Laparoscopic and Robotic-Assisted Hysterectomy for Uterine Leiomyomas: A Comparison of Complications and Costs

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Abstract

Objective: Robotic surgery is increasingly being used for treatment of malignant and benign gynaecologic diseases. The purpose of our study is to compare patient perioperative complications and costs of laparoscopic versus robotic-assisted hysterectomy for uterine leiomyomas.

Methods: A retrospective cohort study using the Nationwide Inpatient Sample database from the United States was conducted, comparing patients who underwent robotic-assisted hysterectomy and laparoscopic hysterectomy (total laparoscopic hysterectomy and laparoscopic-assisted vaginal hysterectomy) for uterine fibroids between 2008 and 2012. Baseline characteristics were compared between the two groups, and logistic regression was used to compare postoperative outcomes between laparoscopic and robotic approaches. Direct costs were compared between the two groups using linear regression models.

Results: Over a five-year period, the total number of hysterectomies performed increased. Patients undergoing robotic hysterectomy were older and had more comorbidities. In adjusted analyses, women who underwent robotic surgery were more likely to have respiratory failure (0.71% vs. 0.39%; $P < 0.0108$), postoperative fever (1.05% vs. 0.67%, $P < 0.0002$), and ileus (1.76% vs. 1.3%; $P < 0.0060$), and less likely to require transfusions (3.4% vs. 3.96%; $P < 0.0037$). Robotic surgery was consistently more expensive, with a median cost of $33 928.00 compared with $23 753.00 for laparoscopic hysterectomy.

Conclusion: While there are only slight differences in postoperative complications between laparoscopic-assisted hysterectomy and robotic-assisted hysterectomy, robotic-assisted hysterectomy is associated with considerably greater direct costs. Unless specific indications for robotic-assisted hysterectomy exist, laparoscopic-assisted hysterectomy should be the preferred approach for minimally invasive surgical treatment of leiomyomas.

Key Words: Laparoscopic hysterectomy, robotic-assisted hysterectomy, uterine leiomyomas, Robotic, Fibroids, Leiomyomas

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Résumé

Objectif : La chirurgie robotisée est de plus en plus utilisée pour le traitement des affections gynécologiques malignes et bénignes. Notre étude visait à comparer les complications périopératoires et les coûts associés à l'hystérectomie pour des léiomyomes utérins effectuée par voie laparoscopique ou chirurgie assistée par robot.

Méthodologie : Nous avons mené une étude de cohorte rétrospective à partir de la base de données Nationwide Inpatient Sample des États-Unis, comparant des patientes qui ont subi une hystérectomie assistée par robot et une hystérectomie laparoscopique (hystérectomie laparoscopique totale et hystérectomie vaginale assistée par laparoscopie) pour des fibromes utérins entre 2008 et 2012. Les caractéristiques de référence ont été comparées entre les deux groupes, et une régression logistique a été utilisée pour comparer les issues postopératoires des approches laparoscopique et robotisée. Nous avons également comparé les coûts directs des deux groupes au moyen de modèles de régression linéaire.

Résultats : Sur une période de cinq ans, le nombre total d'hystérectomies effectuées a augmenté. Les patientes ayant subi une hystérectomie assistée par robot étaient plus âgées et avaient un nombre de comorbidités plus élevé. D'après les analyses ajustées, les femmes ayant subi une chirurgie robotisée étaient plus susceptibles de présenter une insuffisance respiratoire (0,71 % contre 0,39 %; $P < 0,0108$), une fièvre postopératoire (1,05 % contre 0,67 %; $P < 0,0002$) et un iléus (1,76 % contre 1,3 %; $P < 0,0060$), et présentaient un risque plus faible d'avoir besoin de transfusions (3,4 % contre 3,96 %; $P < 0,0037$). La chirurgie assistée par robot était systématiquement plus coûteuse, le coût médian étant de 33 928 $, comparativement à 23 753 $ pour l'hystérectomie laparoscopique.

Conclusion : Bien qu'il n'y ait que de petites différences dans les complications postopératoires entre l'hystérectomie laparoscopique et l'hystérectomie assistée par robot, cette dernière est associée à des coûts directs considérablement plus élevés. À moins d'indication précise pour la chirurgie assistée par robot, l'hystérectomie laparoscopique devrait être l'approche privilégiée pour le traitement chirurgical à effraction minimale des léiomyomes.

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INTRODUCTION

Leiomyomas are the most common benign tumors of the female genital tract arising during reproductive years.[1,2] Prevalence in the premenopausal population varies between 30% and 70% and increases with age.[3] In Canada, 70% to 80% of women develop leiomyomas by the age of 50.[4] More recent longitudinal observational studies report incidence rates of 12.7 to 29.7 per 1000 woman-year.[3,5]

As the most common benign indication for hysterectomy, leiomyomas are responsible for 30% of all hysterectomies in Canada.[6] Although the majority of hysterectomies are still performed abdominally (via laparotomy), minimally invasive approaches are increasing.[7] These techniques allow for shorter hospital admissions, lower intraoperative blood loss, fewer abdominal wall or wound infections, decreased scarring, and faster recovery.[8] Increasingly, robotic surgery is being investigated in gynaecological surgery for benign disease. Despite these attractive features, studies comparing the benefits and limitations of robot-assisted hysterectomy with traditional laparoscopic hysterectomy remain inconclusive.[9–12] In our study, we compare patient demographics, costs, and complications of women who underwent laparoscopic or robot-assisted hysterectomy for uterine leiomyomas.

MATERIALS AND METHODS

We carried out a cohort study using the Healthcare Cost and Utilization Project. These datasets are created by Federal-State-Industry partnerships and funded by the Agency for Healthcare Research and Quality.[13] The associated Nationwide Inpatient Sample database is the largest in the United States, covering 46 states, accounting for more than seven million hospital stays per year, and representing 20% of all discharges from community hospitals (excluding rehabilitation and long-term care centres). Covering all patients—both insured and uninsured—it is a national resource of health care data, offering a spectrum of research opportunities in the medical field.[11] Using this database, we conducted a retrospective cohort study comparing patients with a diagnosis of leiomyomas who underwent a laparoscopic or robotic-assisted hysterectomy. The ICD-9 diagnostic code 218 was used to identify all patients diagnosed with uterine leiomyomas from 2008 to 2012, excluding all patients with any malignant neoplasm of genitourinary organs (ICD-9 codes 179-184).

In addition to being the most common benign indication for hysterectomy worldwide, the indication for hysterectomy in our study was restricted to only uterine leiomyomas in order to reduce potential confounding as the patient population, the difficulty of the surgery, as well as the risk of complications may vary depending on the diagnosis. All patients who underwent a hysterectomy for uterine leiomyomas were stratified according to their mode of surgery: robotic-assisted (ICD-9 code 17.4x) and laparoscopic-assisted (total hysterectomy (ICD-9 codes 54.21, 68.41) and laparoscopic-assisted vaginal hysterectomy (ICD-9 code 68.51).

A three-step analysis was carried out: First, a descriptive analysis was performed to evaluate patient baseline characteristics. These included age (<40, 40–49, 50–59, and 60 or older), median income quartiles, race (White, Hispanic, African American, and Other), payment source (Medicare, Medicaid, private insurance, and no insurance), and comorbidities (hypertension, cardiovascular disease, diabetes, pulmonary disease, renal disease). Cardiovascular disease was identified by the HCUP NIS code for congestive heart failure and ICD-9 codes for chronic rheumatic heart disease, ischemic heart disease, hypertensive heart disease, cerebrovascular disease, other forms of heart disease, as well as disease of blood vessels and of lymphatics.

Second, comparisons were made of perioperative complications between both surgical approaches using logistic regression models adjusted for the baseline characteristics listed in Table 1 (age, income, race, source of payment, and comorbidities), with the laparoscopic surgery group as the reference. Perioperative morbidities were divided into intraoperative complications, such as inadvertent lacerations of the bowel, bladder, and ureter, and also postoperative complications, which involved fever, sepsis, transfusion, venous thromboembolism, acute kidney injury, urinary retention, respiratory failure, pneumonia, ileus, wound infection, seroma, and haematoma. ICD-9 codes related to pulmonary embolism, deep vein thrombosis, and cerebrovascular accident were used to identify VTE. ICD-9 code v64.41 was used for conversion to laparotomy.

Third, median cost per admission, which was obtained from the perspective of the health care system, was compared between laparoscopic and robotic-assisted hysterectomy. Subsequently, the charge for each surgical approach was stratified by admission length, age, and conversion to laparotomy. The difference in cost per admission between the two surgical groups was adjusted using linear regression. All models were adjusted for the following variables: age, income, race, source

ABBREVIATIONS

HCUP	Healthcare Cost and Utilization Project
NIS	Nationwide Inpatient Sample
VTE	venous thromboembolism