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Robotic Duodenopancreatectomy

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Abstract

INTRODUCTION: Advanced methods of treating pancreatic cancer are being explored to minimize some of the adversities associated with traditional laparoscopy. One of the most promising procedures is robotic duodenopancreatectomy, which appears to reduce morbidity, mortality, conversion rate, hospital stay, and improve oncological results among patients. As such, the procedure is gaining popularity in several medical facilities.

AIM: The article describes robotic duodenopancreatectomy, improved surgical treatment of pancreatic cancer that involves the use of augmented reality.

MATERIALS AND METHODS: The study involves a systematic review of existing literature on robotic duodenopancreatectomy. A total of 16 scholarly articles, published within the past 5 years, are used to synthesize information designed to provide a conclusive summary of evidence related to robotic duodenopancreatectomy. All the materials are retrieved from two medical databases, MEDLINE and ProQuest.

RESULTS/OUTCOME: Morbidity: The rate of morbidity associated with the procedure is relatively high, up to 40%, but slightly lower compared to open laparoscopy, which exhibits morbidity rates of approximately 75%. Mortality: There is evidence of incidences of mortality in robotic duodenopancreatectomy, ranging between 1 and 12.5%. The main cause of death associated with the procedure is post-pancreatic hemorrhage. Conversion rate: The conversion rate in robotic surgery is relatively lower compared to open laparoscopy, ranging between 0 and 37.5%. However, it can decrease to 33.3% after subsequent surgeries. Hospital stay: The procedure is associated with a shorter hospital stays (13.7–24 days) compared to open laparoscopy (25.8 days). Oncological outcomes: Robotic duodenopancreatectomy lacks clear oncological results. However, few studies have established a median overall survival of 15 months.

CONCLUSION: Given that robotic duodenopancreatectomy reduces the rates of mortality, morbidity, conversion rate, and length of hospital stays, it appears to be an ideal treatment of pancreatic cancer.

Introduction

One of the medical operations with promising results of reducing mortality rates among pancreatic cancer patients is duodenopancreatectomy, also known as pancreaticoduodenectomy (PD) or the Whipple's procedure. PD is universally accepted and regarded as the sole chance of survival for patients with tumors of the head of the pancreas, malignant periampullary tumors, distal cholangiocarcinoma, and cancer of the first and second portions of the duodenum [1]. Over the years, the procedure has been improved to incorporate the growth in augmented reality devices to enhance the outcomes of the open PD [2], [3]. As a result of this technological improvement, robotic duodenopancreatectomy is gaining popularity in the field of medicine.

Robotic duodenopancreatectomy refers to the use of robotic platforms in the treatment of pancreatic cancer, such as the Vinci surgical system. The practice requires a remarkable mastery of the facets used in the robotic system, including optimal port placement and accurate coordination between the remotely located console and the surgeon cart [4]. While performing the PD resection, the surgeon controls the platform through a system console that is located separately from the patient and displayed in the vision cart for assistant surgeons to view and manage the process [5]. The required instruments are then attached to the arms of the robot, which is in the patient's cart and navigated from the central surgeon console [6]. The process allows the medical practitioner to have a better view of the area under surgery. Joyce adds that the approach enables the physician to have a three-dimensional stereoscopic observation, whereby the visuals of the head of the pancreas, duodenum, and other surrounding tissues are displayed as an output for each eye, making it easier to locate critical vascular structures [7]. Thus, robotic duodenopancreatectomy is perceived to be an accurate form of laparoscopic surgery.

The article describes robotic duodenopancreatectomy, improved surgical treatment of pancreatic cancer that involves the use of augmented reality. Data obtained from the current literature are used to build on clinical knowledge regarding morbidity, mortality, conversion rate, hospital stay, and oncological results associated with the procedure.

Morbidity

While robot facilitated surgery is an attractive option for the treatment of pancreatic cancer, concerns over chances of morbidity associated with the procedure are always evident. Although the practice has been enhanced since the 1930s, the perioperative morbidity rates remain relatively high, approximately 30% [8]. Other studies reveal high rates of up to 40% [1]. Nonetheless, research shows that cases of morbidity in robotic facilitated surgery are lower compared to those of open PD [9]. For instance, a systematic review conducted by Kornaropoulos showed a significant difference between the two approaches, whereby robotic PD and open PD were recorded at 25% and 75% in one study, and 40% and 67% in another, respectively [1]. In addition, Zimmerman *et al*. discovered that the procedure did not increase 30-day morbidity [10]. However, scholarly exploration by Wang *et al*. and Aziz *et al*. resulted in contradicting outcomes [1], [11]. The data collected showed that no substantial differences in morbidity between open and robotic laparoscopic approaches were evident [12], [13]. These statistics reveal that despite the prevalence of morbidity in robotic duodenopancreatectomy, the outcome is promising compared to that of open laparoscopy.

Majority of the incidents of morbidity in robotic duodenopancreatectomy result from post-operative fistula (POPF). McEvoy defines this condition as a "drain output of amylase-rich fluid" (8, p. 3). In a study conducted by Giulianotti, the incidences of POPF stood at 31.6% among patients undergoing robotic PD [2]. Nahm *et al*. solidified this aspect through a review of the previous research, which revealed that 41% of morbidity cases after pancreatic resection are caused by POPF [14]. However, some surgeons have registered successful procedures that were free of this condition.

Mortality

The complexity of robotic PD may sometimes lead to fatality. Some studies report incidences of robotic PD mortality ranging from 1% to 12.5% [1]. Although there has been a reduction in blood loss associated with the robotic procedure, a large portion of these deaths still arises from post-pancreatic hemorrhage. While the procedure is perceived as accurate, some mishaps may lead to broken vascular structures, especially considering the proximity of the pancreas to blood vessels. However, evidence shows that the risks of hemorrhagic complications are higher in institutions with less experienced surgeons [15]. Therefore, medical facilities that offer such complex services are required to have a competent workforce that can operate the several facets of the robotic system. In addition, medical practitioners are expected to incorporate some of the new and improved therapies, such as palliative radiation, to prevent excessive blood loss during surgery.

Conversion rate

Based on data from the previous studies, it is evident that the conversion rate in robotic PD is relatively lower compared to open PD. The average rate of conversion in most pancreatic robotic surgeries ranges from 0% to 18.3% and 0% to 37.5% [1], [10]. Some of the common indicators of conversion rate include hemorrhage and failure of the patient to respond to treatment. However, research also shows that the conversion rate can reduce after subsequent operations. For instance, the rate of conversion in one of the clinical trials dropped from 33% to 3.3% after 20 procedures [1]. The above information proves that the robotic system is a feasible procedure for the treatment of PD.

Hospital stay

Robotic PD is associated with short lengths of hospital stays (LOS). The previous studies show that the mean LOS after robot facilitated surgery is 13.7–24 days [1]. In other researches, the average duration after the procedure was recorded at 10 days [1]. Shorter LOS in the robotic system may be associated with reduced morbidities, such as hemorrhagic complications and fewer cases of cardiac events, thus allowing the patient to leave the hospital a few days after the surgery. In comparison with open PD, robotic PD has shorter LOS, whereby the former exhibits average stays of up to 25.8 days [1]. Hence, robot facilitated surgery is highly recommended as a means of reducing health-care costs related to prolonged hospital stays.

Oncological Results

Studies are yet to establish substantial long-term oncological outcomes of robotic pancreatic surgery. According to Tanaka *et al*., the major challenge involved in obtaining significant results is failure of researchers to follow-up on patients, thus making it difficult to report on survival data [16]. In addition, the author argues that a selection bias exists, whereby fewer patients with oncological diagnoses are selected for the procedure [16]. However, multiple attempts by scholars to record oncological results in the past few years are available. For instance, Giulianotti *et al*. reported a median overall survival (OS) of 15 months among 10 patients that underwent robotic surgery [16]. Besides, a study showed an OS of 1–45 months among 72 patients [16]. The above results reveal that robotic PD enhances the chances of survival among patients with pancreatic cancer.

Conclusion

Robotic PD portrays promising outcomes in the treatment of pancreatic cancer. The procedure not only reduces the rates of mortality and morbidity but also the length of hospital stays. In addition, robotic PD is perceived to enhance surgical accuracy compared to open PD, thus reducing cases of excessive blood loss. If performed by experienced medical personnel, health complications such as hemorrhage can be prevented. However, the most significant challenge that stakeholders are likely to face in the adoption of the system is the high costs of acquiring the equipment, which translates to expensive medical services among pancreatic cancer patients.

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