MINI-REVIEW

Robotic Surgery in Cancer Care: Opportunities and Challenges

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Abstract

Malignancy-associated mortality, decreased productivity, and spiritual, social and physical burden in cancer patients and their families impose heavy costs on communities. Therefore cancer prevention, early detection, rapid diagnosis and timely treatment are very important. Use of modern methods based on information technology in cancer can improve patient survival and increase patient and health care provider satisfaction. Robot technology is used in different areas of health care and applications in surgery have emerged affecting the cancer treatment domain. Computerized and robotic devices can offer enhanced dexterity by tremor abolition, motion scaling, high quality 3D vision for surgeons and decreased blood loss, significant reduction in narcotic use, and reduced hospital stay for patients. However, there are many challenges like lack of surgical community support, large size, high costs and absence of tactile and haptic feedback. A comprehensive view to identify all factors in different aspects such as technical, legal and ethical items that prevent robotic surgery adoption is thus very necessary. Also evidence must be presented to surgeons to achieve appropriate support from physicians. The aim of this review article is to survey applications, opportunities and barriers to this advanced technology in patients and surgeons as an approach to improve cancer care.

Keywords: Cancer care - robotic surgery - cancer surgery - barriers - advantages

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Introduction

According to International Agency for Research on Cancer (IARC) estimated 12/7 million newer cancer cases in 2008 in the worldwide. By 2030, the global burden is expected to grow to 21/4 million new cancer cases and 13/2 million deaths (American Cancer Society, 2011). Mortality due to cancer, decrease people productivity, spiritual and social and physical burden in cancer patient, their families and society imposes heavy costs on communities (Centers for Disease Control and Prevention, 2013). Hence cancer prevention, early detection, rapid diagnosis, on time treatment is very important.

Apply information technology tools in health systems always has been regarded by the high level management and policy makers from the perspective of social, economic aspects with the aims to improve diagnosis and treatment, reduce costs, provide relevant health information to deliver effective health services to patient and support health professionals involved in the delivery of health care services (Mohammadzadeh et al., 2013). Use of modern treatment methods based on information technology in cancer can improve patient treatment and survival and increase patient and health care provider's satisfactions (Clauser et al., 2011; Mohammadzadeh et al., 2013). Robot technology is one of the advance information technology tools that used in different parts of health care like prevention, diagnosis, treatment and assistive care. Robotic agents as assistive tools can enhance the quality of life of elderly people and patient with chronic diseases at home or in a health care centers. This technology generates active services for people who need assistance and guidance (Sharkey et al., 2012). Robot therapy as a preventive tools can be used for prevention of dementia at home (Inoue et al., 2012) or prevent of surgical site infection during organ transplantation (Tzvetanov et al., 2013). In diagnosis field, robot can be an effective tools with minimally invasive. For example da vinci robotic surgical system helps to diagnosis and management of tumors (Kajiwara et al., 2011). Also social robots can be applied to assist in the diagnosis and treatment of autism or other impairment of social abilities (Scassellati et al ., 2012).

Robotic technology in surgery has emerged in past years as advance method in non invasive surgery. This technology is one of the modern technology tools that effect on cancer treatment domain. Robotic surgeries are useful treatment tools in health systems. Nowadays different types of devices in terms of performance, design and level of autonomy is used in various surgical specialties.(Curley, 2005) Computerized and robotics devices in addition to valuable benefits in cancer care, associated with some challenges. The aim of this review article is to survey application, opportunities and barriers of this advance technology for patient and surgeons as an approach to improve cancer care.

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Opportunities of Robotic Surgery in Cancer Care

Due to development of minimally invasive surgical technologies, there is no need to physical presence of surgeon in operating room for a long time and perform operation with their hands. Long manipulators are used to perform operations under manual guidance. Some of the robots capabilities in general for surgeons are include : stability and greater accuracy, improve visualization, manage multiple simultaneous tasks, optimized for particular environment, improve surgeons skills by reducing both performance time and errors (Pitcher et al., 2012), enhance dexterity by tremor abolition, motion scaling and reduce ergonomic problems of surgeons in longer procedure with possible sitting down and use their hands and fingers through ergonomically designed controls (Lee et al., 2011), high quality 3D vision (Mandai, 2013), facilitate complex procedures, enhancement of dexterity to facilitate micro scale operations (Chandra et al., 2010), development of virtual simulator trainers to enhance the ability to learn new complex operations (Kesavadas et al., 2011).General advantages of robots for patient are include: significant reduction in narcotic use and earlier return to normal function, increase patient satisfaction, decrease blood loss, and reduce hospital stay, low overall complication (Mendivil et al., 2009; Kim et al., 2010; Lim et al., 2011), lesser comorbidities, and lower risk and volume tumors (Pruthi et al., 2010), speed recovery and return to normal activities (Ng et al., 2010). Robotic surgery in addition to these general benefits have especial advantages in different cancer. For example in pancreatic neoplasm: safety and feasibility techniques that leads decrease tissue trauma in malignant disease, preserve of immune function, reduction of malignant recurrence, increase efficacy because of access to proper data (Nigri et al., 2011; van Santvoort et al., 2011). In gynecology oncology: easier and more comprehensive lymph adenectomy and overcoming anatomic barriers to the process of staging for endometrial cancer without increasing patient morbidity (Subramaniam et al., 2010; Cardenas-Goicoechea et al., 2011), decrease in hospital stay that directly related to the cost and fewer drug interventions (Lim et al., 2011; Martino et al., 2011), reduce in operating room times, transfusion rates, poor ergonomics associated with laparoscopy, which leads to surgeon discomfort and risk of chronic musculoskeletal occupational injury particularly during longer procedures, and less complications compared to laparotomy (Seamon et al., 2009; Cardenas-Goicoechea et al., 2011). In bladder cancer: The robotic approach to cystectomy appears to provide acceptable operative, pathological and short-term clinical outcomes, seemingly duplicating the principles and practices of the time tested open surgical technique. Lower surgical blood loss, early return of bowel function and more rapid postoperative convalescence, time to flatus, time to bowel movement and time to hospital discharge, are some of the favorable results of robotic surgery approach (Pruthi et al., 2010).

Barriers to Robotic Surgery in Cancer Care

Despite the strong role of robotic surgery to improve cancer care, the challenges associated with implementing this advance technology remain. Lack of surgical community support for apply this technology in health care centers and suffers from their large size and high cost. Also medico legal and economic aspects of robotic surgery are other difficulties (Curley, 2005). Surgical robotics has a significant impact on physician-patient relationship (Ramirez et al., 2012). Cancer patients need to enjoy peace along with assurance, considering this communication challenge between physician and patient and planning for them will affect the improvement of patient satisfaction and quality of care significantly (Mohammadzadeh et al., 2013). Cumbersome, large, inability to process qualitative information, not versatile is the other disadvantages. For use of this technology note to robot characteristic like degree of freedom, workspace and resolution, speed; force and back drivability, dynamic range, force control versus position control, mechanism type, bandwidth, and stiffness are very important (Camarillo et al., 2004; Gomes, 2011). Use of natural language recognition techniques based on all ontologies, a linear planner algorithm and logical predicates to obtain a sequence of operations to be input to the control system of a robot in order to perform a specific sensitive surgical task according to the requirements expressed by the surgeon in the natural language is necessary (Valencia-Garcia et al., 2005). Prompt open conversion is impossible during the robotic procedure because removing the robotic system is a time-consuming procedure. Prompt open conversion is sometimes necessary for immediate control of serious bleeding (Hyuk Baik et al., 2009). Other important limitations to implementation and use of robotic surgery include: the large amount of space necessary to house the equipment, high costs of initial, use and maintenance, absence of tactile and haptic feedback (Advincula et al., 2009; Hyuk Baik et al., 2009; Wook Kim et al., 2011), safety concerns about robot, and current residency curriculum does not support teaching of robotic surgical skills (Garg et al., 2010).

Conclusion

Health care systems use of information technology tools in order to gain benefits such as early and proper diagnosis, improve treatment and reduce costs. Advances in technology provide modern diagnosis and treatment methods and leads to increase patient and health care providers' satisfactions. One of the advance methods in non invasive surgery is robotic technology. Robots use in different fields such as prevention, diagnosis and treatment. Like other technologies, robotic surgeries have opportunities and challenges. Identifying advantages and limitations and reducing barriers will have a significant role in the accelerating apply of this advance tools in cancer care. Comprehensive view to identify all factors in different aspects such as technical, legal and ethical items that prevent robotic surgery adoption is very

important. Note to surgeons needs can help to achieve appropriate support from physicians. Following factors will have essential roles in usage robotic surgery: provide educational programs for surgeons and operations teams , define and determine legal and ethical issues, use smaller and less expensive of robots, find techniques based on robotic surgery that lead to improve patient outcomes, learn from national and international success experiences.

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