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Robotic-assisted hysterectomy in a community hospital after seven years of experience

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ABSTRACT

Background: The da Vinci robotic-assisted laparoscopic hysterectomy is being widely adopted by healthcare institutions and constitutes the highest percentage of the robotic-assisted surgeries. By now da Vinci robotic-assisted hysterectomy (RAH) is used worldwide, and even so, different aspects of this relatively new surgical technique remain under evaluation. There are contradicting reports in the literature about the superiority of RAH versus conventional laparoscopic hysterectomy (CLH) in terms of patient outcomes and costs. The purpose of this small size study was to contribute to this open question by analyzing patient records in a community hospital with extensive seven years of experience in RAH. The analysis of the data compares the surgical outcomes and patient costs of RAH ($n = 23$) versus CLH ($n = 23$).

Method: A retrospective study using the electronic chart review was performed.

Results: There were no statistically significant differences between the two groups for estimated blood loss, duration of surgery, length of stay, 30-day readmission, and patient costs; however, the average cost of RAH was $3116 less than CLH, if not considering the cost and maintenance of the surgical robot indicating surgical team approaching proficiency and maturity in RAH. A strong correlation between uterus weight, blood loss, duration of surgery, and patient cost within only the RAH group was observed, suggesting a more precise surgical technique.

Conclusion: RAH and CLH had similar surgical outcomes. RAH can be a more precise surgical technique, and potentially less costly when the cost and maintenance of the robot are not considered.

1. Introduction

The da Vinci robotic-assisted minimally invasive surgery was approved by the Food and Drug Administration in 2000 for a variety of laparoscopic surgeries and in 2005 for gynecologic procedures.[1–3] Since then the number of robotic-assisted hysterectomies (RAHs) has increased rapidly, leading to a decrease in the number of conventional laparoscopic hysterectomy (CLH) and abdominal hysterectomy (AH).[4,5] In 2016, approximately 250,000 robotic-assisted gynecologic procedures were performed worldwide.[6] The healthcare institutions have adopted this technology to keep market share,[7] and consequently, the perioperative practitioners are being challenged to learn this new technique in order to stay abreast of new health care technologies.[8,9]

Despite the rapid increase in the number of RAH, there lacks consensus in the literature regarding the superiority of RAH versus CLH.[10–13] There is a need for further research on patient surgical outcomes and costs to guide practice. The purpose of this study was to evaluate the short-term surgical outcomes, the 30-day hospital readmission, and the cost of surgery for women who have undergone RAH, and to compare the results with those of CLH. Conclusions were drawn from investigating variables such as patients age, uterus weight, estimated blood loss, duration of surgery, length of stay, patients cost, and 30-day readmission rate for complications related to the surgery. The following research questions guided this study:

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1. Is there a statistically significant difference in the short-term surgical outcomes, and the 30-day hospital readmission of women who have undergone RAH versus CLH?
2. Is there a cost difference for RAH versus CLH?

2. Material and methods

Following approval of the study by the Institutional Review Board (IRB) of Texas Woman's University and a community hospital in Central Texas, a retrospective electronic chart review was performed. A sample of 48 women who had RAH or CLH for benign and malignant indications between February 2013 and September 2015 were selected (24 RAH and 24 CLH). The inclusion criteria were women who had hysterectomy, uni- or bi-lateral salpingo-oophorectomy, anterior and posterior vaginal wall repair, and McCalls culdoplasty. Women who had additional procedures such as vaginal tape bladder suspension, suburethral sling procedure, or other additional procedures, which require additional operative time, were excluded from the study. Paired matching was implemented by choosing patients with similar surgical procedures and data were collected merely by the first author, warranting consistency in data collection. After de-identifying the cases, the following demographic information and surgical outcome variables were collected: age (Age), body mass index (BMI), uterus weight (UteWt), estimated blood loss (EBL), duration of surgery (DurOS), length of hospital stay (LOS), patients' costs (PtCost), and 30-day readmission (Rea30day). The DurOS was recorded as the difference in the operative room time to that of the out of the operative room time to account for the anesthesia induction, surgical preparation, and drapping which constitute the partial cost of the surgery.

3. Data analysis and results

Data were analyzed using the statistical software package SPSS version 19.0.[14] Patients were coded as either a 0 or 1 based on procedure type (1 = RAH and 0 = CLH). The sample size was calculated by considering the population size of patients who had undergone hysterectomies at this community hospital.[15] Between February 2013 and September 2015, 266 cases of RAH and CLH procedures were performed in this facility. Therefore, a sample size of 46 (17.3% of the population under study) is a sufficient sample size for this small size study.[16]

Before performing inferential statistics, Z-scores and box plots were inspected for outliers. Cases having a Z-score value greater than +3 or less than −3 were excluded from the analysis to avoid violating the assumptions of normality. One case in the RAH group and one in the CLH group had Z-scores greater than 3 for the LOS and EBL respectively. After removing these two cases, the sample size was reduced to 46 (23 RAH and 23 CLH). Demographic data was analyzed using descriptive statistics (Table 1). Normality of the variable distributions was assessed by comparing the ratio of skewness or kurtosis to the standard error with three (Statistic/Std Error ≤ 3). According to Kim, it is recommended to use a ratio of 1.96 for sample sizes $n < 50$, and 3.29 for sample sizes of $50 < n < 300$.[17] The LOS for the CLH group showed the largest skewness (Statistic/Std Error = 3.832). Due to concerns of normality violations, bootstrapping was employed. Levenes tests for equality of variance for all variables were greater than 0.05 suggesting equal variance.

Independent sample *t*-tests were computed to determine the significance of mean differences in age, BMI, UteWt, EBL, DurOS, LOS, PtCost, and Rea30day for the two groups (Table 2). Pearson correlation coefficients for different variables were also computed separately for each group to explore possible correlations between variables (Table 3). For each group, the 30-day readmission rates were also evaluated using Chi-Square crosstab for categorical variables. The patient 30-day readmission was coded as 0 and 1 (0 = no readmission, and 1 = readmission).

An independent Sample *t*-test for the mean differences showed women in the CLH group were older than those in the RAH group. A mean difference of 6.41 years in age between the two groups was statistically significant, $p = 0.041$. For the remaining variables, the *t*-test analysis suggested no statistically significant differences except for potential patient cost. The CLH procedure was found to be more expensive than that of RAH with a mean difference of $3116 when the cost and maintenance of the robot was not considered ($p = 0.062$).

Outcome variables within each group were correlated to investigate possible dependences leading to poorer outcomes and lengthier stays. Because the correlation tables are symmetric, they have been combined into a single table (Table 3) for easy comparison of the correlations within each group.

The upper triangular (all values above the main diagonal) of Table 3 shows the correlation coefficients for the CLH group, and the lower triangular (all values below the main diagonal) shows the correlation coefficients for the RAH group. Pearson correlation coefficients associated with *p*-values of 0.05 or less have been flagged by (a) and those associated with *p*-values of 0.01 or less have been flagged by (b). A 95% CI was obtained by bootstrapping. A superscript (c) was placed on those Pearson correlation coefficients where the CI did not contain 0.

The upper triangular for the CLH group showed a medium-sized, negative correlation between age and uterus weight ($r = 0.467$). This correlation is associated with a *p*-value of 0.025 and a CI not containing zero (denoted by a superscript (c) on −0.467). Comparing this correlation to that of the RAH group, it was found that there was no correlation between age and uterus weight ($r = 0.016$ and $p = 0.945$). This apparent inconsistency suggests a difference in the demographics of the two groups. Descriptive statistics (Table 1) showed that the mean patient age for the CLH and RAH groups were 50.04 and 43.57 respectively. The *t*-test results, in Table 2, showed that the mean difference of 6.4 years was statistically significant. Furthermore, the minimum and maximum patient age were 34 and 77 years for the CLH, and 29 and 64 years for the RAH group. Overall, the patients in the CLH group were older.

For the RAH group (lower triangular), strong correlations were found between uterus weight, blood loss, duration of surgery and patient cost. For these variables, the Pearson correlation coefficients were positive and greater than 0.5 with *p*-values less than 0.01 and CI not containing zero. These correlations suggested that the larger the uterus weight, the longer the duration of the surgery. The longer the duration of surgery, the larger the blood loss, and the more expensive the surgery will be. Similar correlations were not found for the CLH group possibly suggesting that conventional laparoscopic surgery is less precise with more variations in surgical outcomes.

The Chi-Square analysis showed no difference in the 30 days return for the two groups. The observed counts were within 0.1 of the expected counts and the significant values were greater than 0.05.