P. National analysis of cost disparities in robotic-assisted versus laparoscopic abdominal operations. Surgery. 2023; 173(6):1340-1345.
9. Ferri V, Quijano Y, Nuñez J, Caruso R, Duran H, Diaz E, et al. Robotic-assited right colectomy versus laparoscopic approach: case-matched study and cost-effectiveness analysis. J Robot Surg. 2021; 15(1):115-23.
10. Keller DS, Senagore AJ, Lawrence JK, Champagne BJ, Delaney CP. Comparative effectiveness of laparoscopic versus robot-assisted colorectal resection. Surg Endosc. 2014;28(1):212-21.
11. Kawka M, Fong Y, Gall TMH. Laparoscopic versus robotic abdominal and pelvic surgery: a systematic review of randomised controlled trials. Surg Endosc. 2023; 37:6672-81.
12. Kumar A, Kaur S. Robotic-assisted colectomy: A review of the literature. J Robot Surg. 2020;14(3): 345-52.
13. Kumar S, Kaur S. Laparoscopic versus open colectomy: A systematic review and meta-analysis of outcomes. JMAS. 2018;14(3): 185-92.
14. Kiran RP, Kauffman HM. Anastomotic leak after colorectal surgery: A review of the literature. J Gastrointest Surg. 2015; 19(1): 1-10.
15. García J, López M. Incidencia de fístula anastomótica en cirugía abierta de colon: un estudio retrospectivo. Rev Cir Dig. 2021;45(2):123-130.
16. Ram E, Kayzer M, Zager Y, Anteby R, Nachmany I, Carter D, et al. Laser hemorrhoidoplasty for II-IV grade hemorrhoids: should we treat them the same? Updates Surg. 2023;75(3): 635-42.
17. Zhi Zheng Tan V, Peck E, Sivarajah SS, Tan WJ, Ho LML, Ng J-L, et al. Systematic review and meta-analysis of postoperative pain and symptoms control following laser haemorrhoidoplasty versus Milligan-Morgan haemorrhoidectomy for symptomatic haemorrhoids: a new standard. Int J Colorectal Dis. 2022;37: 1759-1771.
18. Öztürk E, Gülcü B. Laser Ablation of Fistula Tract: A Sphincter-Preserving Method for Treating Fistula-in-Ano. Dis Colon Rectum. 2014; 60:360-4.
19. Litta F, Papait A, Lucchetti D, Farigu S, Parello A, Ricciardi C, et al. The pathogenesis of cryptoglandular anal fistula: new insight into the immunological profile. Colorectal Dis. 2022; 24:1567-75.
20. Devesa JM, Vicente R, Ballestero A. Anal incontinence: encirclement with a new medical device. Tech Coloproctol 2025 (in press).
21. Devesa JM, Zbar AP, Pescatori M, Ballestero A. Whither the coloproctologist of the future? Returning to the kindred spirit of the barber- surgeon. Tech Coloproctol. 2024;28(1):26.