Clinical Practice Assessment
Robotic surgery

Background:
Surgery is by nature invasive. Efforts have been made over time to reduce complications and the trauma inherently associated with surgery through new instruments, techniques and minimally invasive procedures. Robotic-assisted instruments may allow more flexibility, stability and enhanced vision that could be a further development in this evolution.

The recent introduction of robotic surgery technology has led to questions about the clinical and economic impact that should inform future decisions about its acquisition and potential expanded use. To answer such questions requires comparison studies using robotic assisted surgery with current best practice. These studies need to consider direct surgical costs but also associated costs that may be influenced by:

- Length of stay
- Blood loss and transfusion rates
- Positive margin rates for resection
- Incidence of complications
- Operative times
- Overall recovery time

Studies need to account for bias in case selection and surgeon experience with alternative techniques. The use of robotics may assist a surgeon doing technically difficult laparoscopy cases allowing surgeons the opportunity to offer a wider array of services that would otherwise not be possible.\textsuperscript{12}

Each specific surgery needs to be evaluated separately to determine its usefulness.

Bottom Line:
Robotically assisted surgery may offer certain advantages as a less invasive compared to open procedure and in technically difficult to preform laparoscopy cases. However, the costs are higher and the potential benefits are not necessarily obtained in a community setting. Definite improved clinical outcomes have not been proven. The evidence remains limited and of low quality.

Summary of Cardiovascular Uses of Robot: \textsuperscript{1}

The following provides a summary of limited, low quality data. Interpretation of the available data is complicated by the considerable variability in study comparators and by the heterogeneity within study groups. Outcomes are highly dependent on the specific technique and surgeon skill. Further research, including RCTs are required to define the precise role and patient selection criteria for the various robot-assisted minimally invasive cardiac procedures.\textsuperscript{2}

Robotic Coronary Artery Bypass Grafting vs. Off-Pump bypass (OPCAB)

- Increased Operating Room time
• Reduced transfusion requirements
• Reduced time in ICU
• Reduced intubation time
• Reduced length of stay
• A single level II case-controlled study (comparing IMA grafting + stenting vs. sternotomy CABG using IMA and saphenous veins off-pump) showed reduced major cardiovascular complication over 12 months (4% vs. 26%)
• Increased hospital costs ($18,600 vs. $16,100 without cost of robot; $23,400 vs. $16,100 with cost of robot)

**Robotic Mitral Valve Repair vs. Sternotomy**
• Increased operating room time
• Increased time on cardiopulmonary bypass
• Increased aorta cross-clamp time
• Reduced time in ICU
• Reduced length of stay
• Increased hospital costs ($14,500 vs. $13,900 without cost of robot; $17,900 vs. $13,900 with cost of robot)

**Robotic ASD closure vs. Sternotomy**
• Increased Operating Room time
• No significant change in length of stay
• Increased hospital costs ($11,600 vs. $10,600 without cost of robot; $15,200 vs. $10,600 with cost of robot)

**Summary of Urologic Uses of Robotic Surgery:** – Excluding Prostatectomy

The following summary is based on low quality evidence limited to 10 non-randomized trials with concurrent or historical controls for nephrectomy. 1, 2 13 studies including 1 RCT for radical cystectomy, 2 15 non-randomized trials with prospective or historical controls for pyeloplasty and fewer studies for miscellaneous urologic procedures (varicocelectomy, vasovasotomy, inguinal herniorrhaphy, adrenalectomy, prolapse, bladder diverticulectomy or ureteral-re-implantation). Interpretation of the available data are complicated by the considerable variability in study quality and by the heterogeneity within study groups. Given the limitations of the available evidence and uncertainty about the clinical relevance of the size of benefits of robot-assisted surgery compared with alternative approaches, decisions about the uptake of robot-assisted surgery will be complex and need to be made carefully. 1

**Robotic Surgery for Nephrectomy**
• *Operative time:* Comparable or increased compared with conventional laparoscopic or open surgery for either partial or radical nephrectomy
• *Length of hospital stay:* Reduced or comparable to conventional techniques
• *Estimated blood loss and transfusion rates:* Comparable or reduced compared to laparoscopic or open surgery for both partial and radical nephrectomies
• *Functional and oncologic outcomes:* Similar or reduced warm ischemic time (the time a tissue, organ, or body part remains at body temperature after its blood supply has been reduced) compared to laparoscopic partial nephrectomy
- *Complication rates:* Comparable

**Robotic Surgery for Radical Cystectomy**

- *Oncological outcomes and post-surgical mortality:* Comparable to open radical cystectomy
- *Operative time:* Significantly increased compared to open radical cystectomy
- *Length of hospital stay:* Generally shorter than open radical but comparable to laparoscopic radical cystectomy
- *Estimated blood loss and transfusion rate:* Consistently associated with a significant reduction in mean estimated blood loss and reduction in transfusion rate
- *Complication rates:* Comparable to open radical cystectomy

**Robotic Surgery for Pyeloplasty**

- *Operative time:* No consistent advantages
- *Length of hospital stay:* Reduced or comparable to conventional techniques
- *Estimated blood loss:* Comparable to conventional
- *Complication rates:* Comparable
- In summary, there is limited, low-quality evidence to suggest that comparable outcomes to open and laparoscopic pyeloplasty may be obtained with robot-assisted surgery

**Robotic Surgery for Miscellaneous Urologic Procedures**

- Limited, low-quality evidence that robot-assisted surgery has been used successfully for a diverse range of miscellaneous urologic procedures
- No current evidence suggests that it is superior to conventional surgical techniques

**Summary of Gynecology Uses of Robotic Surgery:**

**Robotic Surgery for Gynecological cancer**

No Randomized Controlled Trials comparing Robotic surgery to laparoscopic or open surgery were found in a Cochrane review on this subject published in January 2012. 

A systematic review published in the Journal Minimal Access Surgery in July 2012 that included only observational cohort studies compared Robotic(12 studies, 327 patients), Laparoscopic (21 studies, 1339 patients) and Open Radical Abdominal (14 studies, 1552 patients) hysterectomies to treat cervical cancer.

- Compared to open abdominal radical hysterectomy, blood loss and the need for blood transfusion were less for both Robotic and Laparoscopic Radical Hysterectomy.
- Post-operative infection was less with robotic and laparoscopic hysterectomy.
- Duration of hospital stay was shorter for robotic radical hysterectomy.
- Non-infectious morbidity, node positivity and positive surgical margins were similar for all three procedures.
Limitations of the analyses include the lack of long-term follow up, the significant heterogeneity among studies, the pooling of prospective and retrospective studies, and the risk of bias due to the lack of randomization and different tumor characteristics among studies.

In one study consecutive robotic endometrial cancer staging procedures over one time period were compared to traditional laparoscopy in a total of 81 obese women. Robotic surgery was associated with significantly shorter operative time, less blood loss and increased lymph node retrieval and shorter hospital stay11.

**Robotic Surgery for Benign Gynecological Conditions Requiring Surgery**

- Cohort study of 264,758 patients comparing laparoscopic vs. robotic assisted laparoscopic hysterectomy. Those with robotic assisted surgery were less likely to have a hospital stay longer that two days with higher cost of $21890 cases with similar complication rates and need for transfusions. Over the length of the study the use of robotically assisted hysterectomy for benign gynecologic disorders increased substantially 10.
- Two randomized controlled trials (n = 158) were included in a Cochrane review published in February 2012 8.
  - The cost of the procedure and operative time for robotic surgery compared to laparoscopic surgery were higher, in one study.
  - Robotic and laparoscopic surgeries were comparable in intraoperative outcomes, complications (including conversion to open procedure), length of hospital stay and quality of life.

**Robotic Surgery Summary:**

An appraisal on the cost analysis of robotic surgery conducted by the Canadian Agency for Drugs and Technologies in Health dated November 7, 2012 concluded “Cost-analysis studies on robot-assisted surgery found conflicting results, due to the heterogeneity of the economic studies, with regional differences in administration and infrastructural costs, size of the hospitals, and procedural costs and charges.” 7

The same agency in a prior review conducted in 2010 concluded that “The investment made in acquiring this technology is large, and institutions that choose to adopt this technology need to monitor their costs and outcomes so that they can maximize its cost-effective use in their center. To decrease costs, centers could “maximize caseloads, consider keeping the robot operational for longer, if possible, and use the technology for multiple indications, particularly those with greater potential impact on patient outcomes and institutional cost savings” 4

**References:**


10Wright JD. Robotically assisted vs laparoscopic hysterectomy among women with benign gynecologic disease. JAMA; 309: 689.


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