INFORMATION BRIEF (RAPID REVIEW)

ROBOTIC MYOMECTOMY FOR UTERINE FIBROID

Malaysian Health Technology Assessment Section (MaHTAS)
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TITLE: ROBOTIC MYOMECTOMY FOR UTERINE FIBROID

PURPOSE

To provide evidence on the safety, effectiveness and cost-effectiveness of robotic myomectomy for the treatment of uterine fibroid based on request from the Director of Medical Practice Division, Ministry of Health as this procedure is not listed in the 13th Schedule of the Private Healthcare Facilities and Services (Private Hospital and Other Private Hospital Facilities) Regulation (2013).

BACKGROUND

Uterine leiomyoma, also known as uterine fibroid, is the most common benign gynaecologic tumor during the reproductive years with a range of prevalence from 5.4% to 77%.[1,2] They are symptomatic in only 20% to 40% of women over 35 years old.[3] Even though uterine fibroids may be asymptomatic, patients commonly report pelvic pain during or outside of menstrual cycles, excessive menstrual blood loss, pressure symptoms including urinary and bowel habit changes, and infertility. Hence, uterine fibroids are the most common indication for hysterectomy in the United States and have an enormous impact on the healthcare costs and quality of life.[1,2]

Management options for fibroids include medical and surgical approaches. Medical therapies include non-hormonal therapies, such as non-steroidal anti-inflammatory drugs and tranexamic acid, and hormonal therapies, including oral contraceptive pills, gonadotropin (GnRH) analogs, and others.[2,4] These options are used as an adjunct to surgical therapy and for those who are approaching menopause and desiring to avoid surgical intervention.[2] There are a multitude of surgical options (e.g., hysteroscopy, conventional laparoscopy, robotic-assisted laparoscopy, open myomectomy, and hysterectomy) and procedural alternatives (e.g., uterine artery embolization [UAE], magnetic resonance–guided focused ultrasound surgery, and radiofrequency volumetric thermal ablation [RFA]) available to patients.[5] Myomectomy, remains the gold-standard for women affected by symptoms who desire uterine preservation.[6] Hysterectomy is the definitive surgical management for myomas; however, myomectomy should be considered prior to hysterectomy, to decrease postoperative morbidity and in cases where fertility preservation is desired.[7]

Traditionally, myomectomy was performed by laparotomy. Laparoscopic myomectomy leads to lower morbidity rates, better anaesthetic results, less adhesions, and faster recovery than does laparotomic myomectomy. Yet, laparoscopy has its limits, as the quality of sutures remains uncertain and it is sometimes impossible to operate on large, poorly accessible, and multiple fibroids. The technical difficulties encountered with laparoscopies are responsible for long learning curves. [8]

The field of robotic surgery has made significant advancements over the last decade, and its application become increasingly common in gynecological surgery. Robotic myomectomy has been said as a minimally invasive alternative to open myomectomy for appropriately selected surgical candidates. Robotic-assisted surgery offers many of the same postoperative advantages as traditional minimally invasive laparoscopy. Advantages as had been reported include excellent cosmesis from smaller incisions, minimal blood loss, lower infection rates, less postoperative pain, and shorter length of hospital stay.[9] Advantages of robotic surgery over conventional laparoscopy mainly lie in the engineering of the robot system that allows for greater wrist mobility, thus allowing the surgeon to execute more complex tasks, such as delicate tissue dissection and intracorporeal knot tying.[10,11] Other cited advantages of robotic technology over conventional laparoscopy include absence of tremor, a 3-dimensional image, superior instrument articulation, downscaling of movements, and comfort for the surgeon.[12]

The first robot approved by the US Food and Drug Administration (FDA) for gynaecologic applications was reported as [redacted]. The instrumentation provides seven degrees of freedom: three degrees provided by the robotic arms (insertion, pitch, yaw) and four degrees from the "wristed" instruments (pitch, yaw, roll, and grip). This improves dexterity and enables the surgeon to manipulate and dissect tissue in a delicate, controlled fashion.[13]

The basic robotic setup consists of the patient-side robot, a vision cart, and the robotic master console. Patient positioning and setup are identical to conventional laparoscopy. Using a combination of hand controls and foot pedals, the robotic surgeon operates from the remote master console. Robotic-assisted laparoscopic myomectomy is performed with a similar technique to conventional laparoscopic myomectomy. The robot was docked at the side of the patient to facilitate hysteroscopy and uterine manipulation as needed. The use of a 3-dimensional camera requires a 12-mm port rather than a 5- or 10-mm port for conventional laparoscopy. Natural hand motions are replicated, eliminating the fulcrum effect seen with conventional laparoscopy in which ports serve as a fixed point around which force is applied. Given the size of the robotic arms, the port sites are typically spaced farther apart (Figure 1 and 2). The camera may be placed supraumbilically rather than intraumbilically to facilitate a wider range of motion. The robotic arms are docked to the corresponding ports, and the laparoscopic instruments are inserted through the instrument ports. The surgeon then sits at the robotic console and completes the surgery. [13]

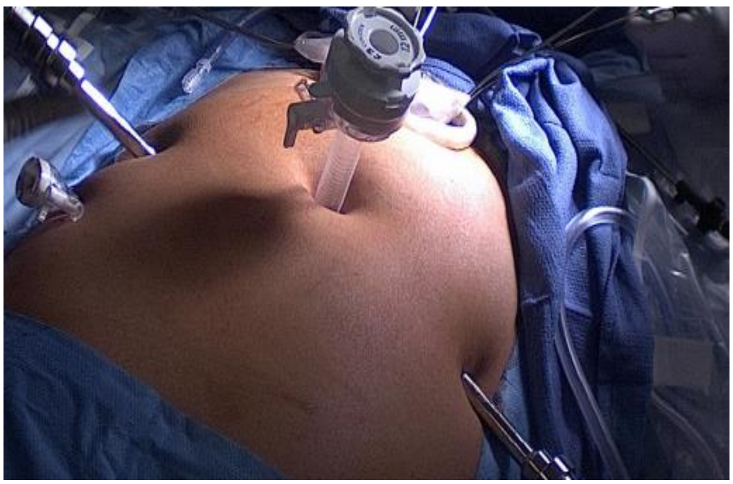

Figure 1: Port sites in robotic assisted laparoscopic myomectomy

Figure 2: Robotic assisted surgery for gynaecology including myomectomy

EVIDENCE SUMMARY

A total of 115 titles were retrieved from the scientific databases such as Medline, EBM Reviews, EMBASE via OVID, PubMed and from the general search engines [Google Scholar and US Food and Drug Administration (USFDA)] on robotic surgery for uterine fibroid or myoma. No limits were applied to the search. The last search was run on 1 June 2023. Additional articles were identified from reviewing the references of retrieved articles. Studies with less than ten subjects were excluded. Studies with benign gynecological diseases including vulva, vagina, cervical, fallopian tube, ovarian disorders as well as endometriosis or vesiovaginal fistula were excluded. Eleven studies were found to be relevant and included in this review, which comprised of systematic review (three), observational studies (three), cost analysis (four) and cost-minimization analysis (one).

EFFECTIVENESS

Wang et al. (2018) in a systematic review compared the three major surgical techniques used in patients with uterine fibroids, abdominal myomectomy (AM), laparoscopic myomectomy (LM) and robotic assisted laparoscopic myomectomy (RALM). Systematic search done from the PubMed, the Cochrane Library, MEDLINE, Embase, and Web of Science databases up to April 22, 2017. The review with meta-analysis included 20 studies (prospective or retrospective observational studies) involving 2852 patients. Most studies (14/20, 70%) were conducted in the United States. They found the number of complications [odd ratio (OR) 0.52, p=0.009], estimated blood loss (EBL) [weighted mean difference (WMD) -33.03, p=0.02], conversions from RALM to LM (OR 0.34, p=0.03), and postoperative bleeding (OR 0.18, p=0.03) in RALM cases was significantly less than that for LM. The numbers of complications (OR 0.56, p=0.03), length of hospital stay (WMD -1.74, p<0.00001), EBL (WMD -77.74, p<0.00001), and numbers of transfusions (OR 0.25, p<0.0001) were significantly decreased, and the operative time (WMD 84.88, p<0.00001) was significantly prolonged in RALM cases when compared to AM cases. Compared with LM and AM, RALM is associated with significantly fewer complications, significantly lower EBL, significantly fewer conversions than both LM and AM, and significantly less bleeding than LM. The authors recommended further research to evaluate the long-term clinical outcomes, economic costs, and postoperative quality of life.[14]

Pundir J et al. (2012) in another systematic review and meta-analysis assessed evidence related to operative outcomes associated with robotic assisted laparoscopic myomectomy (RLM) compared with abdominal myomectomy (AM) and laparoscopic myomectomy (LM). Outcome measures included estimated blood loss (EBL), blood transfusion, operating time, complications, length of hospital stay (LOHS), and costs. Meta-analysis (i) compared RLM vs AM, and meta-analysis (ii) compared RLM vs LM. Studies scored moderately well on the Newcastle-Ottawa Quality Assessment Scale. All included studies (12) were retrospective observational studies. Seven compared RLM vs AM; and four compared RLM vs LM. One study compared RLM vs AM and LM, hence was included in both groups. In group (i), the seven studies included 1127 participants: 435 women who underwent RLM and 692 women who underwent AM. In group (ii), these 4 studies included 602 participants, of whom 318 underwent RLM and 284 underwent LM. The sample size per study varied across the trials and ranged from 15 to 393 participants. No significant differences were found in age, body mass index, or number, diameter, and weight of myomas. In meta-analysis (i) comparing RLM with AM, EBL, blood transfusion, and LOHS were significantly lower; risk of complications was similar; and operating time and costs were significantly higher with RLM. Pooled EBL was significantly lower in RLM group compared with AM [WMD 78.60 (95% CI: 102.16 to 55.03)]. Pooled risk for blood transfusion was significantly lower in the RLM group [RR 0.37 (95% CI: 0.16 to 0.85)]. Pooled results showed LOHS was significantly lower in the RLM group compared with the AM group (WMD, 1.82; 95% CI, 2.29 to 1.35); similarly, cost was significantly higher in the RLM group (WMD, 19116.80; 95% CI, 16159.56 to 22074.04).In meta-analysis (ii) comparing RLM with LM, no significant differences were noted in EBL, operating time, complications, and LOHS with RLM; however, blood transfusion risk and costs were higher. It was concluded that as for operative outcomes, RLM has significant short-term benefits compared with AM and no benefits compared with LM. Long-term benefits such as recurrence, fertility, and obstetric outcomes remain uncertain.[15]

Iavazzo C et al. (2016) in another systematic review evaluated evidence on robotic compared to laparoscopic and open surgical approach in patients underwent myomectomy. PubMed, Scopus and Cochrane databases were systematically searched and 15 studies met the inclusion criteria for the SR. All included studies were retrospective observational studies, whereby eight studies compared robotic technique to laparoscopic, while nine studies to open/abdominal technique. In total, 2,027 patients were included. In studies comparing between the robotic myomectomy (RM) and open myomectomy (OM), the robotic technique showed significant higher operative time [84.85 min per operation (95%CI: 60.41 to 109.29)], but superior in estimated blood loss [92.78 ml/operation (95% CI 47.26 to 138.29)], the need for transfusion [981 patients; OR 0.20 (95% CI 0.09 to 0.43)], total complications [(1101 patients, OR 0.31 (95%CI: 0.11 to 0.87) and in the length of hospital stay [1.84 days/patient (95%CI 1.40 to 2.29)] over open myomectomy. However no significant difference was found for comparison between robotic assisted and laparoscopic technique. Robotic myomectomy has the advantage of less blood loss, less need for blood transfusion and less hospital stay. Additionally, long-term outcomes may need to be clarified including pain control, fertility and pregnancy rates postoperatively, as well as possible recurrence rates. [16]

Gunnala V et al. (2016) in a single medical center in the US determine if robot-assisted myomectomy (RAM) is feasible for women with large uterine myomas. RAM cases performed by one gynecologic surgeon's between May 2010 and July 2013 was retrospectively reviewed. Large uterine myomas, defined as the largest myoma ≥9 cm by preoperative magnetic resonance imaging, was age- and time-matched to controls. Primary surgical outcomes compared were operative time and estimated blood loss (EBL). They included 207 patients; 66 (32%) patients were in the ≥9 cm group, while 141 (68%) patients were in the <9cm group. There was a statistically significant increase in the operative time (130 min versus 92 min) and EBL (100ml versus 25ml) for the ≥9 cm group compared with the <9cm group. Ten (4.8%) patients had the largest myoma measuring ≥15 cm and 11 (5.3%) patients had a specimen weight >900gm, of which no major adverse outcomes were observed. All patients in the study cohort were discharged on the same day after surgery. It was concluded that RAM is a feasible surgical approach for patients with myomas ≥9 cm. Although RAM is associated with greater operative time, there was no change in major adverse outcomes. Patients with large myomas undergoing RAM are also candidates for same-day discharge after surgery. [17]

Cheng H et al. (2015) in a single tertiary medical center in northern Taiwan highlighted their experience in the management of complex myomectomy using this robotic-assisted laparoscopic system. A total of 21 patients with symptomatic complex uterine myomas were evaluated from October 2010 to March 2012. Complex myomectomy was defined as surgery involving more than two fibroids, large fibroids, or preexisting pelvic adhesions. Preoperative characteristics of the patients and the fibroids, detailed surgical time, and several postoperative outcomes to evaluate the feasibility and efficacy of robotic-assisted LM (RALM) for complex fibroids were recorded and analysed. A total of 21 patients with complex fibroids were enrolled in this study. The mean age of the patients was 40.1 ± 4.5 years and the mean size of the largest fibroid was 7.3 ± 3.5 cm. They found RALM achieved satisfactory results, including a short postoperative hospital stay (3.1 ± 0.9 days), a low conversion rate (none of our patients required conversion to either a minilaparotomy or conventional open surgery), and a low complication rate (one case in 21 patients, 4.8%). The average estimated blood loss was 235.7 ± 283.3 ml. It was concluded that RALM is a safe and effective method for handling complex fibroids.[18]

Lee C et al. (2018) in another study in Taiwan evaluated surgical outcomes and feasibility of robotic myomectomy in large uterine myomas. The retrospective study reviewed robotic myomectomies performed from October 2012 to August 2017 by a single surgeon in a tertiary care referral hospital. Demographics, diagnosis, perioperative variables, operative outcomes and complications were recorded. Large uterine myoma was defined as the estimated diameter of dominant myoma equal to or larger than 10cm by sonography. Seventy-four patients were included whereby 32 (43.2%) patients had large uterine myoma. Patients with myoma larger than 10 cm showed significantly heavier myoma weight (446.5 ± 206.2 mg vs. 288.1 ± 147.5, p<0.001), similar blood loss (309.4 ± 190.3 ml vs. 200.9 ± 285.9 ml, p= 0.06), and longer operative time (263.4 ± 83.7 min vs 219.1 ± 75.7 min, p=0.02) compared with patients with myoma <10 cm. The largest myoma removed was 20 cm in diameter. Perioperative complications were rare. It was concluded that robotic myomectomy is feasible for managing large uterine myomas, considered as a safe procedure with acceptable longer operative time. [19]

The SOGC Clinical Practice Guidelines on the management of uterine leiomyoma (2015) in its recommendations stated that 'treatment of women with uterine leiomyomas must be individualized based on symptomatology, size and location of fibroids, age, need and desire of the patient to preserve fertility or the uterus, the availability of therapy, and the experience of the therapist. In women who do not wish to preserve fertility and/or their uterus and who have been counselled regarding the alternatives and risks, hysterectomy by the least invasive approach possible may be offered as the definitive treatment for symptomatic uterine fibroids. Hysteroscopic myomectomy should be considered the first line conservative surgical therapy for symptomatic intracavitary fibroids. Surgical planning for myomectomy should be based on mapping the location, size, and number of fibroids with the help of appropriate imaging'. [20]

SAFETY

In April 2005, th[redacted] was the first robot approved by the US Food and Drug Administration (FDA) for gynaecologic applications.[13]

COST-EFFECTIVENESS

No evidence retrieved on cost-effectiveness analysis of robotic myomectomy for uterine fibroid from the scientific databases.

Behera MA et al. (2012) performed a cost-minimization analysis of abdominal, traditional laparoscopic and robotic-assisted myomectomy among women undergoing myomectomy in an academic medical center. They developed a decision model to compare the costs ($2009) of different approaches to myomectomy from a healthcare system perspective. The model included operative time, conversion risk, transfusion risk, and length of stay (LOS) for each modality. Baseline estimates and ranges were based on reported values extracted from existing literature. They analyzed two different models: (1) Existing Robot model and (2) Robot Purchase model. They found in the baseline analysis for the Existing Robot model, abdominal myomectomy (AM) was the least expensive at $4937 compared with laparoscopic myomectomy (LM) at $6219 and robotic-assisted laparoscopic myomectomy (RM) at $7299. The abdominal route remained the least expensive when varying all parameters and costs except for two cases in which LM became least expensive: (1) If AM length of stay was greater than 4.6 days, and (2) If the surgeon's fee for AM was greater than $2410. When comparing LM to RM, the cost of RM was consistently higher unless the robotic disposable equipment costs were less than $1400. In the Robot Purchase model, only the RM costs increased while AM and LM costs remained the same. It was concluded in this cost-minimization analysis, abdominal myomectomy is the least expensive approach when compared to laparoscopy and robotic-assisted laparoscopy.[21]

Nash K et al. (2011) evaluated robotic-assisted laparoscopic myomectomy versus abdominal myomectomy in a comparative analysis of its surgical outcomes and costs. Records were reviewed for the first 27 RALM procedures at the institution. Age, BMI, insurance status, race, uterine size, and operative indication were used to select comparable patients who had undergone AM. Clinical and efficiency outcomes were compared stratifying for uterine size, specimen weight, and matched propensity scores. They found IV hydromorphone use was significantly lower for RALM (p<0.01), with no significant differences in blood loss or complications. The RALM patients had significantly shorter hospital stays; however, total hospital charges were higher (p<0.0001). This likely reflects longer operating room time (p< 0.0001), which was magnified as specimen size increased (p<0.0001). It was concluded that RALM patients require less IV hydromorphone, have shorter hospital stays, and have generally equivalent clinical outcomes compared with AM patients. Additionally, as specimen size increased, the operative efficiency of RALM decreased compared with AM.[22]

Bonafade et al. (2018) conducted cost comparison in women with newly diagnosed uterine fibroids, assessing treatment patterns for selected treatment options in the US. The primary objective of this study was to describe surgical treatment patterns among women with newly diagnosed uterine fibroids (UF). A secondary objective was to estimate the medical costs associated with other common surgical interventions for UF. Claims-based commercial and Medicare data (2011–2016) were used to identify women aged ≥30 years with continuous enrollment for at least 12 months before and after a new diagnosis of UF. Receipt of a surgical or radiologic procedure (hysterectomy, myomectomy, endometrial ablation, uterine artery embolization, and curettage) was the primary outcome. Health care resource utilisation and costs were calculated for women with at least 12 months of continuous enrollment following a UF surgical procedure. Among women who met selection criteria, 31.7% of patients underwent a surgical procedure; 20.9% of these underwent hysterectomy. An increase was observed over time in the percentage of women undergoing outpatient hysterectomy (from 27.0% to 40.2%) and hysteroscopic myomectomy (from 8.0% to 11.5%). The cost analysis revealed that total health care costs for hysteroscopic myomectomy ($17,324) were significantly lower (p<0.001) than those for women who underwent inpatient hysterectomy ($24,027) and those for women undergoing the three comparison procedures. It was concluded that hysterectomy was the most common surgical intervention. Patients undergoing inpatient hysterectomy had the highest health care costs. Although less expensive, minimally invasive approaches are becoming more common; they are performed infrequently in patients with newly diagnosed UF. This result may be useful in guiding decisions regarding the most appropriate and cost-effective surgical treatment for UF. [23]

Soliman A et al. (2015) in a systematic review summarized the direct and indirect costs per patient associated with uterine fibroid tumors in international studies. Systematic search with from MEDLINE and EMBASE done for studies published from January 2000 to November 2013. The review included primary studies published in English and that reported either direct costs (drug costs, procedure costs, and medical service costs) or indirect costs (such as productivity loss) among patients with uterine fibroid tumors. A total of 26 studies that were identified and included in the data extraction included 19 studies in the US, studies in the Netherlands (two), one study each in Germany, China, Italy, and Canada, and one study reported data were collected from Germany, France, and England. The studies differed in perspectives that were adopted for analysis, designs, data elements that were collected, setting, population and outcome measurements. Among three studies that reported total direct costs during the year after uterine fibroid tumor diagnosis, two studies reported an average of $9473 and $9319 per patient, respectively; two studies reported the excess costs over controls to be $6076 and $5427, respectively. The indirect costs per patient ranged from $2399 to 15,549, and the excess indirect cost per patient over control groups ranged from $323 to 4824 in the year after the diagnosis. The total costs, sum of direct and indirect costs, ranged from $11,717 to 25,023 per patient per year, after diagnosis or surgery among patients with uterine fibroid tumors. Compared with control, the additional annual cost ranged from $2200 to 15,952 per patient. This study highlighted the substantial direct and indirect costs associated with uterine fibroid tumors to healthcare payers and society. The large number and the variety of studies identified also emphasize the growing awareness of the economic impact of uterine fibroid. [24]

Wright KN et al. (2012) estimated the incidence of operative complications and compared operative cost and overall cost of different methods of benign hysterectomy including abdominal, vaginal, laparoscopic, and robotic techniques. They performed a retrospective cohort analysis of all patients who underwent a hysterectomy for benign reasons in 2009 at a single urban academic tertiary care center. A multivariate regression analysis was also performed for predictors of costs. Cost data were gathered from the hospital's billing system; the remainder of data was extracted from patient's medical records. They found in 2009, 688 patients underwent a benign hysterectomy; 185 (26.9%) hysterectomies were abdominal, 135 (19.6%) vaginal, 352 (51.5%) laparoscopic, and 14 (2.0%) robotic. The rate of intraoperative complication was 1.7% for abdominal, 0.8% for vaginal, 0.3% for laparoscopic, and 0 for robotic. Mean total patient costs were $43,622 for abdominal, $31,934 for vaginal, $38,312 for laparoscopic, and $49,526 for robotic hysterectomies. Costs were significantly influenced by method of hysterectomy, operative time, and length of stay. Though complication rates did not vary significantly among minimally invasive methods of hysterectomy, patient costs were significantly influenced by the method of hysterectomy.[25]

ORGANISATIONAL

Soomro et al. (2020) in a systematic review aimed to identify the available evidence investigating surgeon learning curves in robot-assisted surgery. Learning curves describe the rate of progress in gaining experience or new skills and are widely reported in surgery. MEDLINE, EMBASE and the Cochrane Library were searched in February 2018, alongside hand searches of key congresses and existing reviews. Eligible articles were those assessing learning curves associated with robot-assisted surgery in patients. They found 2316 records, of which 68 met the eligibility criteria, reporting on 68 unique studies. Of these, 49 assessed learning curves based on patient data across ten surgical specialties (urology, otorhinolaryngology, general, bariatric, paediatric, gynaecology, thoracic, colorectal, cardiovascular and orthopaedic). All 49 studies were observational, largely single-arm (35 of 49 studies) and included few surgeons. Out of the 49 studies, seven were on gynaecology surgeries (robot assisted hysterectomy and robot-assisted sacrocolpopexy). Learning curves exhibited substantial heterogeneity, varying between procedures, studies and metrics. Standards of reporting were generally poor, with only 17 of 49 quantifying previous experience. Methods used to assess the learning curve were heterogeneous, often lacking statistical validation and using ambiguous terminology. It was concluded that learning curve estimates were subjected to considerable uncertainty. Robust evidence was lacking, owing to limitations in study design, frequent reporting gaps and heterogeneity in the methods used to assess learning curves. Opportunity remains for the establishment of optimal quantitative methods in assessing learning curves, to inform surgical training programmes and improve patient outcomes.[26] The steep learning curve of this novel system has been said in its implementation by the gynaecologist.[27]

CONCLUSION

There were fair evidences retrieved on robotic myomectomy for the management of uterine fibroid. Based on the above review, robotic myomectomy appeared effective in the management of uterine fibroid with lower bleeding, fewer complications and fewer conversion; compared to laparoscopic myomectomy and abdominal myomectomy. Robotic laparoscopic myomectomy showed lower estimated blood loss, blood transfusion and length of hospital stay; but its operating time and cost were higher compared with abdominal myomectomy. Robotic myomectomy appeared feasible, safe and effective approach in the management of large and complex uterine fibroids. However, learning curve estimates were subjected to considerable uncertainty, and the cost implication may need to be considered.

REFERENCES

1. Sparic R, Mirkovic L, Malvasi A, et al. Epidemiology of uterine myomas: a review. Int J Fertil Steril 2016.9(4);424-435.
2. Drayer SM, Catherino WH. Prevalence, morbidity and current medical management of uterine leiomyoma. Int J Gynecol Obstet 2015. 131(2);117-122.
3. Baird DD, Dunson DB, Hill MC, et al. High cumulative incidence of uterine leiomyoma in black and white women:ultrasonic evidence. Am J Obstet Gynecol 2003.188;100-107.
4. Kashani BN, Centini G, Morelli SS, et al. Role of medical management for uterine management. Best Prac Res Clin Obstet Gynecol 2016. 34;85-103.
5. Gingold JA, Gueye A and Falcone T. Minimally invasive approaches to myoma management. Journal of minimally invasive gynecology 2018.25(2);240-246.
6. Gobern JM, Rosemeyer CJ, Barter JF, et al. Comparison of robotic, laparoscopic and abdominal myomectomy in a community hospital. JSLS 2013.17;116-120.
7. Donnez J, Dolmans MM. Uterine fibroid management: from the present to future. Hum Reprod Update 2016.22(6);665-686.
8. Falcone T, Bedaiwy MA. Minimally invasive management of uterine fibroids. Curr Opin Obstet Gynecol 2002.14:401–7. doi:10.1097/00001703-200208000- 00007
9. Chiu LH, Chen CH, Tu PC, et al. Comparison of robotic surgery and laparoscopy to perform total hysterectomy with pelvic adhesions or large uterus. J Minim Access Surg. 2015;11(1):87–93.
10. Palep JH. J Minim Access Surg. 2009;5(1):1–7.
11. Nguan C, Girvan A, Luke PP. Robotic surgery versus laparoscopy; a comparison between two robotic systems and laparoscopy. J Robot Surg. 2008;1(4):263–268.
12. Magrina JF. Robotic surgery in gynecology. Eur J Gynaecol Oncol. 2007; 28:77-82.
13. Visco AG, Advincula AP. Robotic gynecologic surgery. Obstet Gynecol. 2008; 112:1369-1384
14. Wang T, Tang H, Xie Z, et al. Robotic-assisted vs. laparoscopic and abdominal myomectomy for treatment of uterine fibroids: a meta-analysis. Minimally Invasive Therapy & Allied Technologies. 2018. ISSN: 1364-5706 (Print) 1365-2931 (Online).https://doi.org/10.1080/13645706.2018.1442349
15. Pundir J, Pundir V, Walavalkar R, et al. Robotic-Assisted Laparoscopic vs Abdominal and Laparoscopic Myomectomy: Systematic Review and Meta-Analysis. Journal of Minimally Invasive Gynecology 2013. 20(3), 335-345.
16. Christos Iavazzo C, Ioannis Mamais I and Gkegkes I. Robotic assisted vs laparoscopic and/or open myomectomy: systematic review and meta-analysis of the clinical evidence. Arch Gynecol Obstet DOI 10.1007/s00404-016-4061-6

17. Gunnala V, Setton R, Pereira N, et al. Robot-Assisted Myomectomy for Large Uterine Myomas: A Single Center Experience.Minimally Invasive Surgery 2016. 2016, Article ID 4905292.http://dx.doi.org/10.1155/2016/490529
18. Cheng H, Chen J, Wang P, et al. Robotic-assisted laparoscopic complex myomectomy: A single medical center's experience. Taiwanese Journal of Obstetrics and Gynecology 2015. 54(1); 39-42
19. Lee C, Chen I, Torng P, et al. Robotic myomectomy for large uterine myomas. Taiwanese Journal of Obstetrics & Gynecology 2018.57;796-800
20. Vilos GA, Allaire C, Laberge P, et al. SOGC Clinical Practice Guidelines on the management of uterine leiomyoma. J Obstet Gynaecol Can 2015;37(2):157–178
21. Behera MA, Likes CE 3rd, Judd JP,et al. Cost analysis of abdominal, laparoscopic, and robotic-assisted myomectomies. J Minim Invasive Gynecol. 2012.19(1):52-7. doi: 10.1016/j.jmig.2011.09.007. Epub 2011 Nov 18. PMID: 22100443.
22. Nash K, Feinglass J, Zei C, et al. Robotic-assisted laparoscopic myomectomy versus abdominal myomectomy: a comparative analysis of surgical outcomes and costs. Arch Gynecol Obstet. 2012.285(2);435-40. doi: 10.1007/s00404-011-1999-2. Epub 2011. PMID: 21779774.
23. Bonafede MM, Pohlman SK, Mille JD, et al. Women with Newly Diagnosed Uterine Fibroids: Treatment Patterns and Cost Comparison for Select Treatment Options Population Health Management 2018. 21(1);S13-S20. DOI: 10.1089/pop.2017.0151
24. Soliman AM, Yang H, Du EX , et al. The direct and indirect costs of uterine fibroid tumors: a systematic review of the literature between 2000 and 2013. American Journal of Obstetrics and Gynecology 2015.213 (2); 141-160. https://doi.org/10.1016/j.ajog.2015.03.019
25. Wright KN, Jonsdottir GM, Jorgensen S, et al. Costs and Outcomes of Abdominal, Vaginal, Laparoscopic and Robotic Hysterectomies Journal of Society Laparoendoscopy Surgeon 2012.16;519 – 524.
26. Soomro NA, Hashimoto DA, Porteous AJ, et al. Systematic review of learning curves in robot-assisted surgery. BJS Open. 2020.4(1):27-44. doi: 10.1002/bjs5.50235. Epub 2019 Nov 29. PMID: 32011823; PMCID: PMC6996634.
27. Sara E Arian SA, Munoz JL, Ki S, et al. Robot-assisted laparoscopic myomectomy: current status. Robotic Surgery: Research and Reviews. 2017.4;7-18.

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