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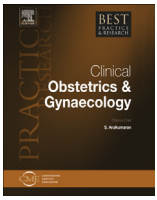

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Robot-assisted gynaecological cancer surgery—complications and prevention

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Ever since the US Food and Drug Administration approval of the use of da Vinci surgical systems (Intuitive Surgical Inc., Sunnyvale, California) in gynaecology in 2005, robot-assisted surgery has been widely adopted in different countries. Some of the applications in benign and oncological gynaecology include myomectomy, sacrocolpopexy, tubal anastomosis, simple hysterectomy, radical hysterectomy, radical trachelectomy, pelvic and/or para-aortic lymphadenectomy and even debulking surgery for ovarian cancer and pelvic exenteration for recurrent cervical and vaginal cancer. Although there is robust evidence on the safety and treatment outcomes in robot-assisted surgery, complications still rarely occur. Team approach is particularly important in robotic surgery and thorough communication between the bedside assistant and the console surgeon cannot be stressed any more. Thus, complications can be due to miscommunication between the console surgeon and bedside assistant, positioning of the patients, the length of the operations, the malfunction of the instrument and the risks specific to the types of anaesthesia and surgery per se, leading to thromboembolism, haemorrhage, organ damage, and so on. The most important strategies that can prevent complications are to have thorough preoperative assessment of the patients' fitness, good communication between surgical team members, caution regarding the positioning, a good knowledge of the pelvic

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and abdominal anatomy, careful and meticulous manipulation of the instrument and early recognition of the complications. In this article, different types of complications and the preventive measures are described.

Introduction

Robot-assisted surgery was the most major breakthrough in minimally invasive surgery in the last decade. The first robotic system, 'Arthrobot', was introduced in 1983 [1]. Since then, the robotic system has undergone several evolutions. The da Vinci surgical system (Intuitive Surgical Inc., Sunnyvale, California) was first introduced in 1998 and was approved by the Food and Drug Administration of the United States in 2000. In 2005, its application in gynaecology was approved.

Robotic system has some potential drawbacks especially the loss of tactile feedback, making the surgeons unable to 'feel' the tissue planes during dissection and assess the knot tension during suturing. Nevertheless, its three-dimensional view, i.e., the magnification, its stability, the dexterity and seven degrees of motion, allows the access to difficult areas, provides a clear image of the anatomy and improves the precision of the operation, thus leading to an exponential increase in the scope and usage of robotic surgery in gynaecology. To date, robotic technology has been adopted in many benign and oncological gynaecological operations, such as myomectomy, sacrocolpopexy, tubal anastomosis, deep endometriosis resection, simple hysterectomy, radical hysterectomy (RH), radical trachelectomy, pelvic and/or para-aortic lymphadenectomy and even debulking surgery for ovarian cancer.

There were multiple level I and II analyses that verified the safety and treatment outcomes of robot-assisted surgery, and it is associated with less blood loss and shorter length of hospitalisation than traditional laparotomy. However, complications are an inherent element of every kind of operation. According to Clavien et al., 'negative outcomes' included sequelae, failure to cure and complications [2]. While sequelae referred to inherent and unavoidable after-effects of an operation (e.g. loss of fertility after hysterectomy) and failure to cure referred to failure to achieve the initial goal of surgery (e.g. suboptimal debulking for a patient with ovarian cancer), complications were defined as any deviation from the normal postoperative course. Most of the complications from robot-assisted surgery are similar to those in conventional laparoscopic surgery. Fortunately, the incidence is low. For example, the overall peri-operative risk of robotic RH was approximately 6–13% including minor and major complications [3–5]. In this review article, the causes and types of complications of robot-assisted cancer surgery and the preventive strategies are discussed.

Causes of complications

Complications can occur directly or indirectly related to the robotic system (Table 1), and approximately 21% of the resulting injuries were operator-related [6]. Direct causes include careless handling

Table 1
Causes of complications in robot-assisted operations.

Direct	Indirect
Poor knowledge about distorted anatomy	Positioning of the patients
Not keeping instrument in view	Pneumoperitoneum
Defects in the protective sheaths of the hot shears	Port and trocar placement
Collision of instrument	Use of traumatic grasper in retracting tissues
Poor angulation of the instrument	Infection including cuff abscess
Poor tissue handling	Vault dehiscence
Blunt dissection in dense adhesion	Lack of communication within the team
Inadequate uterine elevation	Nature of the operations per se
	Immobility of the patients
	Anaesthetic agents and analgesics

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