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Editorial

Precision Surgery: Three-dimensional Visualization Technology in the Diagnosis and Surgical Treatment of Abdominal Cancer

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Over the past 60 years, surgery has undergone a major transformation. Very possibly, this has been superior to those that occurred in all previous centuries. In this period of time, this specialty has reached all its splendor with a more integrated and complex exponential growth. Oncological surgery is a faithful exponent of this.

Technology has been able to change the presence of surgery. It is one of the specialties that has required more of its advances. Its incorporation has been slower than in other sectors. It has benefited not only from technological advances in surgery itself but also from those developed in other related specialties: radiology, nuclear medicine, gastroenterology, etc.

The concept of "personalized treatment" also known as "individualized treatment", is well known in cancer therapy. It represents a great advance in the treatment of any malignant tumor process. There is little doubt about its effectiveness, although it is true that the number of patients who benefit from this option, although it continues to increase progressively, is still not very numerous. Another similar concept, although less well known, is that of precision medicine. This type of medicine defines a logical and sensible way of reasoning and acting, which is also essential in surgery. It attempts to offer something obvious "the right treatment at the right time to the right patient. On the basis of these clinical concepts, is it possible to establish the same concept in surgery? Do we have a chance to perform real precision surgery? We believe that it is not only possible but necessary.

Precision surgery must be based on three general aspects: 1) Planning and simulation of the surgery to be performed based on the information obtained pre-operatively with a 3D reconstruction. 2) Incorporation of these studies into the surgical act itself with superimposition of the model on the affected organ (augmented reality) and 3) A surgical technique that associates a new technology (robotic surgery) with a minimum invasion and an increase in the rigor and safety of the procedure to be performed, without losing effectiveness.

Precision surgery

1) 3D reconstruction

In recent years, the axial and two-dimensional vision of anatomy in classical radiological studies (tomography) has been modified by a new three-dimensional concept with planes in any direction of space.

Regardless of sophisticated endoscopic procedures, radiological (helicoidal CT) and radiological/metabolic tests (PET/CT or PET/MRI) in association with the specialty of nuclear medicine are now essential in order to obtain accurate and adequate information on tumor disease. The development of new generations of helicoidal CT equipment, together with the improvement of computer supports, has meant a spectacular evolution in image processing and in the expansion of three-dimensional (3D) images, generating this type of technique in less time and with greater resolution.

The realization of 3D images through the fusion of the images obtained with the previously mentioned PET/CT and PET/MRI or PET/CT is a new resource that the surgeon has

to evaluate much more subtly, various tumor pathologies; pancreatic cancer, primary or secondary liver tumors, rectal cancer and retroperitoneal tumors. In the last 5 years, other pathologies have been added to this type of study. New 3D reconstruction models are being consolidated in general surgery with promising results; gastric and esophageal tumors and peritoneal carcinomatosis. This is at least our assessment of the preliminary results obtained in the research studies we are carrying out at our hospital.

From an oncological point of view, the 3D reconstruction offers in the established models important benefits. Our experience obtained with more than 800 cases carried [1] out in the evaluation of different oncological processes, has allowed us to adjust to the maximum radicality of the surgical technique and to diminish the surgical risk when extending the information on the local extension of the tumor. As a consequence of all this, we believe that it can and must improve the survival of the patient.

In liver surgery, the surgeon knows with maximum precision the number and location of the tumor lesion(s) as well as its possible spread. Information is obtained about the volume of parenchyma to be resected and the remaining volume (healthy liver after tumor resection). It allows the perfect planning of the surgery before it is performed, that is before the patient arrives at the operating room [2]. In pancreatic tumor surgery, 3D reconstruction is also of great diagnostic importance. It provides information on the glandular or extra-glandular nature of the tumor process and fundamentally on possible vascular affectation, an affectation that can condition the operability of the patient and/or the resectability of the tumor. It has a great capacity to select the patient for surgical treatment. In short, it allows for operation on the patient who can really benefit from surgery, avoiding unnecessary surgical treatments [3].

In addition to all this, 3D reconstruction represents an excellent way to perform teaching, teaching anatomy and surgical techniques to students and surgeons in training. There is no doubt that it is the way of teaching these disciplines in this century.

2) Robotic surgery

The robotic system represents the gold standard approach in several areas of general surgery since providing three-dimensional imaging, greater instrumental movement, and filtering of surgeon tremor [4]. These benefits allow surgeons to perform minimally invasive procedures with excellent results overcoming important specific limitations of the laparoscopic approach. Developing of robotic surgery is continuously increasing and many studies in the literature confirm the fact that even if robotic surgery is more expensive it results in a cost-effective alternative to laparoscopic and open approaches [4].

The Da Vinci® (Intuitive Surgical) platform represented the most advanced robotic system and in the last few years, Da Vinci® has been the main actor defining the rules of robotic surgery, despite new designs by competitors having recently been developed. Technological research has made possible the introduction of new robotic platforms in recent years such as the new HUGOTM robotic system. HUGOTM robotic system introduces a new concept in this field, designing independent robotic arms with the possibility to move into the operating room and to allow greater maneuverability in the various surgical fields. This configuration appears to offer more flexibility compared with other systems [5].

3) Augmented reality

Finally, augmented reality has gained interest in medicine and it has begun to be used in a multitude of settings, including both medical training and patient care. Augmented reality in precision surgery allows the inclusion of digital information into the surgeon's field of view especially during robotic surgery, creating a seamless integration of virtual and real-world elements. This technology offers a three-dimensional visualization of anatomy, allowing surgeons to navigate through well-identified structures with great accuracy. In particular, augmented reality in surgery can be employed in intraoperative guidance and training regarding instructions, identification of target structures, and the correct use of instruments [6]. The real-time overlay of critical information, such as vital signs or preoperative imaging, improves decisions during surgery, contributing to safer and more effective procedures [7]. This transformative technology continues to mature, it may revolutionize surgical practices, deliver improved outcomes for patients, and set the stage for a future where precision surgery becomes the standard rather than the exception. The journey towards the widespread adoption of augmented reality in precision surgery is an exciting one, with the potential to redefine the boundaries of what is possible in the operating room.

Conclusion

Consolidating precision surgery means an important contribution to the quality of medical care and to multidisciplinary research among physicians of different specialties. It facilitates the incorporation of other professionals such as physicists and engineers, to the development of surgery. The patients, the main objectives of our action, have the possibility to access to first level technological services.

Precision surgery is beginning to have a marked impact on medical practice and will probably have a much greater impact on the future, a future that no one, even the most unrealistic, can imagine today.

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