

# Comparison of Robotic-assisted and Conventional Total Laparoscopic Hysterectomy for Atypical Complex Hyperplasia and Early-stage Endometrial Carcinoma in the Hong Kong Chinese Population

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**Objectives:** To compare the outcomes of conventional total laparoscopic hysterectomy with robotic-assisted total laparoscopic hysterectomy in Chinese patients with early-stage endometrial carcinoma and atypical complex hyperplasia.

**Methods:** This retrospective study was performed at the Pamela Youde Nethersole Eastern Hospital from 1 January 2010 to 30 July 2012. The study compared conventional and robotic-assisted total laparoscopic hysterectomies for International Federation of Gynecology and Obstetrics stage 1A grade 1-2 endometrial carcinoma or atypical complex hyperplasia in a Chinese population.

**Results:** A total of 19 women underwent conventional total laparoscopic hysterectomy and 26 women underwent robotic-assisted total laparoscopic hysterectomy. The robotic-assisted group had significantly less postoperative opiate use (0% vs. 26.3%;  $p=0.01$ ) and fewer postoperative complications (3.8% vs. 52.6%;  $p<0.001$ ) than the conventional group. All robotic-assisted total laparoscopic hysterectomies were performed by consultants, but for conventional total laparoscopic hysterectomies, the proportion was only 11 (57.9%) cases ( $p<0.001$ ).

**Conclusion:** Robotic-assisted total laparoscopic hysterectomy is as safe and efficient as conventional total laparoscopic hysterectomy for treating atypical complex hyperplasia and early-stage endometrial carcinoma in a Chinese population. Whether fewer short-term complications and less opiate use were due to the use of robotic-assisted surgery or surgeons' experience could not be determined in this study.

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## Introduction

Total abdominal hysterectomy accounts for two-thirds of all hysterectomies performed in Hong Kong<sup>1</sup>. Minimally invasive techniques are fast gaining popularity. There has been a 5-fold increase in laparoscopic hysterectomy over the past 10 years from 209 in 1997 to 1057 in 2007<sup>2</sup>. Recent studies show that laparoscopic hysterectomy results in decreased morbidity, shorter hospital stay, and faster return to normal activities in comparison with open procedures<sup>3,4</sup>. The laparoscopic technique is set to become the new gold standard for hysterectomy in women for whom this approach is feasible.

Conventional total laparoscopic hysterectomy presents challenges such as restricted vision and lack of tactile sensory input. Hence, trainee surgeons need time to master the use of non-articulated instruments and hand-eye coordination. Long difficult operations involving large uteri

and adhesions result in fatigue that can affect performance. These factors explain the reluctance to replacing abdominal hysterectomy with the laparoscopic approach<sup>5</sup>.

The da Vinci Surgical System (Intuitive Surgical, Sunnyvale [CA], US) was approved for use for hysterectomy by the United States Food and Drug Administration in 2005. The system offers a high-resolution 3-dimensional (3D) view, shorter learning curve, and articulated wrist-like movements of the robotic arms, without tremor, to optimise dexterity and fine movements<sup>6-9</sup>. However, robotic surgery is very expensive. The latest da Vinci S system costs over US\$2 million and additional operational costs per case are approximately US\$2400<sup>10</sup>.

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Currently, several studies<sup>11-14</sup> have compared the outcomes of conventional and robotic-assisted total laparoscopic hysterectomy for the treatment of benign and malignant gynaecologic pathology. There was no evidence of significant differences in the overall efficacy or surgical outcomes between the two procedures. A similar study with Hong Kong data was not found on a literature search, but it would be interesting to ascertain the situation in Hong Kong.

The Pamela Youde Nethersole Eastern Hospital (PYNEH) is one of four public hospitals performing robotic surgery in Hong Kong, and robotic gynaecological operations have been performed since 2010. This study aimed to compare hysterectomies performed by the conventional total laparoscopic approach with the alternative robotic-assisted total laparoscopic procedure. Comparison of clinical outcomes of the two approaches gave insight into their efficacy and safety. These results might be relevant to other public hospitals considering adoption of this technology.

## Methods

This retrospective study was conducted at PYNEH from 1 January 2010 to 30 July 2012. The study was approved by the Hong Kong East Cluster Ethics Committee. Clinical and operative records of conventional and robotic-assisted total laparoscopic hysterectomies performed during this period were reviewed. Patients suitable for conventional total laparoscopic hysterectomy were also suitable for robotic-assisted total laparoscopic hysterectomy, and the decision was determined by the resources and expertise available.

Only patients of Chinese ethnicity were included. To ensure the similarity of the surgical procedures, only patients with atypical complex hyperplasia or early-stage endometrial carcinoma of corpus, defined as International Federation of Gynecology and Obstetrics stage 1A grade 1-2, were included. Histological diagnoses and grading were confirmed by endometrial biopsy before the operation. Women with uterine leiomyomas or ovarian cysts of sizes manageable by laparoscopic approaches were included.

Women with malignancy, with more advanced stages, and those who required lymph node dissection or sampling, omentectomy, or debulking were excluded. Other exclusion criteria included patients with other surgical indications: those with co-existing pathologies, such as large uterine leiomyomas that rendered laparoscopic approaches unfeasible; conditions that required subtotal

hysterectomy due to extensive pelvic adhesions; those requiring concurrent procedures in the same surgery, such as procedures for treatment of urinary incontinence; and those surgeries done by the vaginal approach.

Conventional total laparoscopic hysterectomy was performed in the following manner. The peritoneal cavity was accessed through the umbilicus by either the open technique described by Hasson<sup>15</sup> or the closed method. Three accessory trocars were inserted in the right lower quadrant of the abdomen, the left lower quadrant, and the suprapubic region. Peritoneal washing was collected for cytological study. The hysterectomy began with identification of both ureters, followed by coagulation and division of both infundibulopelvic ligaments. The round ligaments were divided near the pelvic sidewall. The bladder was dissected away from the upper vagina. The uterine pedicles were isolated and divided at the isthmus and carried down the para-cervix to the level of the vaginal cuff. A colpotomy was created and extended. The intact uterus and appendages were removed vaginally for all patients, weighed, and sent for frozen section. The colpotomy site was closed laparoscopically with a continuous "O Vicryl" suture. There was no running of the edges.

Robotic-assisted total laparoscopic hysterectomy was performed with the da Vinci Surgical System following the same general principles as for conventional total laparoscopic hysterectomy, except for different port sites: a 5-mm left subcostal port; 3-arm robotic setup with 12-mm camera system at the umbilical or supra-umbilical port and two lateral ports at the left and right sides of the abdomen; and a 12-mm port at the left lower abdomen.

If the frozen section result confirmed atypical complex hyperplasia or early-stage endometrial carcinoma, no further procedure was required. If the staging or grading were more advanced, the surgeon would proceed to a full staging procedure, and the patient would be excluded from the study. Oral paracetamol was prescribed for postoperative pain relief, as required, and intramuscular pethidine would be given if paracetamol was inadequate. Complete blood count was checked on postoperative day 2.

The demographic characteristics, and preoperative, intra-operative, and postoperative factors were compared between the two groups. The demographic and preoperative characteristics of these two groups were noted prior to surgery. Preoperative characteristics included prior abdominal or pelvic surgery, known history of endometriosis, or pelvic inflammatory disease.

Intra-operative findings included presence of pelvic adhesions, or co-existing small uterine leiomyomas or ovarian cysts. Skin-to-skin operation time, weight of the uterus after hysterectomy, and estimated blood loss were noted. The levels of experience of the chief surgeons were also compared between the two groups. Intra-operative complications, which included injuries to the ureters, bladder, bowels, and major vessels, or conversion to laparotomy, were compared. Postoperative complications included fever, defined as body temperature of  $>38^{\circ}\text{C}$  with onset from day 3 onwards after the operation. Pelvic and wound infections, vaginal vault haematomas, and other medical and anaesthetic complications were noted. The duration of stay in hospital, incidence of anaemia, and drop in haemoglobin level within the first two postoperative days were also compared. Postoperative anaemia was defined as haemoglobin level of  $<80\text{ g/L}$  (reference range, 120-150 g/L).

Statistical analysis was performed using PASW Statistics for Windows version 18.0 (SPSS Inc., Chicago [IL], US). Chi-square test and Fisher’s exact test were used for categorical data. For continuous data with normal distribution, the independent-sample *t* test was used. For continuous data with a highly skewed distribution, a non-parametric test (i.e. Mann-Whitney *U* test) was used. A *p* value of  $<0.05$  was considered significant.

## Results

Within the study period, 64 women were diagnosed to have atypical complex hyperplasia or stage 1A grade 1-2 endometrial carcinoma of the corpus. Thirty women underwent conventional laparoscopic hysterectomy and 34 women underwent robotic-assisted laparoscopic hysterectomy. A total of 19 women were excluded from the study, including three from The Philippines, one who requested a subtotal hysterectomy, two with stage 1B disease who underwent concurrent pelvic lymph node dissection, one who underwent concurrent pelvic floor repair, one who underwent colposuspension, and 11 who underwent vaginal-assisted hysterectomy. Therefore, 45 women were included in the final analysis, of whom 19 underwent conventional total laparoscopic hysterectomy and 26 underwent robotic-assisted total laparoscopic hysterectomy (Figure).

The two groups had similar demographic characteristics as summarised in Table 1. Their numbers of participants were comparable, but there was a difference in distribution of atypical complex hyperplasia and early-stage endometrial carcinoma, though statistically insignificant ( $p=0.137$ , Table 1). When comparing the clinical characteristics of the cases between the two groups (Table 2), robotic-assisted total laparoscopic hysterectomy cases were as complex and difficult as for conventional

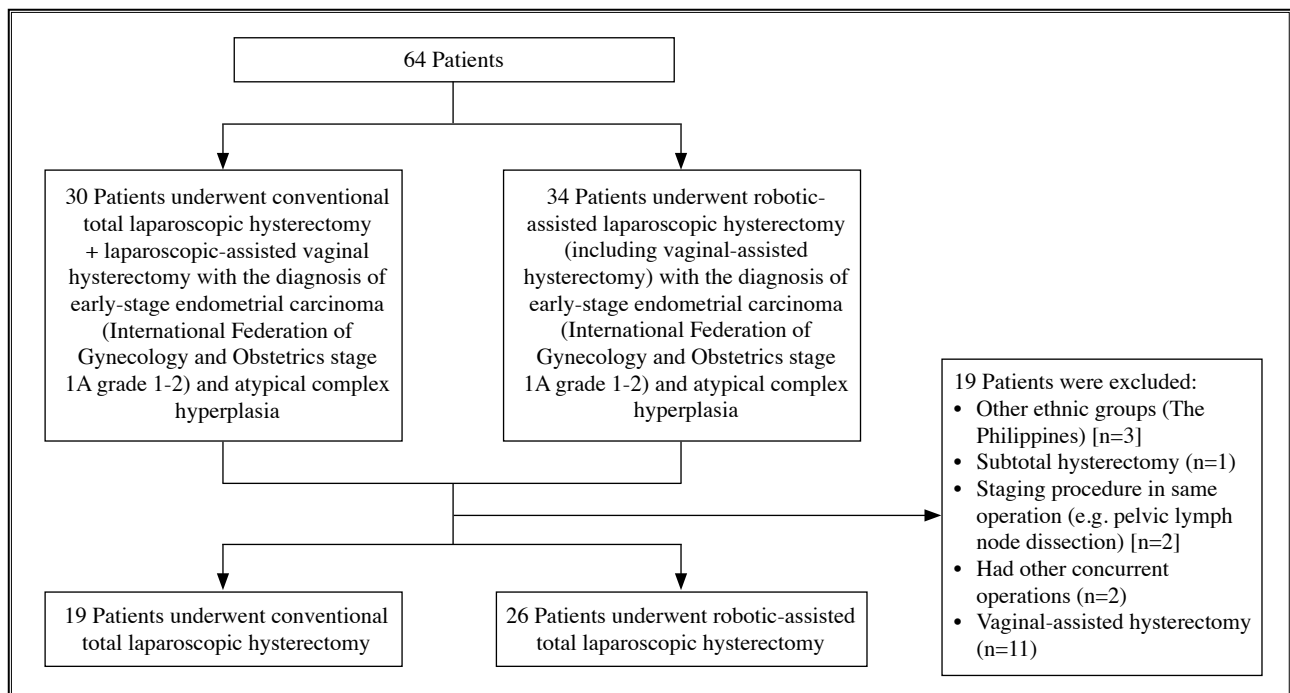


Figure. Flowchart showing the recruitment of participants

total laparoscopic hysterectomy, but this was statistically insignificant (p value, 0.102-1).

Regarding surgical outcomes (Table 3), the robotic-

assisted total laparoscopic hysterectomy group had significantly less postoperative opiate use (0% vs. 26.3%; p=0.01) and fewer postoperative complications (3.8% vs. 52.6%; p<0.001) than the conventional total laparoscopic

**Table 1. Demographic characteristics of women undergoing conventional total laparoscopic hysterectomy or robotic-assisted total laparoscopic hysterectomy\***

Characteristic	Mean $\pm$ standard deviation, median (interquartile range), or No. (%)		p Value
	Conventional (n=19)	Robotic-assisted (n=26)	
Age (years)	52 $\pm$ 11.81	54.31 $\pm$ 8.25	0.444
Gravidity	2 (1-4)	2 (0.75-3)	0.417
Parity	2 (1-3)	1 (0-2)	0.486
Type of disease			0.137
Atypical complex hyperplasia	6 (31.6)	3 (11.5)	
Early-stage endometrial carcinoma	13 (68.4)	23 (88.5)	

\* Univariate analyses tested by independent-sample t test, Mann-Whitney U test, Pearson Chi-square test, or Fisher's exact test

**Table 2. Clinical characteristics of women undergoing conventional total laparoscopic hysterectomy or robotic-assisted total laparoscopic hysterectomy\***

Characteristic	No. (%), mean $\pm$ standard deviation, or median (interquartile range)		p Value
	Conventional (n=19)	Robotic-assisted (n=26)	
Prior abdominal or pelvic surgery			0.187
No	12 (63.2)	21 (80.8)	
Yes	7 (36.8)	5 (19.2)	
History of endometriosis			1
No	19 (100)	25 (96.2)	
Yes	0	1 (3.8)	
History of pelvic inflammatory disease			-
No	19 (100)	26 (100)	
Body weight (kg)	62.34 $\pm$ 10.59	63.96 $\pm$ 12.64	0.653
Intra-operative findings of pelvic adhesions			0.102
No	12 (63.2)	10 (38.5)	
Yes	7 (36.8)	16 (61.5)	
Co-existing pathology			0.646
Nil	16 (84.2)	17 (65.4)	
Fibroid	2 (10.5)	6 (23.1)	
Ovarian cyst	1 (5.3)	2 (7.7)	
Hydrosalpinx	0	1 (3.8)	
Uterine weight (g)	110 (69-180)	135.5 (103-180)	0.306
Conversion to laparotomy			0.422
No	18 (94.7)	26 (100)	
Yes	1 (5.3)	0	

\* Univariate analyses tested by independent-sample t test, Mann-Whitney U test, Pearson Chi-square test, or Fisher's exact test

hysterectomy group.

One woman in the robotic-assisted total laparoscopic hysterectomy group had an acute asthmatic attack postoperatively. In the conventional total laparoscopic hysterectomy group, six patients had vault haematoma, one had abdominal wound infection, two had postoperative fever, and one had postoperative anaemia with a haemoglobin level of 76 g/L.

In the robotic-assisted total laparoscopic hysterectomy group, there were fewer laparotomy conversions (0% vs. 5.3%;  $p=0.422$ ), intra-operative complications (0% vs. 5.3%;  $p=0.422$ ), and mean decrease in haemoglobin (3.5 g/L vs. 7.0 g/L;  $p=0.645$ ) than the conventional total laparoscopic hysterectomy group. These differences were statistically insignificant, but could be clinically relevant.

The robotic-assisted total laparoscopic hysterectomies were all performed by consultants, while

42.1% of the conventional total laparoscopic hysterectomies were performed by less experienced associate consultants. The difference in the level of experience of the chief surgeons was statistically significant ( $p<0.001$ ).

### Discussion

The PYNEH conventional total laparoscopic hysterectomy and robotic-assisted total laparoscopic hysterectomy surgical outcomes were comparable to both Hong Kong<sup>2</sup> (Table 4) and global data<sup>10,16,17</sup> (Table 5).

This study demonstrated that robotic-assisted total laparoscopic hysterectomy outperformed conventional total laparoscopic hysterectomy in terms of fewer postoperative complications. While there was a high complication rate in the conventional total laparoscopic hysterectomy group<sup>2</sup>, all complications were minor. The complication of acute asthmatic attack in the robotic-assisted total laparoscopic hysterectomy group was probably not directly related to the surgical procedure. With better high-resolution 3D views and the articulated

**Table 3. Surgical outcomes of women undergoing conventional total laparoscopic hysterectomy or robotic-assisted total laparoscopic hysterectomy\***

Characteristic	No. (%) or median (interquartile range)		p Value
	Conventional (n=19)	Robotic-assisted (n=26)	
Skin-to-skin operating time (mins)	145 (127-170)	140 (112.75-191.25)	0.696
Conversion to laparotomy			0.422
No	18 (94.7)	26 (100)	
Yes	1 (5.3)	0	
Intra-operative complications			0.422
No	18 (94.7)	26 (100)	
Yes	1 (5.3)	0	
Postoperative complications			<0.001
No	9 (47.4)	25 (96.2)	
Yes	10 (52.6)	1 (3.8)	
Any postoperative opiate use			0.01
No	14 (73.7)	26 (100)	
Yes	5 (26.3)	0	
Estimated blood loss (mL)	50 (50-150)	50 (30-100)	0.431
Drop of haemoglobin (g/L)	7 (0-14)	3.5 (0-14.2)	0.645
Length of hospital stay (days)	3 (3-5)	3 (3-4)	0.222
Experience of chief surgeon			<0.001
Consultant	11 (57.9)	26 (100)	
Associate Consultant	8 (42.1)	0	

\* Univariate analyses tested by independent-sample t test, Mann-Whitney U test, Pearson Chi-square test, or Fisher's exact test

wrist-like movements of the robotic arms, robotic assistance ensured better suturing performance than conventional total laparoscopic hysterectomy. Better suturing of the vault was attributed to fewer vault complications in the robotic-assisted total laparoscopic hysterectomy group.

Vault haematomas accounted for six postoperative complications in the conventional total laparoscopic hysterectomy group. All these haematomas were diagnosed by transvaginal ultrasonography after noting postoperative vaginal bleeding. As shown in other studies<sup>16,18</sup>, vault haematoma formation resulted in greater demand for analgesia. Therefore, the higher rate of vault complications in the conventional total laparoscopic hysterectomy group probably explained the higher rate of postoperative opiate use in this group.

Robotic-assisted total laparoscopic hysterectomy was associated with a smaller decrease in postoperative haemoglobin level than conventional total laparoscopic hysterectomy, although this did not reach statistical significance. These findings are consistent with those of similar international studies<sup>8,18-21</sup>.

The mean operating time was similar for both robotic-assisted and conventional procedures (Table 3), and was comparable to the robotic-assisted total laparoscopic

hysterectomy reported in other series (Table 5). However, some studies<sup>16,22</sup> have found that robotic-assisted total laparoscopic hysterectomy took longer to perform than conventional procedures. Further analysis of the data in the present study showed that the mean operating time for the last 10 robotic-assisted total laparoscopic hysterectomies was approximately 15 minutes shorter than the previous 16 procedures. Moreover, the mean docking time for the robotic system was approximately 10 minutes faster for these later procedures. This finding is supported by the study by Payne and Dauterive<sup>8</sup>. Robotic surgery is a new technology to learn. The PYNEH started robotic gynaecologic surgery in early 2010, and robotic-assisted total laparoscopic hysterectomy was still in the learning phase for both the surgeons and the operating team during the earlier part of the study period. With practice, it is possible that the mean operating time may be further reduced in the future.

Although the difference in levels of experience of the chief surgeons between the two groups could be a confounding factor and may have partly accounted for better outcomes for robotic-assisted total laparoscopic hysterectomy, all associate consultants and consultants performing the surgeries have achieved advanced laparoscopic accreditation from the Hong Kong College of Obstetricians and Gynaecologists.

This study compared the outcomes of robotic-

**Table 4. Comparison of conventional total laparoscopic hysterectomy between the Hong Kong College of Obstetricians and Gynaecologists (HKCOG) audit and the present study**

Item	Present study	HKCOG Audit 2007 <sup>2</sup>
Mean operating time (mins)	145	147
Mean duration of hospital stay (days)	3	3.1
Mean blood loss (mL)	50	223

**Table 5. Comparison of robotic-assisted total laparoscopic hysterectomy between the present study and other studies<sup>10,16,17</sup>**

Item	Present study	Soto et al <sup>10</sup>	Shashoua et al <sup>16</sup>	Sarlos et al <sup>17</sup>
Mean operating time (mins)	140	150.82	142.2	108.9
Mean uterine weight (g)	135.5	94	212	217
Intra-operative complications (%)	0	0	0	0
Mean conversion to laparotomy rate (%)	0	0	0	0
Mean estimated blood loss (mL)	50	131.5	113.5	81
Mean haemoglobin decrease (g/L)	0.35	-	18.7	-
Mean duration of hospital stay (days)	3	1.9	1	3.3



assisted total laparoscopic hysterectomy and conventional total laparoscopic hysterectomy for cases of similar complexity. In the study by Giep et al<sup>5</sup>, robotic-assisted laparoscopic hysterectomy was performed for more complex cases with better outcomes compared with conventional laparoscopic-assisted vaginal hysterectomy. Moreover, in the study by Kilic et al<sup>23</sup>, robotic hysterectomy was performed successfully for patients with larger uterine size compared with conventional laparoscopic hysterectomy (uterine weight >250 g, n=11 vs. n=5). According to the data analysis for this study (Table 2), robotic-assisted total laparoscopic hysterectomy was performed successfully for patients with greater body weight, heavier uterine weight, more pelvic adhesions, and more co-existing pathology than for conventional laparoscopic hysterectomy without increasing the operation time. Only one patient in the conventional total laparoscopic hysterectomy group required conversion to laparotomy because of dense adhesions around the uterovesical fold. In this patient, even if the vaginal-assisted approach had been adopted, conversion to laparotomy was necessary to avoid bladder injury. It is possible that with the higher resolution view and finer movements provided by the robotic system to facilitate dissection, conversion to laparotomy might have been avoided. However, these differences were not statistically significant.

The power of this study was limited by the sample size. Further study with a larger number of patients from Hong Kong is awaited. This study could serve as a basis for further studies of more complex cases such as radical

hysterectomy for cancer of the cervix or hysterectomy with pelvic lymph node dissection for endometrial carcinoma, with various surgical pathologies as indications or with larger uterine size. These outcomes are important to establish the role of robotic-assisted laparoscopic surgeries in gynaecological practice.

Quality of life and long-term safety of the procedure, such as recurrence, could not be ascertained in this study. However, based on this database, these factors can be examined in a future study.

The cost of robotic-assisted surgery is currently a concern. Sarlos et al<sup>17</sup> showed that robotic-assisted total laparoscopic hysterectomy cost  $\square$ 2000 more per case than conventional laparoscopic hysterectomy. In Hong Kong, there is no such evidence available yet. Further study is needed to ascertain the cost effectiveness of this new technology. However, with increasing popularity, the cost will probably be reduced in future. By then, robotic-assisted total laparoscopic hysterectomy may well become the surgical modality of choice for hospitals in Hong Kong.

## Conclusion

Robotic-assisted total laparoscopic hysterectomy is as safe and efficient as conventional laparoscopic hysterectomy for treating atypical complex hyperplasia and early-stage endometrial carcinoma in a Chinese population. Whether fewer short-term complications and less opiate use are due to the use of robotic-assisted surgery or more experienced surgeons could not be determined in this study.

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