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REVIEW ARTICLE

Critical Analysis of Robotic Surgery for Laryngeal Tumours☆

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Abstract In recent years, transoral robotic surgery (TORS) with the Da Vinci robot has been used for the removal of laryngeal cancers with the objective to improve functional and aesthetic outcomes without worsening survival. The advantages of TORS are described in this article. However, its disadvantages, mainly high cost amongst others, do not make robotic surgery the current treatment of choice for laryngeal tumours; transoral laser surgery is superior in most cases. Major technical improvements are expected. Smaller, more ergonomic, new-generation robots better adapted to the head and neck will probably be available in the near future.

PALABRAS CLAVE
Cirugía robótica;
Da Vinci;
Tumores laríngeos;
Laringe;
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TORSS

Análisis crítico de la cirugía robótica laríngea

Resumen Recientemente se ha introducido en el bagaje quirúrgico del otorrinolaringólogo el empleo del robot Da Vinci para tratar tumores laríngeos con la justificación de mejorar los resultados funcionales y estéticos sin comprometer la supervivencia. En esta revisión se describen las ventajas de la cirugía robótica transoral (TORS), aunque las desventajas de la misma, principalmente su elevado coste, nos hacen preferir otras modalidades terapéuticas, principalmente la cirugía láser transoral. Se esperan en el futuro inmediato mejoras técnicas importantes en la cirugía robótica, con aparatos más pequeños, ergonómicos, de nueva generación, mejor adaptados al área cervicofacial.

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Figure 1 Experimental operating theatre in the headquarters of the Iavante Foundation, Granada, where training takes place using live animal models and human cadavers (Cryopreserved heads).

Introduction

The Da Vinci surgical Robot was officially launched in the Hospital Virgen del Rocío in Seville on 13 September 2007, and the first operation took place on 18 September–a radical prostatectomy. Prior to that, a team comprising 3 urologists and 2 scrub nurses travelled to Strasbourg to undertake an intensive training course. The only robotic equipment for national robotic surgery training is in Granada, in the headquarters of the *Fundación Iavante*; it has been used to train a great many Spanish and foreign surgeons in robotic surgery techniques. The authors of this article travelled to this Foundation firstly to attend an intensive course on robotic surgery on live pigs and human cadavers and this was then completed with repeated operations on cryo-preserved cadaver heads (Fig. 1). In addition to broad experience in open cervical surgery and transoral laser surgery, this team has also trained in extended endoscopic surgery of the skull base, and therefore we intended initially to cover the indications accepted in international literature on robotic surgery in otolaryngology.

Paradoxically, despite the great coverage in the media on robotic surgery, there are very few publications on the subject. In the field of ENT, robots have been used firstly in transaxillary surgery of the thyroid and by extension of the neck, where its cosmetic benefits largely justify its use as no visible scar is left; then for oropharyngeal tumours and obstructive sleep apnoea; and finally, less frequently, in laryngeal surgery. Articles are increasingly appearing on the fields of development where we consider that the robot will play a major role in the future: rhinopharyngeal and skull base surgery.

However this article is a story of frustration. In our experience, ''conventional'' transoral laryngeal laser surgery is so superior to robotic surgery that we have as yet had no laryngeal case for which the use of a robot has been justified. Sleep apnoea surgery is not very developed in our centre.

Oral cavity and oropharyngeal cancers are treated by the maxillofacial department, who, although also trained in the use of robots, have not requested its use. Surgery of the rhinopharynx and skull base, possible areas of development for this surgery with numerous theoretical applications for the future, in our opinion, require far more appropriate instruments than those available at present. All these aspects will be developed on in the relevant sections. It should not be forgotten that the initial idea of the robot was the idea of a surgeon operating on a patient, each in a separate operating theatre (not a separate country, but a separate planet!). The idea was not to achieve a panacea–like the laser or so many other scientific techniques and advances–superior to other conventional techniques. In fact, after the unanimity of the first publications on the advantages of the robot, articles have been continually appearing of late which question its use, indications, high cost and safety; this has meant that the enthusiasm for entering a career in robotics has dwindled.

The Da Vinci System

The term *robot* was coined by the Czech writer Karel Kapek who used the word in his language to allude to serfs or slaves in his work of 1921 ''R.U.R'' (Rossum's Universal Robots). The Robot Institute of America's (1079) definition of a robot is ''a reprogrammable, multifunctional manipulator designed to move material, parts, tools, or specialised devices through various programmed functions for the performance of a variety of tasks''.[1]

The first surgical robot was called Puma 560 and was used from 1985 to perform high precision, neurosurgical biopsies. Different devices have been developed since then, although only one has been approved by the FDA and consequently marketed in the field of cervicofacial surgery: the Da Vinci robot (Intuitive Surgical Inc.). The origins of this robot go back to the NASA project to offer surgical care to astronauts in orbit[2] and was seen by the US Defence Department as a potential protection mechanism for the few surgeons who could operate from a remote location. The Intuitive Surgical Corporation was created in 1995 in order to develop telerobotic systems for commercial use.

Although this ''astronautical'' vision of robotic surgery has not become a reality, this technology has been applied in the various surgical robots, which are chiefly used in minimally invasive procedures. In our speciality, the Da Vinci system uses robotic (or roboticised) systems to enable microsurgery in various areas which are difficult to tackle using conventional endoscopic techniques. The Da Vinci surgical system is a master-slave telerobotic platform consisting of a console, a surgical trolley and a display system. The main surgeon controls the robot without entering the surgical field, at a distance from the patient, and an assistant changes and/or adjusts the different robotic arms or instruments used. The surgeon's console provides an amplified three-dimensional image of the surgical field and allows the robotic arms to be controlled, transferring the movements of the surgeon's hands and fingers to the robotic arms and the instruments inserted in them, and there is no physical hand tremor.

Indeed, the Da Vinci robot is used throughout the world in the area of ENT in particular, despite its high cost. The following reasons have been used to justify its use: