CIR ESP. 2023;101(7):463–465

CIRUGÍA ESPAÑOLA

www.elsevier.es/cirugia

Editorial

Robotic HBP surgery: a real opportunity with future potential

Cirugía robótica HPB: una oportunidad real con vocación de futuro

The term *robotics* is not new. Some 80 years ago, in 1942, Isaac Asimov formulated what are known as the "Three Laws of Robotics":

1 A robot may not injure a human being or, through inaction, allow a human being to come to harm.
2 A robot must obey orders given it by human beings, except where such orders would conflict with the First Law.
3 A robot must protect its own existence as long as such protection does not conflict with the First or Second Laws.

Despite his work being considered science fiction, there is no doubt that he was a visionary and that many of the writings that seemed unthinkable are already a reality today.

With the advancements and improvements made in robotic surgery, we have been witnessing a revolution similar to the implementation of laparoscopy in recent years. However, equating these two minimally invasive techniques and arguing over whether one technique is better than the other can lead to a sterile debate. Laparoscopic surgery has reached its peak development, and it is already in phase 3–4 according to the IDEAL model.[1] Meanwhile, surgery with robotic platforms is still practically in its infancy, in phase 2 of development, in which only a few innovative surgeons have improved the technique; even so, it has already managed to unseat laparoscopy in certain surgeries.[2]

In hepatobiliary and pancreatic (HBP) surgery, the implementation of the laparoscopic approach has been slow and is often reserved for procedures considered simple. Bearing in mind that the first laparoscopic liver surgery in the world and the first in Spain were performed more than 20 years ago,[3–5] one would expect minimally invasive surgery to be widely extended and established in all specialized hospitals, but the reality is quite often different. Data show that almost half of surgeons have never performed complex laparoscopic liver surgery, and less than 20% have performed any sort of robotic surgery.[6] The cause of this is possibly multifactorial and trying to resolve it now would be daring, to say the least. However, if some of the reasons are revealed, robotic surgery could be part of the solution:

1 The inherent difficulty presented by HBP surgery. The level of skill needed for this surgery is high since large vessels are involved and reconstructive techniques are sometimes required. The similarity with the natural movement of the hand means that robotic surgery can be more widely accepted by surgeons, and implementation would therefore be faster.
2 The surgeries are usually long, requiring sustained concentration and physical capability. The ergonomics and adaptation of the machine to the surgeon, and not the other way around, make surgery more comfortable. In short, and from an ethical point of view, what is good for the surgeon should be good for the patient.
3 The automatism of laparoscopic HBP surgery is not easy because there is evident interoperator variability. Also, despite the known standardization of techniques, different manners of conducting them reveal some gaps in laparoscopy. With robotic surgery, the automatisms are more defined, and movements are simplified in order to facilitate the procedure. This would seem a fundamental requirement in HBP surgery, which is already complex in itself.
4 Training in complex surgeries continues to be an Achilles heel that makes the generational transmission of knowledge of the technique more difficult than we might expect. To teach the robotic technique, a double console must be used, with which the experienced surgeon and the apprentice surgeon can easily exchange control of the platform for regulated, step-by-step training.

Today, the future evolution of robots is difficult to quantify or imagine. However, given the progress of technology in

recent years, it seems daring and naive to consider robotic surgery simply a new technique or a new way of operating, Robotic platforms are not only going to enable us to operate with more precision, but the ability to grow and incorporate the latest technological advances also seems to have no limit. Augmented reality, artificial intelligence, 3D models, and intraoperative navigation will all be integrated into one same system. During surgery, the platform itself will prevent us from cutting in the wrong place, while demonstrating the correct path to follow. Internal anatomy will be visualized in such detail that any current debate about where to find the portal pedicle or any other structure will become obsolete.

Predicting the future is not our goal, but technological evolution is quick, and we must be able to endure a few years of continuous change.

Surgical societies must be prepared for this new ''Big Bang''. Organized training is essential to optimize resources and achieve technical excellence,[7] and this leads us to wonder who, where and how HBP procedures should be trained in robotic surgery. Such questions must be initially answered by these societies before the industry attempts to. Likewise, surgical societies must lead the organization of specialized training and courses for young surgeons with a special interest in HBP surgery. In short, a road map needs to be established. The objectives of one and the other are different, but there must be a symbiosis and noticeable involvement of the industry so that the generalized use of robotic surgery lowers costs lower and makes implementation faster.

From a theoretical point of view, the above argument seems simple, but the day-to-day reality is somewhat more complicated. Furthermore, from a practical point of view, HBP robotic surgery is a small part of the whole, and investment from the industry has meant that robotic surgery has become consolidated in other surgical specialties first. HBP surgery, due to its complexity and particularity, requires different surgical instruments, and it is logical for robotic systems developers to only invest in areas that promise growth. Whichever company manages to adapt basic, necessary instrumentation to this type of surgery will have practically the entire community of liver and pancreatic surgeons agreeing that robotic surgery is indeed unparalleled.

Robotic HBP surgery represents a conceptual change. Its functionality is distinct, and it could even be defined as *microscopic surgery*, in which the quality and proximity of the camera achieve even greater detail than open surgery.

The management of the platform must first be practiced in simulation, completing ''flight hours'' to achieve adequate coordination and handling of the console before moving on to real low-complexity surgeries. Although robotic surgery demonstrates its superiority in the most complex surgeries, training programs should be organized in phases and start with less demanding surgeries, like cholecystectomies. In this context, once again, the economic support of the industry is essential. A surgeon specialized in liver surgery should not have major complications when performing a cholecystectomy; however, if all general surgeons in robotic surgery training begin performing cholecystectomy, the consequences could be catastrophic,[8] and even more so if they do not perform them on a regular basis. Therefore, and in accordance with the current trend towards super-specialization, neither the training nor the learning curve should be the same for all general surgeons. If the training program is not well defined, this would inevitably lead to failure of the surgery (unnecessary conversions), higher morbidity, and greater costs, all of which compromise excellence in surgical quality, to the detriment of the patient.

In this context, a mentor who is technically qualified is essential to impart a training program based on surgical quality and professionalism. These mentors are the link between one generation of surgeons, who had to be trained in open surgery, then laparoscopic surgery, and now robotic surgery, and a younger generation that is already maturing alongside the world of robotic surgery.

This suggests that, just as today's younger surgeons have performed practically no open cholecystectomies, there will be more complex procedures (such as pancreaticoduodenectomy or distal pancreatectomies) that some surgeons may learn to perform directly with robotic surgery, without the need to go through laparoscopy.

In the same way that Isaac Asimov imagined a robotic world years ago, the quantum leap in surgery that we have witnessed over the last decade should lead us surgeons to be willing to lead a philosophical, conceptual, technological and surgical change that is unprecedented to date.

REFERENCES

1. Cook JA, McCulloch P, Blazeby JM, Beard DJ, Marinac-Dabic D, Sedrakyan A, et al. IDEAL framework for surgical innovation 3: randomised controlled trials in the assessment stage and evaluations in the long term study stage. BMJ. 2013;346:f2820. http://dx.doi.org/10.1136/bmj.f2820. PMID: 23778425; PMCID: PMC3685513..
2. Allan C, Ilic D. Laparoscopic versus robotic-assisted radical prostatectomy for the treatment of localised prostate cancer: a systematic review. Urol Int. 2016;96(4):373–8. http://dx.doi.org/10.1159/000435861. Epub 2015 Jul 18. PMID: 26201500.
3. Azagra JS, Goergen M, Gilbart E, Jacobs D. Laparoscopic anatomical left lateral segmentectomy- technical aspects. Surg Ensoc. 1996;10:758–61.
4. Gagner M, Rheault M, Dubuc J. Laparoscopic partial hepatectomy for liver tumor. Surg Endosc. 1992;6:99.
5. Cugat E, Olsina JJ, Rotellar F, Artigas V, Suárez MA, Moreno-Sanz C, et al. Resultados iniciales del Registro Nacional de Cirugía Hepática por Laparoscopia [Initial results of the National Registry of Laparoscopic Liver Surgery]. Cir Esp. 2005;78(3):152–60. http://dx.doi.org/10.1016/s0009-739x(05)70909-x. PMID: 16420816.
6. Ciria R, Berardi G, Nishino H, Chan ACY, Chanwat R, Chen KH, et al. A snapshot of the 2020 conception of anatomic liver resections and their applicability on minimally invasive liver surgery. A preparatory survey for the Expert Consensus Meeting on Precision Anatomy for Minimally Invasive HBP Surgery. J Hepatobiliary Pancreat Sci. 2022;29(1):41–50. http://dx.doi.org/10.1002/jhbp.959. Epub 2021 Apr 21. PMID: 33787072.
7. Targarona EM, Salvador Sanchís JL, Morales-Conde S. Formación en cirugía laparoscópica avanzada. ¿Cuál es el mejor modelo? [Advanced training in laparoscopic surgery: what is the best model?] Cir Esp. 2010;87(1):1–3. http://dx.doi.org/10.1016/j.ciresp.2009.10.006. Epub 2009 Nov 14. PMID: 19914610.

8. Hoffman AB, Myneni AA, Towle-Miller LM, Karim SA, Train AT, Burstein M, et al. The early (2009–2017) experience with robot-assisted cholecystectomy in New York State. Ann Surg. 2021;274(3):e245–52. http://dx.doi.org/10.1097/SLA.0000000000004932. PMID: 34397456.

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2173-5077/