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COMPARATIVE OUTCOME OF OPEN VS ROBOTICS ASSISTED SURGERY IN HEPATOBILIARY MALIGNANCIES

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Abstract
This review presents a detailed comparison of open surgery and robotics-assisted surgery in the treatment of hepatobiliary malignancies. Conventional open surgery remains the standard of care in managing large complex tumors because it allows for visual, and palpation based intraoperative assessment of the resection margins and extent of tumor clearance crucial in achieving a R0 resection. But it is linked with increased risk of postoperative complications such as Surgical Site Infection, Wound dehiscence and hemorrhagic events and more hospital stay and longer time to recovery. On the other hand, robotics assisted surgery uses less invasive approaches that improve the accuracy, flexibility and visibility of surgeries using high-definition stereoscopic vision. This modality is linked with reduced intraoperative blood loss, decreased post-operative complications and shortened time for the recovery, because of the decreased inflammation processes and enhanced local tissue repair. At the same time, high costs of robotic systems and long years needed for the surgeon to master the system remain the major challenges that limit the application of robotic surgery. This review makes it clear that, though the oncological results of both surgical approaches are similar in terms of OS and DFS, open surgery is often chosen for extensive resections because of its effectiveness. The growth of robotics-assisted surgery is expected to increase over time due to the development of technologies that make the costs of surgeries less costly and more accessible. Further studies are necessary to determine the oncological outcome, including local recurrence and disease-free survival, as well as the quality of life of the patients. Therefore, the selection of the surgical approach should be personalized based on the patients and tumor characteristics and the resources available at the particular center.

Keyword: Hepatobiliary malignancies, Open surgery, Robotics-assisted surgery, R0 resection, Postoperative recovery, Surgical outcomes.

Introduction
Liver, gallbladder, and biliary tract cancers are some of the most difficult to treat because of their biological characteristics and the fact that they are usually diagnosed at an advanced stage. These malignancies: particularly HCC and CC are associated with high morbidity and mortality particularly in areas with high prevalence of chronic liver disease or cirrhosis [1, 12]. Hepatocellular carcinoma

is responsible for over 75% of primary liver cancer, and surgical resection is one of the few curative options possible, if the cancer is localized and resectable [2]. In table one we see some of the signs that may be associated with such condition if neglected for some time.

Table 1: Common Known Factors and Reasons for Hepatobiliary Malignancies

Common Factors/Reasons	Description	Impact on Overall Survival
Chronic Viral Infections	Hepatitis B and C infections leading to liver damage	Can decrease survival due to liver cirrhosis and cancer risk
Alcohol Consumption	Long-term excessive alcohol intake	Increases risk of liver disease, affecting survival rates
Obesity and Metabolic Syndrome	Non-alcoholic fatty liver disease (NAFLD)	Associated with higher cancer risk and reduced survival
Chronic Inflammation	Conditions like primary biliary cholangitis	Increases risk for malignancies, impacting survival
Genetic Predisposition	Family history of liver cancer or genetic syndromes	May elevate risk and impact treatment outcomes
Exposure to Aflatoxins	Natural toxins found in improperly stored grains	Linked to liver cancer; can adversely affect survival
Age and Gender	Older age and male gender are higher risk factors	Age and gender significantly influence prognosis

Traditional Surgical Approaches

Previously, the standard treatment of hepatobiliary malignancies has been through open surgery. One advantage of open surgery is that it provides direct access to the liver and biliary tract, and that it is the best technique to use for large or malignant tumors that need extensive resection [10]. This method is well understood and has been the benchmark in the treatment of hepatobiliary cancers for many years [13]. However, open surgery has certain disadvantages such as long postoperative hospital stay, more postoperative pain, more infection rate and substantial blood loss [3, 5]. However, open surgery is still crucial for the cases where minimal invasive methods cannot be applied [9]. Surgeons depend on touch sensation which is essential during tumor resection with vessels or during extended liver resection. However, advancement in medical technology has brought other approaches which seem to reduce some of the effects of open surgery.

Robotics-Assisted Surgical Techniques

In the last two decades, robotics assisted surgery has been described as a significant advancement in the treatment of hepatobiliary malignancies [7]. Such equipment comprises the da Vinci Surgical System in providing challenging operations to be minimally invasive and accurate to surgeons. Robotic surgeries have some advantages over open surgeries such as the type of approach used in the surgical incisions, the bleeding and the postoperative convalescence periods [6]. Furthermore, the robotic platform amplifies the surgeon’s movement and vision as well as offers the precision required in eradicating tissues surrounding the hepatic artery and the portal vein [7]. However, the application of robotics-assisted surgery for the treatment of hepatobiliary malignancies is still under debate. However, the MIP are related to the decreased number of days in hospital and the shortened recovery time, the costs and the training of the robotic systems are thus issues [8]. Furthermore, data on the mid- and long-term follow-up outcomes of the robotics-assisted and open surgeries are limited and even more so in cases where radical resection is necessary.

Purpose of the Review

The present review aims at presenting an overview of the available data comparing open versus robotic surgery in treatment of hepatobiliary malignancies. Criticizing patient outcomes, complication rates, recovery time and overall survival, this article seeks to draw a comparative analysis of both surgical procedures. As such it will add to the current discourse on the optimal management of these difficult tumours and serve to inform clinicians regarding the care of patients with these diseases. In fig 1 you can see how the tumors begins and how it progresses.

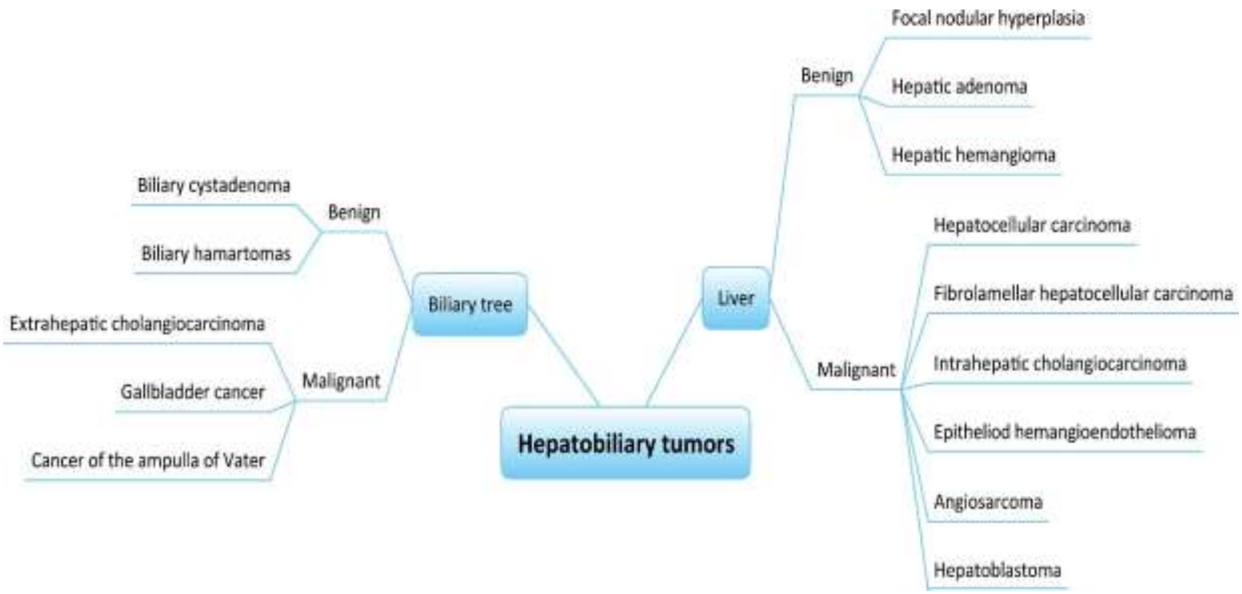

Figure 1: Enumeration of benign and malignant hepatobiliary cancers [49].

Hepatobiliary Malignancies: Current Surgical Landscape

Hepatobiliary malignancies include hepatocellular carcinoma, cholangiocarcinoma, and gallbladder cancer, and pose therapeutic dilemmas. These cancers are mainly diagnosed at an advanced stage because their symptoms are not specific and early screening programs for these cancers are not effective. Consequently, hepatobiliary malignancies are characterized by a relatively poor survival rate and limited therapeutic strategies. Surgical resection remains the mainstay of therapy for patients with localized tumor but many of the patients are considered as surgically unresectable at the time of diagnosis because of extent of disease or involvement of major vascular structures.

While surgery is the mainstay management for hepatobiliary malignancies, an option considered when the tumor is confined to the liver and potentially resectable. Surgical resection or liver transplantation is considered the best curative treatment for patients with early-stage hepatocellular carcinoma (HCC). Liver transplantation should be carried out in patients who have either irresectable tumours or cirrhosis, since simple tumour resection is insufficient to ensure their survival. However, the number of donor organs is scarce, and there are many patients that do not qualify for a transplant.

However, cholangiocarcinoma and gallbladder cancer, which are less common than the other hepatobiliary malignancies, present difficulties because of their location and behavior. Complete surgical resection remains the only curative therapy for these patients, but the architecture of biliary system and the high rate of involvement of surrounding vascular structures make surgical intervention challenging.

The development of new techniques in the management of hepato-biliary diseases over the past few years has increased the spectrum of hepatobiliary operations. Although conventional laparotomy is still the benchmark for extensive resections and complex tumors, the rapid development of robotic surgery has changed the situation. The capacity of making very accurate dissections with reduced invasiveness has made robotics assisted surgery a favorable choice for some patients. However, robotics application in hepatobiliary surgeries is not fully explored and further research is required to establish its long-term effectiveness over the conventional open surgery.

Open Surgery in Hepatobiliary Malignancies

Conventional open surgery has been embraced for years as the reference modality for the management of HBP tumors especially for the complex and advanced stage malignancies [14]. This is an extensive procedure that involves making a large incision to enable direct visualization of the liver, bile ducts or gallbladder, extensive tumour resection and examination of close structures. This approach is recommended for large tumours, tumours close to vital vascular structures, or when a large area of the liver has to be removed [16; 17]. Nevertheless, open surgery cannot be replaced completely in many clinical situations because of its efficiency in performing complex resections [18]. US is employed transabdominally and endoscopically (EUS); it is also the sole imaging method used intraoperatively in HPB surgery (IOUS) in figure 2. Other methods include contrast enhancement (CEUS), doppler mode or elastography have also been used. US became a standard of care in any surgical facility performing liver surgery to image complex and individually variable areas of liver anatomy and to improve tumor detection in real time.

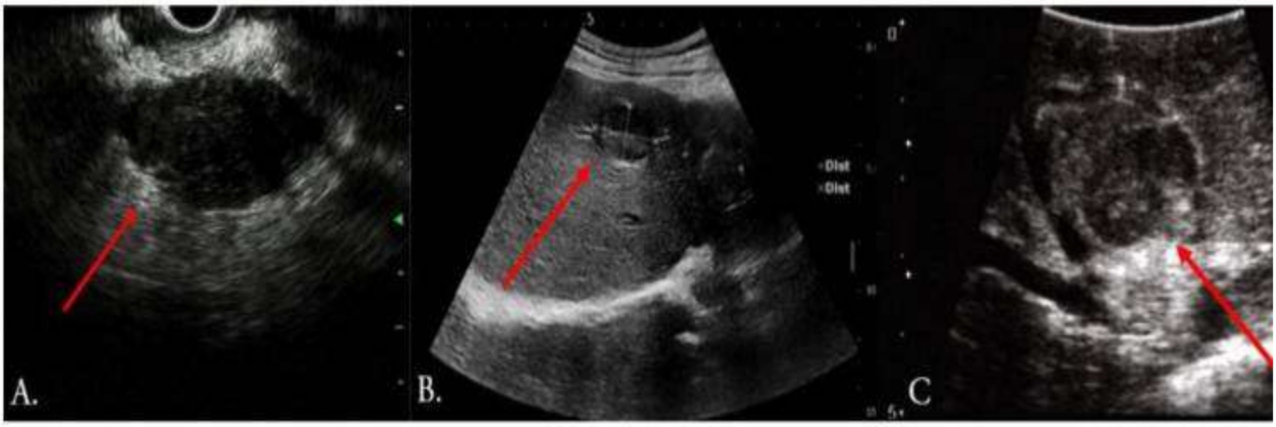

Figure 2: Commonly used ultrasound methods (red arrow indicates mass): (A) endoscopic ultrasound of pancreatic lesion, (B) preoperative transabdominal ultrasound of HCC liver lesion, (C) intraoperative ultrasound of HCC liver lesion close to the vasculature (identical lesion to image (B)). Original figure [50].

Procedure Overview

As with most open surgeries, the surgeon is able to make an incision in the upper abdomen that exposes the hepatobiliary area [17]. Specifically, in liver resection, the surgeon performs the excision of the affected part of the liver containing the tumour with the least amount of healthy liver tissue as possible [20]. In cholangiocarcinoma or gallbladder cancer, the surgeon may have to resect the bile ducts, gallbladder and parts of the adjacent organs if required [16]. Because these cancers are often multifocal, the surgeon needs to avoid injuring these vessels: hepatic artery, portal vein, and inferior vena cava [22].

Benefits of Open Surgery

The main advantage of open surgery is the ability to see the tumour and the area around it and hence have better control of the resection [23]. In open surgery the surgeon is able to feel the liver tissue which is important when assessing the size of the tumour and its spread to the neighbouring structures [14]. This feel is critical in tumors that may not be well visualized on imaging studies [15].

Open surgery also has the benefit that tumors involving major vessels can be treated, and the surgeon has full access in case of the need for vascular reconstruction [16]. Consequently, major hepatectomies, including those exceeding 70% of the liver or multiple segments, are frequently performed through open surgery since the robotic or laparoscopic techniques may be inadequate in terms of exposure and manoeuvrability [17].

Risks and Drawbacks

However, the open surgical procedure has been proved to be efficient in such cases as well as it has a number of drawbacks and complications [18]. Open surgery also carries the risk of postoperative complications because the incision is larger, and may include wound infections, blood loss, and hernias [19]. Further, patients who undergo open surgeries are likely to spend more time in the hospital and also take longer time to recover than patients that undergo minimally invasive surgeries [20]. Possible postoperative complications include postoperative liver failure; this is more prevalent in cirrhotic patients [21]. In these patients, adequate amount of liver tissue must be left behind after resection because the liver is prone to complications after surgery [22]. The rate of liver regeneration is usually slower in patients who have poor liver health, this makes the recovery process to be tougher [23].

Clinical Outcomes

Many papers have compared the survival of patients who have undergone open surgery for hepatobiliary malignancies [14]. Despite the fact that open surgery is generally linked to increased postoperative morbidity, it remains the gold standard for attaining negative surgical margins (R0 resection) in cases with large or complex lesions [15]. Adjuvant negative margins are essential in minimising the chances of cancer relapse, especially in HCC and CC [16]. It has been shown that patients who have R0 resections following open surgery have better long-term survival rates compared to patients with positive margins, R1 or R2 resection [17]. However, the morbidity that comes with open surgery cannot be underrated since; bile leaks, infections and liver failure pose a threat to the quality of life and survival of patients [18].

Robotics-Assisted Surgery in Hepatobiliary Malignancies

Robotics technology has recently become an important advancement in the area of hepatobiliary oncology. This technique enables surgeons perform complicated resections through minimally invasive manner unlike the open surgery as depicted in fig 3. The da Vinci Surgical System is the most common robotic technology used in hepatobiliary operations [24; 25]. It offers improved 3D view, more flexibility, and finer degree of control which are particularly important when doing complicated operations, like liver operations or bile duct surgeries.

Figure 3: During robotic surgery, the camera and other surgical instruments are operated by the robot, which the surgeon controls from a console [51].

Procedure Overview
Robotic surgery involves operation on the patient through several small ports with the help of robotic instruments controlled by the surgeon sitting in a console. Robotic instruments are controlled directly by the surgeon with a significantly greater level of accuracy than is possible using standard laparoscopic instruments [26]. In the context of HPB surgery this approach can be employed for partial hepatectomy, biliary resection, and lymphadenectomy [24]. The fact that the da Vinci system can articulate more than the human hand comes in handy in dissecting around sensitive structures such as the hepatic artery and portal vein [27].
This is because the robotic system gives the surgeon a 3D magnified view of the liver and the biliary tree thereby enhancing the understanding of the surgeons on the detailed anatomy of the liver and the biliary tree. This is especially helpful in detecting small tumor or lesions when other imaging methods may not be able to see [27]. The improved visualization and the use of robotics in turn lessen the amount of tissue that has to be removed and the amount of damage that can occur to the surrounding tissues [28].

Benefits of Robotics-Assisted Surgery
Compared to open surgery, robotics assisted surgery has many advantages especially for the patient and his recovery. The first and foremost is minimally invasive surgery that reduces size of the incisions and amount of blood loss [24]. Patients who have undergone robotics assisted surgery for surgery reported less postoperative pain and less time to recovery than those who have been subjected to open surgery [26].
Apart from shorter time to recovery, robotics assisted surgery also entails less days in the hospital and less time to get back to normal functioning [29]. Patients that have undergone robotic liver resections have been found to have lower postoperative morbidity including bile leakage and infections than those who undergo open surgery [24]. This is especially helpful for patients with preexisting liver disease in which reducing operative invasiveness could be crucial [26].
Another important advantage is the ability to accomplish the same work with higher accuracy when working with intricate procedures. This means that the robotic system has a better capacity in the operating theatre to perform delicate dissection and suturing without many mistakes. This is particularly so for tumors that may be close to critical vessels or in parts of the liver that are hard to access [24; 25].

Risks and Limitations
As valuable as it may be, however, robotics-assisted surgery has several drawbacks. A major disadvantage is the cost of the robotic systems themselves, as well as the perpetual maintenance costs that are synonymous with robotic applications [29]. The capital outlay required for acquiring a robotic system, the costs incurred in the training of surgeons and the cost of maintaining the system are challenges which are expensive for many healthcare organisations [28].
A limitation is the fact that there is a rather steep learning curve while practicing robotic surgery. Compared to the conventional laparoscopic techniques the da Vinci system offers improved capabilities, but surgeons have to undergo a steep learning curve to become familiar with the system [27]. This can influence the early results of operative procedures when surgeons adapt robotic techniques from the conventional ones [29].
In addition, robotics-assisted surgery may be ineffective for all patients or all kinds of hepatobiliary malignancies (see table 2). However, for the large or complex tumor, the open surgery could still be the choice because it allows more extensive exposure of the liver and surrounding structures [24]. Robotic surgery is in most instances most appropriate for smaller tumors or where high levels of precision and minimal invasiveness is most advantageous [29].

Table 2: Risks and Limitations of Robotics-Assisted Surgery in Hepatobiliary Malignancies

Risk/Limitations	Description
High Cost	Significant upfront investment for robotic systems, ongoing maintenance, and training costs.

Learning Curve	Requires extensive training for surgeons to achieve proficiency, which can impact early procedural outcomes.
Patient Suitability	Not suitable for all patients or types of tumors; larger or complex tumors may still require open surgery.
Access Limitations	Limited access to the entire liver and surrounding structures compared to open surgery.
Best Use Cases	More effective for smaller tumors or cases benefiting from precision and minimally invasive techniques.

Clinical Outcomes

Several researchers have shown that robotics-assisted surgery holds a significant potential in the treatment of hepatobiliary malignancies. Specifically, patients who have robotic liver resections are likely to record fewer complications and less days in hospital than patients who have open surgery [27]. In a 2021 study comparing robotic and open hepatectomy for hepatocellular carcinoma it was observed that robotic surgery was less marginal in terms of blood loss, transfusion requirement and bile leakage [24].

However, the longer-term effects of robotics in surgery still remain a research topic. The benefits that have been described include less pain and early mobilization but there is still paucity of information on survival and recurrence rates when compared to open surgery [28]. Several authors have indicated that robotics assisted surgery may offer equivalent oncological results of open surgeries, but more studies should be carried out to establish these results on larger population sizes [25; 26].

Comparative Outcomes Between Open and Robotics-Assisted Surgery

The two approaches of open and robotics-assisted surgery in treating hepatobiliary malignancies remain up for discussion. Each of these approaches possess their own merits and demerits, and the selection of the method totally depends on the status of the patient, literature characteristics of the tumor, and the experience of the surgeon. A number of works have focused on the results of both types of surgery regarding the differences in the operation time, blood loss, complications, and the time to recovery, and 5-year survival rates.

Operative Time and Blood Loss

Among the most important factors which are considered when performing surgery are the time required for the surgery, the time that a patient stays under anesthesia, or the time needed to complete the surgery, which can all influence the outcome of the surgery. It was established that the usage of robotics in performing surgery results in longer operating time compared to open surgeries, mainly due to time spent to prepare the robotic apparatus and positioning the robotic instruments [30]. Robotic vs open hepatectomy meta-analysis published in 2020 found that average operative time for robotic surgery was around 30 minutes longer than that for open surgery [31].

Even though the overall operating time is more with a robotic approach, the blood loss is less as compared to the other procedures. The robotic system has better control and visualization, hence performing more delicate dissection without causing harm to other tissues and blood vessels [32]. Several investigations have concluded that blood loss in robotically performed liver resections is lower than in open surgery and that the rate of blood transfusion is also lower [33].

Complication Rates and Recovery Times

Robotics-assisted surgery is shown to have a lower incidence of postoperative complications than open surgery. Robotic surgery, being minimally invasive leaves tiny scars and minimal chances of wound infection, developing hernia or any other concomitant complications linked to the large opening made in conventional surgeries [34]. A study done in 2019 by Liu et al. Retrospective cohort study showed that patients who received robotics-assisted hepatectomy had less bile leakage, wound infection rates, and other complications than open surgery [35].

In the case of patients who undergo robotics-assisted surgery, they have shorter recovery time than the rest. Less tissue handling and trauma mean less pain after the surgery and early rehabilitation [36]. Most patients who have been operated on by the use of robots have lesser hospital stays and early normal activity recovery. On the other hand, laparoscopic surgery entails shorter hospitalization and shorter rehabilitation time as compared to open surgery since it involves a larger incision and is more complex [37].

Long-Term Survival and Oncological Outcomes

The short-term advantages of robotics-assisted surgery are evident in the recovery and complication rates; however, the oncologic results are still a controversy. The main objective of resection for hepatobiliary cancer is to obtain clear margins (R0 resection) which minimizes the risk of cancer relapse [38]. While open and robotic surgeries seek to obtain R0, the ability of robotic surgery to achieve R0 resections, especially in complex cases, has not been established yet.
Several authors have indicated that oncological results of robotic surgery are comparable to those of open surgery, especially in the case of small-medium sized tumours [39]. However, for large or centrally located tumors that involve critical structures, open surgery may provide the best shot at accomplishing a greater extent of resection [40]. A recent study of robotic versus open liver resections published in 2021, concluded that both approaches have comparable five-year survival probabilities; however, the study identified that the patients with large or complicated tumors have better survival probability if they underwent open surgery [38].

Cost Considerations

The high cost of the equipment is probably one of the major drawbacks of using robotics in surgery. The initial cost involved in procuring robotic systems combined with the cost of maintenance and training of the robot makes the robotic surgery expensive than open surgery [41]. Some authors have questioned the cost-effectiveness of robotic surgery especially in the situation where the outcomes are as good as those achieved by open surgery [42]. In addition to reduced complication rates and shorter hospital stays, the financial costs of robotic surgery may far outweigh the benefits for centres with limited resources [43]. Table 3 presents the difference conditions of each kind of surgery.

Table 3: Comparison of Open Surgery and Robotics-Assisted Surgery in Hepatobiliary Malignancies

Criteria	Open Surgery	Robotics-Assisted Surgery
Incision Size	Large incision required	Small incisions (minimally invasive)
Operative Time	Shorter setup time, faster for large/complex tumors	Longer setup and operative time (especially in early cases)
Blood Loss	Higher blood loss, may require transfusion	Reduced blood loss due to enhanced precision
Complication Rates	Higher complication rates (e.g., infections, hernias)	Lower complication rates (e.g., fewer infections, less trauma)
Recovery Time	Longer hospital stays and recovery periods	Faster recovery and shorter hospital stays
Tactile Feedback	Provides direct tactile feedback	Lacks tactile feedback, relying on enhanced visualization
Cost	Lower upfront cost	High upfront and maintenance costs
Surgeon Learning Curve	Surgeons are generally more experienced in open surgery	Steep learning curve; requires extensive training
Oncological Outcomes (R0)	Reliable for achieving R0 resections in complex cases	Comparable R0 resection rates for smaller tumors
Suitability for Complex Cases	Preferred for large, complex, or centrally located tumors	Best suited for small to medium tumors, minimally invasive cases

Table 1 summarizes the similarities and differences of robotic and open surgery, stating that, although the setup time for robotic surgery is longer than for open surgery, the precise control of the instruments used in robotic surgery minimizes intraoperative risk. Further, robotic operations have less blood loss compared to open procedures to reduce the number of transfusion and improve healing. The use of robotic surgery is not invasive, thus; it results in less postoperative complications and hence patients can be discharged early. The overall survival rates are similar for both techniques however open surgery is more often used in the case of larger or more advanced tumours. But the robotic surgery is more expensive because of the equipment and their maintenance charges.

Cost and Training Considerations in Robotics-Assisted Surgery

Hepatobiliary malignancy has benefited from robotics assisted surgery because it has provided enhanced accuracy in many cases. However, the use of robotic systems in operating rooms is limited because of the high cost of these technologies and necessary equipment, as well as the time needed for surgeons to master robotic systems.

Cost of Robotics-Assisted Surgery

Robotic surgeries are relatively expensive, and the cost of investment in robots essential for the surgeries is much higher than that used in open surgeries. The Robotic surgical systems include the da Vinci Surgical System which costs between $1.5 to $2 million USD per unit [43]. Besides initial costs, there are also operational costs, which include maintenance, software updates, and replacement of parts such as robotic arms, which may run to thousands of dollars per procedure [44].

Research has indicated that the cost of robotic surgery is often more expensive than open surgery, despite shorter hospital stays and few complications [45]. A further 2019 study comparing economic cost of robotic and open liver resection showed that the robotic procedures cost between 20 and 30 percent more than the open procedures because of the costs of the robotics equipment and accessories [46]. In hospitals, this is equivalent to increased procedural costs, which can hamper the practicality of robotics-assisted surgery, particularly in the developing world [47]. Despite the claims that the longer-term costs of fewer complications and shorter lengths of stay might just about cover these in advance, the costs are high, and, especially for smaller health care delivery institutions, prohibitive [46]. The issue of cost-saving in the use of robotic surgery is still contentious even where the clinical results are comparable with those of open surgery [43].

Training and Learning Curve

Another driver that plays a key role in the decision to adopt the technology is the high cost of training the surgeons to master the use of this technology. Even though the robotic system increases the dexterity and control of the surgeon, its operation poses a challenge to mastery. The robotic system requires surgeons to complete special training to understand its functions, movements, and how to apply it safely for robotic surgery [48].

Robotic surgery has a steep learning curve and the data emerging from some of the research indicate that a surgeon may need to perform more than 20 to 30 operations to become proficient [49]. This is partly a concern, especially given the fact that there are many surgeons who have practiced open surgical procedures for many years and are now facing the reality of having to master other skills [50]. Education on the use of robots in surgeries is expensive and takes a lot of time. The training of hospitals requires simulation-based training modules, workshops and proctoring programs and all these increase the cost of implementing robotics-assisted surgery [44]. Besides, the learning curve associated with robotic surgery may initially affect the rate of effective surgeries performed by a surgeon [45]. In Fig 4 we can see how much of difficulty in learning robotics assisted surgery.

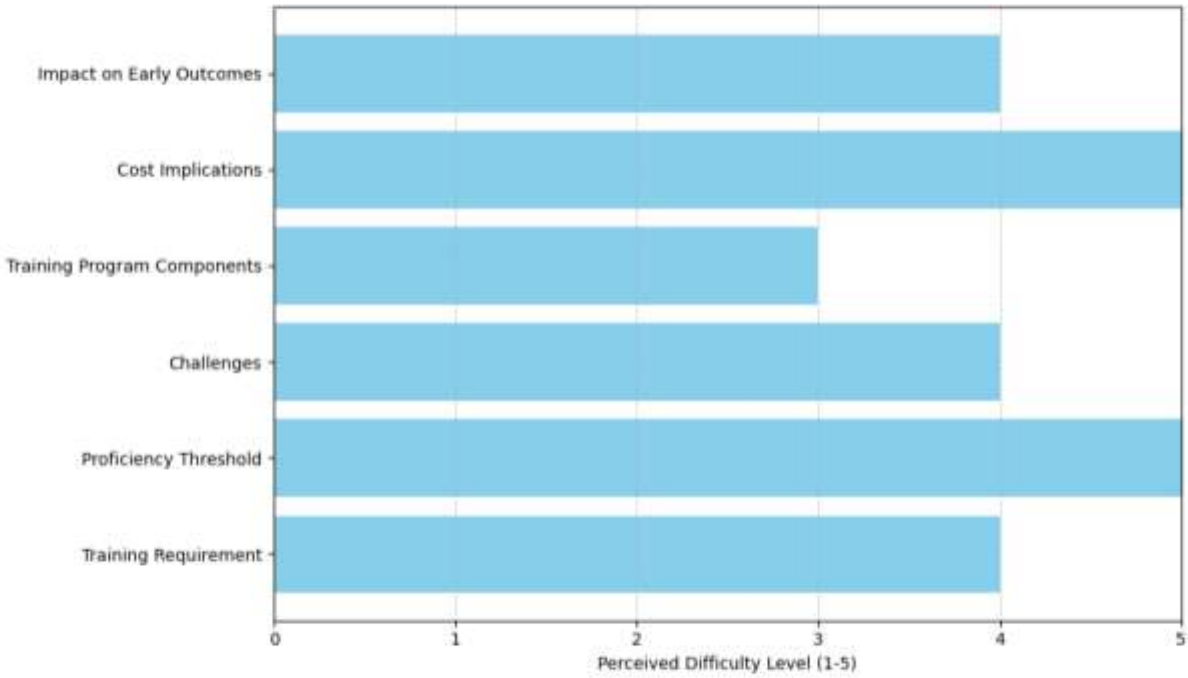

Figure 4: Challenges in the Training and Learning Curve for Robotics-Assisted Surgery

Impact on Healthcare Institutions

The cost of financing and learning robotics-based operations may prove to be a challenge in health care institutions especially when the institutions have constrained resources. It was noted that small hospitals may not afford the initial costs of robotic systems, mainly due to the limited number of performed hepato-biliary operations [43]. Moreover, if there is a requirement for constant training which in turn involves expenditure, then the possibilities of implementing robotic systems may decrease [46].

On the other hand, larger Academic Medical Centres and specialized cancer hospitals will be better placed to adopt the use of robotics in surgery. These institutions usually have the capacity to procure the sophisticated equipment, and it would take surgeons a shorter time to be trained in the use of the robotic systems that are employed [50]. Robotic-assisted surgery is also informed by institutional reputation. Robotic surgery is viewed by many of the highest ranked hospitals as a means of attracting patient volume to those seeking the most advanced minimally invasive surgery [48]. This has created a vicious circle where hospitals spend on robotic systems to be among the first in line in surgical procedures even though the system may not be very economical at the initial stages [49].

Key Points:

- Costs: Robotic surgery is expensive mainly because of equipment and their maintenance costs.
- Training: The high initial learning curve and the continuous education programs that are needed for the adoption of robotic surgery also create longer time and more investments.
- Impact on Healthcare: Constraints on funds and training can slow down the use of robotic surgeries, particularly in mid-sized health facilities. (See. fig 5)

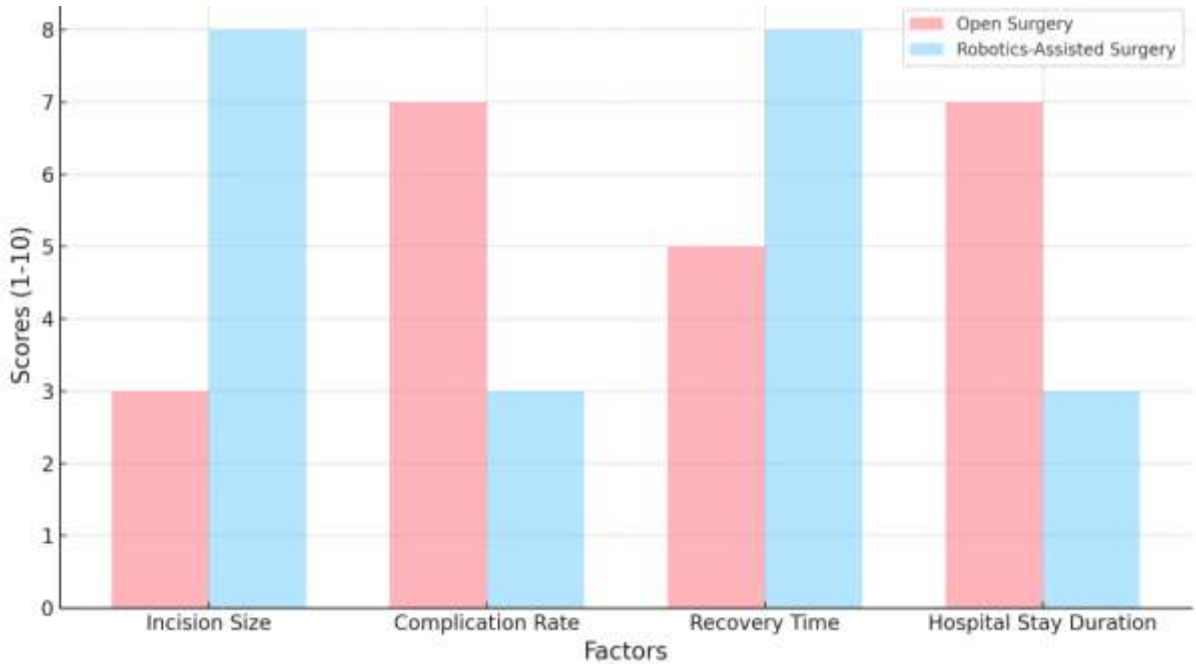

Figure 5: Comparison of open surgery vs robotics-assisted surgery

Conclusion

The present study compares open and robotics-assisted surgery for the treatment of hepatobiliary cancers and the benefits and issues with each method. Open surgery permits direct visualization and handling of the tissues, permits gross excision of large, bulkier and more complicated tumors, which is a major predictor of outcome. However, the open procedures expose more aspects to complications, cause longer hospital to stay and a longer recovery time mainly because they are invasive. On the other hand, robotics assisted surgery is done endoscopically, where there is better vision and control, little blood loss, pain and hospital stays. While outstanding for small cancers or patients requiring small invasion, costs remain high and extensive learning is mandatory. At present, long-term effectiveness data of robotics are essentially scanty; they are even scarce as to large tumors, therefore, the problem still deserves further investigation. Robotics adoption may benefit from technology advancements that may reduce the costs and increase the availability of solutions. Despite the fact, that open surgery is optimal for larger or complex tumours, robotics assisted techniques could potentially equal or even surpass open approach for the specific patient if only more data shows similar or better results. When determining the best approach to the surgery, the doctors look at both the patient and tumor factors, alongside the capacity of the hospital. In conclusion, open surgery is still paramount in the management of hepatobiliary cancer; however, robotics-assisted surgery has started to show its potential where it is applicable. The two techniques have been compared between larger groups of patients over a longer duration than 2 years, and possible variations of tumor size and complexity have been excluded to allow for better understanding of their application. Solutions that help make robotic systems more financially viable may soon increase their use. However, patients, tumour characteristics, and hospital resources should guide the determination of the most suitable mastectomy type.

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