Paving the way towards cost-effective robotic surgical stapling

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Alongside with the introduction of endoscopic trans-anal surgical techniques, the main current technical innovation in the field of minimally invasive colorectal surgery has been the introduction of robotic surgery. It is hypothesized that yet to be demonstrated (1) clinical outcomes associated with robotic colorectal surgery may derive from a stable high-definition three-dimensional view, high degree of instrument articulation, and superior ergonomics.

When it comes to restore intestinal continuity after colorectal resections, anastomotic failures remain the most important concern. Anastomotic failure following left colonic resection is associated with increased morbidity and mortality. The incidence of anastomotic failure may reach 11% and it has been demonstrated not to be responsive to advances in operative techniques or stapling technology (2). Morbidity and mortality derived from anastomotic fistulas may be significant for patients undergoing elective colorectal cancer surgery, especially for older patients harboring rectal lesions (3). Moreover, anastomotic infectious complications harbor a negative prognostic impact on local recurrence and long-term cancer specific survival after restorative colorectal cancer resections (4,5).

Although it is our belief that no patient harboring benign or malignant colorectal conditions should be denied the advantages of a minimally invasive approach (6), the issue of endoscopic surgical stapling in colorectal surgery remains cumbersome. Although laparoscopic surgical staplers are articulated, maneuverability is compromised particularly during rectal surgery. Limitations usually derive from a less than desirable flexion of the equipment tip, excessive large cartridges, and finally, due to the fulcrum effect at the trocar level characteristic of laparoscopic surgery.

Holzmacher *et al.* (7) have recently published an unprecedented study comparing the performance of robotic and laparoscopic stapling during robotic-assisted colorectal operations. They have studied immediate surgical outcomes and cost in both groups. In their single-center retrospective review, they have analyzed 93 patients undergoing robotic-assisted operations with intestinal anastomosis (right-sided and transverse colon lesions were excluded). In this same-surgeon experience, laparoscopic or robotic linear staplers loading a 45-mm cartridge were used for intestinal reconstruction in 58 and 35 patients, respectively. The authors have reported no difference between groups regarding demographic data or complications rate. Interestingly, more stapler fires per patient were observed in the laparoscopic than in the robotic group (2.69 *vs.* 1.86; P=0.001) resulting in a higher direct cost associated to stapler devices ($631.45 *vs.* 473.28; P=0.001) in the laparoscopic stapling group.

Robotic linear stapling still does not prevent complications related to the lack of haptic feedback. However, using a linear robotic stapler, the surgeon is currently capable of evaluating tissue thickness based on stapler clamp completion. With the Da Vinci® robotic system SmartClamp™ technology, a computerized feedback of the staple jaws closure is enabled in order to determine if there is adequate staple closure according to the cartridge previously chosen by the surgeon. Moreover, the robotic stapler is fully controlled by surgeon's hands at the console and provides fully wristed articulation. Ultimately, robotic staplers have a wide 108° side-to-side and 54° up-anddown articulation, leading to a potentially more precise positioning particularly in the deep pelvis.

In spite of the operational advantages of robotic over laparoscopic linear stapling devices, to demonstrate superior clinical outcomes associated with robotic stapling represents a challenging task. In 2008, Ito *et al.* (8) first suggested that the number of stapler firings during laparoscopic surgery increases the risk of colorectal anastomotic leak in a multivariate analysis. Kim *et al.* (9) confirmed this finding in a univariate analysis having also demonstrated that the number of stapler firings was significantly increased in men and in patients harboring rectal cancer at a lower level. As reported by Holzmacher *et al.* (7), it is a significant achievement that patients being operated on using a robotic-assisted approach may benefit from less robotic than laparoscopic stapler firings for the construction of intestinal anastomosis, especially when considering that this finding caused a reduction in cost associated with endoscopic linear stapling. However, when it comes to the major clinical outcome of interest, e.g., anastomotic leak, the study is far from being conclusive. In spite of reporting "a trend" towards risk reduction for leak in the robotic stapling group, cases operated on using laparoscopic and robotic stapling in the series were not matched according to the type of operation performed and other variables of interest. Ultimately, when considering on reporting on anastomotic leak, a multivariate analysis should be considered.

There is much work ahead of us on these issues. In the meanwhile, the authors should be greeted for the first report of a comparison between robotic and laparoscopic stapling during robotic-assisted colorectal operations. Holzmacher *et al.* (7) are accurate when arguing that their series represent a typical robotic colorectal caseload. Moreover, institutions around the globe running out robotic colorectal surgery programs, in order to advance cost management, may use the expertise of reduced patient cost associated with stapler firing as demonstrated in this paper.

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Footnote

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