Editorial Commentary

A critical appraisal about robotic-assisted surgery

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Recently, an interesting study from China evaluating short-term outcomes and complications after robotic versus laparoscopic rectal resection surgery was published in *Surgical Oncology* (1). The authors from Chongqing, China, compared 556 patients with rectal cancer undergoing robotic-assisted surgery with 1,029 patients receiving laparoscopic-assisted surgery during 2010 to 2016. The study was retrospective and the surgical approach (robotic versus laparoscopic) was selected by the patients after providing informed consent following an explanation of the advantages, disadvantages, and all possible outcomes of robotic and laparoscopic surgery in detail. The study was approved by the local ethics committee and all participants provided written agreement allowing the use of the clinical records. In light of previous problems with ethical standards in medical research in China (2), the authors of the present study must be applauded for the planning and handling of the ethical issues. In many countries, such a retrospective study design would not require approval from a local ethics committee, but the fact that the authors actually went through such ethical approval is therefore positive.

The study found postoperative complication rates of 14% with no difference between robotic and laparoscopic surgical technique. Thus, robotic-assisted surgery for rectal cancer is technically safe but it does not provide significant advantages regarding complication rates compared with laparoscopic-assisted surgery. This study confirms the results of numerous previous reports in the literature as summarized in recent systematic reviews and meta-analyses (3-6). The same pattern, with no significant difference in complication rates between robotic-assisted surgery and laparoscopic or even open surgery has also been shown for radical prostatectomy (7), radical cystectomy for bladder cancer (8), as well as for robot-assisted surgery in gynecology (9). So why will numerous surgical departments around the world still invest so heavily in these robots when complication rates seem to be similar compared with conventional open or laparoscopic techniques?

When robotic-assisted surgery was introduced, some surgeons had concern that procedures performed with the robot would involve higher long-term complication rates compared with laparoscopic or open technique. However, the few available studies reporting long-term results after robotic-assisted surgery have not confirmed this initial concern (10-13), and we therefore now have no reason to believe that robotic-assisted surgery involves higher long-term complication rates compared with laparoscopic or open surgery.

Robotic surgery has been around for decades already (14), and it certainly seems as we have not yet found the final platform for robotic surgery. When laparoscopic surgery was introduced into general surgical operations around 1990 there was initial excitement about this new technique, and the excitement around robotic colorectal surgery somewhat echoes that generated by the introduction of laparoscopic surgery (15). However, even though robotic general surgery has been around now for many years, we have still not been able to show significant advantages for patient outcome compared with open or laparoscopic surgery.

Nevertheless, there may be some areas where robotic-assisted surgery may become standard of care because of better patient outcome. A recent systematic review, meta-analysis, and meta-regression (16) showed that for the subgroup of patients being obese and undergoing robotic

colorectal surgery there might be advantages compared with laparoscopy. Thus, robotic surgery provided earlier recovery with shorter length of stay and reduced re-admission rates for the obese patients. In the Chinese study by Bo *et al.* (1) where the authors could not show a difference in complication rates, the patients were not obese having BMI of 23 in both the robotic and the laparoscopic group. This may therefore be one of the reasons why they could not show difference in complication rates between the different surgical approaches. Another area, where robotic-assisted surgery is clearly expanding is within operations for cancers of the head and neck. A recent systematic review and meta-analysis showed remarkable superiority over open surgery for the treatment of cancers of the head and neck (17), and interestingly, patients who previously could only be treated with radio-chemotherapy can now undergo surgical resection with anticipated better outcome since robotic-assisted surgery can be used for the management of more advanced tumors in this region (18).

Historically, robotic-assisted surgery gained acceptance initially and primarily in radical prostatectomy where the majority of urologists went directly from using open surgery to using the robotic technique. Thereby, the urologists bypassed extensive laparoscopic training, so even nowadays many urologists can operate on an expert level during open surgical cases as well as with robotic-assisted surgery, whereas in laparoscopic surgery they are often not trained extensively including with the ability to suture with laparoscopic technique, and suturing is much easier in the robot because it resembles the open technique. This development is in contrast to colorectal surgeons around the world where the colorectal surgeons typically are already skilled and experienced laparoscopists and therefore their need for the robot is less obvious (19). Colorectal surgeons being happy working with the robot will often argue that when operating in patients with a high splenic flexure or with a narrow pelvis the robot may prove to be an advantage. However, if we go back to the Chinese study (1) the majority of patients operated with laparoscopic technique were male (62%) with 68% of tumors being placed less than 10 cm from the anus. Thus, the Chinese study clearly showed that laparoscopic rectal resection for low tumors in male patients is certainly feasible with complication rates and conversion rates similar to that of robotic assisted surgery. In fact, conversion rates have been studied in detail in a recent randomized clinical trial comparing robotic-assisted with conventional laparoscopic surgery in 471 patients undergoing rectal resection for cancer (20). Also, this study showed that there were no difference in conversion rates to open laparotomy comparing robotic with laparoscopic technique and these findings suggest that robotic-assisted laparoscopic surgery does not confer an advantage in rectal cancer resection.

With the introduction of the robot many of us had the hope that it would be important for surgeons' ergonomics. Working conditions for surgeons have gained increased interest in recent years and studies have shown alarming high prevalences of multisite musculoskeletal pain and high pain intensities in surgeons (21). Thus, musculoskeletal pain was reported by 93% of the surgeons and 77% experienced multisite pain (21). However, recent studies have shown that the robotic console may constrain postures leading to static loads that have been associated with musculoskeletal symptoms from the neck, torso and shoulders (22). Another recent study showed high levels of static and mean muscular activity, increased perceived physical exertion from pre-to-post surgery, and moderate to high risk for musculoskeletal injuries when using the robot (23). Thus, robotic-assisted surgery may for some muscle complaints be an advantage, but other muscle groups seem to take over the risk of musculoskeletal pain and injuries. At present, it is not possible to state that robotic surgery is better or equal to laparoscopic surgery when looking at ergonomics, but it is certain that robotic-assisted surgery does not solve the problem of musculoskeletal pain in surgeons.

Introduction of robotic-assisted surgery in general surgical procedures is also a problem for education. Thus, a recent study from a large teaching hospital showed that in only 1% of operations a surgical resident attended the procedure as a scrubbed assistant and never as an operating surgeon (24). Therefore, thousands of teaching operations are removed from the pool of operations available for surgical training by laparoscopy or open surgery and this is a serious problem for future surgical treatment of patients with for instance colorectal cancer as well as other intra-abdominal diseases.

Finally, robotic surgery is more expensive than both open and laparoscopic procedures costing an additional €1,425 to €3,900 per procedure without taking into account the initial purchase price of the robot (€450,000 to €1,875,000 per robot) as well as the annual maintenance cost which is typically around €100,000 per machine (15).

Such an expense has to be justified by better patient outcome, and in the routine care of patients with colorectal

cancer as well as other intraabdominal diseases it does not seem to be justified to perform robotic surgery with our current knowledge. There are, however, subgroups where use of the robot can make sense. This may be in the obese patient with a narrow pelvis undergoing rectal resection or in surgery for oropharyngeal cancer where the robot may make the surgical approach possible and thereby avoiding devastating radio-chemotherapy and hopefully a better oncological result in the future. This area is quickly expanding and seems to be promising since robotic-assisted surgery makes it possible to perform surgical procedures that were not possible previously. There can be an analogy to other clinical specialties where operations may be possible where patients previously did not have the surgical option for cure. Future studies exploring new fields or indications for robotic-assisted surgery should of course preferably be randomized clinical trials instead of case-series or retrospective analyses (25).

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