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Review Article

ROBOT-ASSISTED SURGERY IN PAKISTAN: A SWOT ANALYSIS

MUJAHID MUF[*1], BAIG Z[2]

[1]*Medical Student, University of Health Sciences, Lahore, Pakistan*
[2]*Demonstrator, Lahore Medical & Dental College, Lahore, Pakistan*
**Correspondence author email address: theansariuf@gmail.com*

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Abstract: *The Sindh Government Qatar Hospital in Karachi installed Pakistan's first DaVinci S (DVS) system in 2011. Later, in 2013, Civil Hospital Karachi adopted more advanced DaVinci Si (DVSi) robotic equipment. Recently, in April 2023, the Pakistan Kidney and Liver Institute (PKLI) performed Radical Nephrectomy Robot-assisted Surgery. Essential search terms were finalized for a systematic review, and selection criteria were defined. The finalized keywords were entered into Pub-Med, Pakmedinet, and ERIC databases, resulting in 2084 articles. Grey literature was searched through Google Scholar, yielding 509 articles. After the initial screening of 437 out of 509 studies, 72 articles met the eligibility requirements according to the PRISMA guidelines. However, 39 articles were excluded, leaving 33 to be incorporated into the study. A successful robotic surgery program requires well-trained operating room personnel, dedicated surgeons, supportive hospital administration, adequate financial resources, and a strong marketing strategy. Despite meta-analyses indicating that robotic surgery has not outperformed conventional surgery, marketing can help mitigate the high treatment costs by increasing the number of patients, thereby ensuring the program's long-term viability.*

Keywords: Robot-Assisted Surgery, SWOT Analysis, Davinci Si (Dvsi), Marketing

Introduction

In 2011, Karachi's Sindh Government Qatar Hospital made history in Pakistan by installing the country's first DaVinci S (DVS) system, a robotic surgical system designed to assist surgeons in performing minimally invasive surgeries. However, the system eventually collapsed due to a lack of feasibility studies before the acquisition and issues with the procurement of instruments and funding for maintenance (Ghazanfar, 2019; Ullah et al., 2023).

Two years later, the Civil Hospital Karachi adopted a more advanced robotic surgical equipment, the DaVinci Si (DVSi). The Sindh Government also funded this system, and they now support 150 cases annually at no cost to patients. The UK-based Cambridge Medical Robotics Surgical (CMR) was also deployed at the Sindh Institute of Urology and Transplantation (SIUT) in Karachi, further expanding the robotic surgery options in Pakistan (Ghazanfar et al., 2019).

Other hospitals in Pakistan have also reported performing robotic surgeries, including the National Hospital and Medical Centre in Lahore. In April 2023, the Pakistan Kidney and Liver Institute (PKLI) made history by performing a Radical Nephrectomy Robot-assisted Surgery. 1st Robotic Surgery at JPMC was performed in october, 2023 in which the gallbladder of a 34-year-old patient was removed in just 25 minutes and the patient recovered steadily (Ullah et al., 2023).

Adopting robotic surgical systems in Pakistan has been a slow but steady process, with some setbacks due to financial and logistical issues. Nonetheless, the continued success of these systems in various hospitals across the country is a promising sign for the future of minimally invasive surgeries in Pakistan (Finotti et al., 2023; Lanfranco et al., 2004).

Methodology

After the initial screening of 437 out of 509 studies, 72 articles met the eligibility requirements according to the PRISMA guidelines. However, 39 articles were excluded, leaving 33 to be incorporated into the study.

This SWOT Analysis aimed to identify the issues that were or were not addressed in the selected original articles about robot-assisted surgery in Pakistan between 2018 and 2023. The basic methodology used was the SWOT Analysis, which measures the strengths, weaknesses, opportunities, and threats of robot-assisted surgery in Pakistan. Key phrases searched for included "robot surgery, robot-assisted surgery, robot surgery in Pakistan, artificial intelligence in surgery, and research ethics" in consideration of the primary research question, "What are the current strengths and weaknesses of robotic surgery in Pakistan along with its future opportunities and threats?" After finalizing the search parameters, selection criteria for the systematic review were established.

The conclusive keywords were entered into PubMed, Pakmedinet, and ERIC databases, which led to the discovery of a total of 2084 publications. The search for grey literature was conducted using Google Scholar, and it yielded 509 articles. During the preliminary screening, 437 out of 509 were eliminated. 72 articles satisfied the

requirements to be eligible for the study; however, 39 were disqualified, leaving a final count of 33 articles to be included.

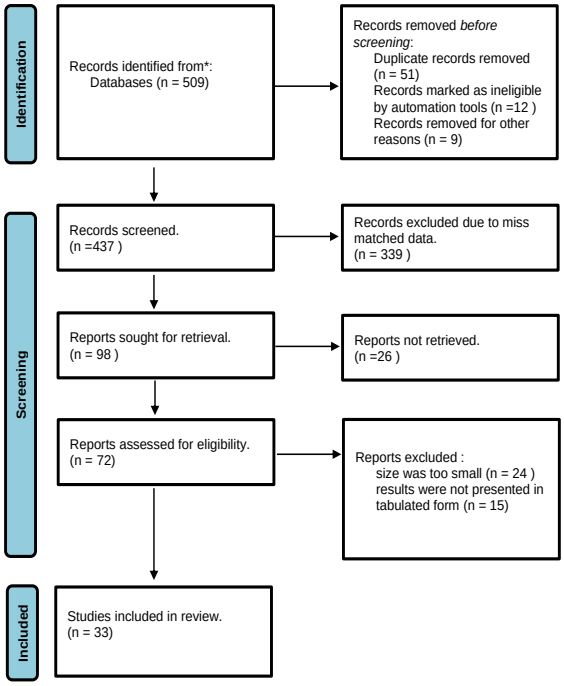

Figure 1: Selection Flow-Chart According to PRISMA Guidelines:

Criteria for the Selection of Identified Studies
Article Selection Criteria (Upon Title Search)
1. Articles in English Language 2. Studies from 2018-2023 3. Original articles 4. Systematic Reviews of Original Articles
Inclusion Criteria of Full Text
1. Research concerning and focusing on robot-assisted surgery's Strengths, Weaknesses, Opportunities, and Threats. 2. Research based on work conducted in Pakistan
Full-Text Exclusion Criteria
1. Research articles before 2018 were excluded 2. Articles not relating to our study aim were excluded

SWOT Analysis:

1. **STRENGTHS**

i. **Addition to Proficient Surgeon's Contingent:**

Robotics has also advanced surgical precision because of its enhanced ergonomics, motion scaling, and tremor filtration (Vigneswaran et al., 2020). In Pakistan, where the number of experienced surgeons is rising, it is a very valuable addition to the field of surgery (Bittner IV et al., 2018).

ii. **Volume of Patients:**

Any surgical project relies on many patients, standardization of all surgical stages, and repeated experiences with the same illness to reinforce precise management guidelines and ensure effective and economical resource use (Bora et al., 2020). Pakistan is the 5th most populous country in the World, with a median age of 22.8 Years (Adams et al., 2021). Thus, it reduces the burden on a surgeon, and there are numerous opportunities for the intellectual development of a surgeon to develop novel procedures and techniques due to increased patient volume.

iii. **Reduced Length of Stay of Patients in Hospital:**

In Pakistan, Due to resource constraints and population growth, tertiary hospitals have struggled to meet public healthcare needs (Malik and Bhutta, 2018). City hospitals have patient inflow from faraway regions. They are overworked and lack financial and human capital, with a 94% bed Occupancy rate daily and a shortage of beds for patients (Faisal et al., 2023). Robotic surgery reduces the time of stay of patients in the hospital (Chiu et al., 2023; Kaouk et al., 2020; Nobbenhuis et al., 2023) and allows same-day discharge (Abaza et al., 2021). It also has low surgical costs (Lenfant et al., 2021).

Summary of Strengths of Robot-Assisted Surgery in Pakistan
1. Enhanced ergonomics, motion scaling, tremor filtration, and robotics have also advanced surgical precision.
2. Reduces the burden on surgeons along with intellectually developing surgeons of a developing country
3. Standardization of all surgical stages despite the high number of patient inflow in countries like Pakistan
4. Low Surgical Costs due to the increased volume of patients in populated countries like Pakistan
5. Reduces length of stay in hospital, thus minimizing shortage of hospital beds.

2. **WEAKNESSES**

i. **Huge Investments:**

The price of a Da Vinci Robot is not less than 2 million United States dollars on average, which does not include the cost of maintenance every year. As a result, significant cash expenditures are necessary for robot-assisted surgery at the end of the hospital (Ielpo et al., 2018).

ii. **Recurring Cost of Consumables**

The recurring costs of consumables are also always present (Abdelmoaty et al., 2019). New robots are expensive. Therefore, a comprehensive maintenance, growth, and progress strategy is required to successfully deploy a robotics program that meets global standards in Pakistan. Before beginning, evaluate cost, resources, patient duress, appropriateness, and efficiency. The business paradigm for robotic surgery should align with Pakistan's healthcare

system. In countries with low per capita income, like Pakistan, project efficacy and outcomes may require frequent modification and adaptation. Financial and commercial trends should guide the monitoring of robotic surgical procedures. The course necessitates maintenance, employment, and instruction. Due to high installation and maintenance costs, hospitals may avoid implementing robotic programs (Khoraki et al., 2020; Ullah et al., 2023).

iii. **Device Malfunction**

The risk of devise function always stays intact while using robotics. A study by Covas et al. found that the median operating time was 121 min, console time 85 min, and blood loss 50 ml. No complications arose. The final pathology showed four Gleason 6, 20 Gleason 7, one Gleason 8, and one Gleason 9.30% were ≥pT3a and 70% were ≤pT2. Positive surgical margins were 11%. This study is restricted by the small number of patients and short follow-up to assess this cutting-edge device's operational and oncological effects (Moschovas et al., 2020). Robotic devices used for surgery have certain limitations in the era of efficient value-based health care due to various factors, but they are a very beneficial innovation (Moschovas et al., 2020; Moschovas et al., 2021).

iv. **Training and Research:**

Pakistan doesn't have any proper training Regarding Robotic surgery. A study concluded that although IT and healthcare specialists demonstrated a high level of expertise in their respective fields, only a select few possess digital and healthcare expertise. Trans-disciplinary curricula and multi-disciplinary teams are essential for bridging skill disparities between disciplines and driving the implementation of digital health initiatives (Lee et al., 2023). Pakistan has a low proportion of research productivity (Imran, 2023). Thus, any future concern will not get early recognition in these conditions. Thus, a proper registry of robot-assisted surgeries must be formulated to recognize and eradicate such matters.

Summary of Weaknesses of Robot-Assisted Surgery in Pakistan
1. Initially, significant cash expenditures are necessary for the robot-assisted surgery at the end of the hospital.
2. The recurring costs of consumables, which are not easily available in industrially deprived countries like Pakistan
3. Comprehensive maintenance, growth, patient duress, appropriateness, and progress strategy are required to successfully deploy a robotics program that meets global standards in Pakistan.
4. Pakistan lacks proper training Regarding Robotic surgery, and only a few surgeons possess digital and healthcare expertise.
5. Robotic devices used for surgery have certain limitations in the era of efficient value-based health care due to various factors.

3. OPPORTUNITIES

i. **Utilization of Multi-disciplinary Technologies Advancement**

Hicks et al. concluded that to establish evidence-based guidelines, progress must be made in personalizing interventions to an individual's social, cultural, and built environments and evaluating the relationships between mobile technology data and health. By reviewing these strategies and emphasizing future research directions, we promote using theory-based, personalized, and human-centered initiatives to encourage health behaviors (Hicks et al., 2023).

ii. **Medical Tourism**

Robotic surgery has immense potential to attract medical tourism (Collins et al., 2022; Hanefeld and Smith, 2019; Wong and Hazley, 2020). It is also promising in Pakistan (Malik and Bhutta, 2018).

iii. **Standardization Based on Technology**

An instance of open discussions led to considerable changes in the use of EPR within team meetings, and one of the results of these changes was the reconfiguration of components of multi-disciplinary practice. Our research contributes to the expanding body of research that examines both the practicability and the imperativeness of reaching high levels of standardized, uniform utilization of health data technology in healthcare settings (Oborn et al., 2011).

Summary of Opportunities of Robot-Assisted Surgery in Pakistan
1. Robotic surgery has immense potential for attracting medical tourism, especially in Pakistan, due to its geographical location, low living costs, and other factors.
2. Utilization of Multi-disciplinary Technologies Advancement in IT and Healthcare Sector as both are emerging domains in Pakistan
3. Automatic standardization Based on Technology which is necessary in Pakistan

4. THREATS

i. **Training Exposure Compromise**

Pakistan requires a skilled staff serving hundreds of thousands outside of urban areas. Due to the scarcity of robotic equipment, skilled surgeons/ Urologists who can perform both open and laparoscopic procedures are preferred. Conversely, residents and fellows are exposed to fewer open and laparoscopic procedures in educational institutions with robotic facilities. This can result in a void in the educational experience of these new residents, who will be required to execute open/laparoscopic surgeries independently in settings where robot-assisted facilities are unavailable.

ii. **Fear of Missing Out**

In the lack of robotics, laparoscopy is preferred to robotic surgery in developing nations. The majority of urologic treatments are laparoscopic. Robotic assistance improves vision, ergonomics, and dexterity, but its curative properties remain unknown. Robot-assisted surgery is prohibitively

expensive compared to laparoscopy. Wristed technological advances and 3D visualization can overcome the limitations of laparoscopy for less money than robotic technologies. In nations with limited resources, laparoscopic urology is growing. Technology expenditures should be rational (Bansal et al., 2021).

iii. **Infection's Risk**

Robotic instruments had more protein and residue contamination. According to Saito et al., complicated robotic surgical tools require new cleaning and categorization. Removing protein from surgical equipment entirely is nearly impossible, which puts patients at risk for unknown pathogens and prion-based disorders (Saito et al., 2017). Robotic surgery has not outperformed conventional surgery in meta-analyses, casting doubt on its efficacy (Chang et al., 2018; Ilic et al., 2018; Venkatramani et al., 2020).

Summary of Threats of Robot-Assisted Surgery in Pakistan
1. Compromise in training exposure of young surgeons as technology exposure should be rational, especially in developing countries where it is nearly impossible to imply ample robotics.
2. It is nearly impossible to entirely remove protein from surgical equipment, which puts patients at risk for unknown pathogens and prion-based disorders.
3. Robotic surgery has not outperformed conventional surgery in meta-analyses, casting doubt on its efficacy; thus, further research is required, which is impossible in developing countries like Pakistan.

Discussion

Between 2018 and 2023, the research review article examined the strengths, weaknesses, opportunities, and threats (SWOT analysis) of robot-assisted surgery in Pakistan. Among the strengths identified are the huge number of patients in Pakistan, shorter hospital stays, and the incorporation of robotics into the surgeon's arsenal. Increased precision and comfort during robotic surgery are assets in a country with a growing need for qualified surgeons. Pakistan's enormous population and patient volume also provide many opportunities to advance surgeons' skills and techniques. The term "robot-assisted surgery" refers to a procedure that involves using a computer program. Robotic systems' high initial and ongoing costs may discourage hospitals from adopting them. Hospitals need a thorough plan before using robotics because of the ongoing expenditures of consumables and the danger of equipment breakdown. Furthermore, future difficulties relating to robotic surgery may be less easily identified and resolved due to the absence of suitable training facilities and low research productivity in Pakistan. The research review also found opportunities for the development of robotic surgery in Pakistan. Patient outcomes can be enhanced through personalized therapies and transdisciplinary technologies. Robotic surgery might boost medical tourism and healthcare practices, and data utilization would benefit from technological standardization. The SWOT analysis also revealed potential threats to robotic surgery in Pakistan. Residents and fellows may be deprived of valuable training opportunities because of a lack of available robotic facilities. Also, some may hesitate to adopt costly robotic technologies for fear of losing access to conventional laparoscopic surgery. Further complicating matters is the potential for infection from robotic equipment and skepticism over the superiority of robotic surgery over more traditional approaches.

Conclusion

Overall, the research review highlights the potential benefits and obstacles facing implementing robot-assisted surgery in Pakistan. The potential benefits of using robotic systems are shown by the strengths of increased precision and shorter patient hospital stays. However, the weaknesses must be addressed to ensure successful adoption, such as high initial costs and device malfunctions. Medical tourism, standardization, and multi-disciplinary technology all create opportunities for advancement. However, there is a need to carefully manage threats such as training exposure, cost-effectiveness, and infection risks. In sum, the results of this research review can educate healthcare policymakers, institutions, and stakeholders in Pakistan on the existing and future status of robot-assisted surgery in the country. The entire potential of robotic surgery cannot be attained without sufficient funding for training facilities, incentives for increased research output, and supplies. Pakistan may better serve its people by utilizing the benefits of this novel surgical strategy once the country has addressed the identified weaknesses and threats.

Declarations

Data Availability statement

All data generated or analyzed during the study are included in the manuscript.

Ethics approval and consent to participate

Approved by the department concerned.

Consent for publication

Approved

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Conflict of interest

The authors declared the absence of a conflict of interest.

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