



Disparities in Robotic Surgery for Gastrointestinal Cancers

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The use of robotics in surgery has increased significantly in the last decade from its initial applications in urologic procedures [1]. Robotic surgery has been increasingly utilized not only for urologic and gynecologic procedures [1,2], but also in other gastrointestinal disease sites, particularly for cancers of the rectum, pancreas, stomach, and esophagus [3]. As the use of robotic surgery becomes more widespread for gastrointestinal malignancies and the potential benefits of this approach become better defined, an understanding of disparities in access and availability of robotic surgery across different racial and socioeconomic factors is increasingly relevant. In this short commentary, we aim to discuss the use of robotic surgery specifically for gastrointestinal malignancies with a focus on disparate patient factors that have recently been associated with the receipt of this approach.

With regard to gastrointestinal malignancies, laparoscopic surgery has been more extensively investigated as compared to robotic surgery with respect to its short- and long-term outcomes as compared to open surgery [4,5]. For example, several studies, including prospective randomized controlled trials, have shown equivalent oncologic results between laparoscopic and open surgery for rectal cancer [6,7].

Advantages of the laparoscopic approach include hastened post-operative recovery culminating in shorter hospital length of stay and improved post-operative pain control [6,8-10]. Initial results of the RObotic Versus LAParoscopic Resection for Rectal Cancer (ROLARR) study, comparing laparoscopic to robotic-assisted surgery for rectal cancer, showed no difference in conversion rates or short-term oncologic outcomes [11-13], though the final analyses for long-term outcomes are still pending. This study currently represents the only prospective trial comparing robotic surgery to laparoscopic surgery in patients with rectal cancer. There is retrospective evidence, however, which suggests that robotic surgery has similar benefits to the laparoscopic approach for rectal cancer. For example, a recent meta-analysis by Sun, *et al.* showed that robotic anterior resection was associated with shorter hospital stay, lower conversion rate, lower rate of circumferential margin positivity, and lower overall complication rate compared to the laparoscopic approach [14]. Furthermore, there were no differences with respect to operative time or days to return of bowel function.

In the current setting of robotics for gastrointestinal cancer surgery and the extrapolation of laparoscopic studies to the use of robotics, it would be reasonable to assume that robotic surgery will continue to be utilized for gastrointestinal malignancy, if not grow further in its applications. Additional evidence of this phenomenon is apparent in the educational goals and missions of multi-institutional consortiums in the robotic training of surgeons, particularly for those in Urology [15-17]. Standards are being proposed to incorporate robotics in the education of surgical trainees in General Surgery

to allow for a general proficiency among these trainees [18]. There are certainly valid critiques regarding the disadvantages of robotic surgery as it pertains to gastrointestinal procedures, namely increased operative times and higher overall costs associated with robotics [19]. However, as the learning curve improves for robotic surgeons, perhaps with these educational initiatives, these disadvantages may be addressed and minimized. Many advocate that the learning curve for robotic surgery is shorter than that for laparoscopic surgery, which may hasten proficiency with robotic approaches to gastrointestinal procedures [20-22]. Decreased operative times and lower operative costs may therefore be reasonable results to achieve with improved training and proficiency of general surgeons performing robotic-assisted gastrointestinal procedures.

Thus, in the existing climate of minimally invasive surgery where robotics is playing a more significant role in the field of gastrointestinal surgery, there are many aspects that must also be considered which extend beyond the short- and long-term outcomes. A very relevant, contemporary aspect of robotic surgery and minimally invasive surgery in general, and to gastrointestinal malignancies specifically, encompasses the disparate access to these minimally invasive approaches to surgery, and in turn, disparities to the benefits of robotic and laparoscopic surgery as discussed above. Disparities in surgical approach comprise an important issue in gastrointestinal cancer care, which has been the subject of increasing recognition.

Our group was the first to report on such disparities in surgical approach for gastrointestinal malignancies using the US National Cancer Data Base (NCDB) in rectal cancer as well as for pancreatic tumors [23,24]. In the first of these studies, robotic surgery accounted for 2.6% of rectal cancer cases and 1.7% of pancreatic cases. Compared to open rectal surgery, several disparate factors were associated with an increased odds ratio (OR) for robotic surgery on multivariable analysis. These included private insurance (as compared to the uninsured), higher patient income, and performing the surgery at academic institutions (as compared to community cancer centers). These findings were validated by a recent study from Turner, *et al.*

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Received: November 21, 2016; **Accepted:** January 13, 2017;
Published online: January 17, 2017

Citation: Berkley BS, Gabriel E (2017) Disparities in Robotic Surgery for Gastrointestinal Cancers. J Robotics Autom 1(1):8-9

where the authors found similar disparate factors associated with surgical approach for patients with rectal cancer [25]. In this study, which also utilized the NCDB but unlike the previous study by Gabriel, *et al.* included patients who received neo-adjuvant chemotherapy, patients who were uninsured were found to be less likely to undergo laparoscopic or robotic surgery.

In a study investigating pancreatic tumors, patients who were treated at academic institutions were more likely to have minimally invasive surgery, including the robotic approach [24]. More specifically, for patients with tumors located in the body or tail of the pancreas, those of Hispanic ethnicity were less likely to undergo surgery through a minimally invasive approach than non-Hispanics. Taken together with the previous studies on rectal cancer, there are multiple disparities among patient demographics, which may influence the surgical approach that is offered to these patients with gastrointestinal malignancies. These factors range from race/ethnicity, socioeconomic variables, and proximity or access to different types of institutions, which may have varying levels of resources and surgical expertise.

The availability, access, and marketing of robotic surgery by hospitals may also have an impact on disparities related to surgical approach for GI cancers. Although data for these aspects of surgical approach have mainly been described for urologic or gynecologic procedures, these observations may have important parallels to GI diseases. Wright, *et al.* recently reported that patients undergoing urologic or gynecologic procedures, including prostatectomy, nephrectomy, hysterectomy or oophorectomy, were more likely to have a robotic-assisted approach in geographic areas where regional competition due to the presence of multiple hospitals and limited market share influenced individual hospital marketing of robotic surgery [26]. This is consistent with the trend of increasing spread of robotic surgery in hospitals across the US, in part as a response to the increasing regional competition experienced in various parts of the nation [27,28].

In summary, robotics continues to play a significant role in gastrointestinal cancer surgery and may offer equivalent oncologic outcomes while providing similar benefits achieved with laparoscopic surgery. As education and training evolve to optimize operating time and costs associated with robotic surgery, the application of robotics in gastrointestinal cancer surgery and for surgery in general may continue to expand. Therefore, it is important to recognize and address disparities not only in minimally invasive approaches to gastrointestinal cancer surgery, but also more specifically in robotic surgery to increase the likelihood that the benefits of robotics can be experienced equally among patients of different racial or socioeconomic backgrounds. Thus, hospital reform has been advocated for and is needed to address these cancer-related disparities in surgical approach [29]. Surgeons are in a prime position to commence such change, and highlighting these disparities to those outside of the medical and surgical fields is also necessary to increase awareness of this important issue.

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