Robotic hysterectomy using the Vessel Sealer for myomatous uteri: technique and clinical outcome

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ABSTRACT

Objective: Robotic procedures using the Vessel Sealer are not well reported in the literature, especially given the advantages of sealing devices already studied in standard laparoscopic procedures. This study reports our experience with the EndoWrist™ One™ Vessel Sealer in robotic hysterectomy for myomatous uteri.

Study design: In this retrospective cohort study of the first 50 consecutive patients with myomatous uteri undergoing a robotic hysterectomy, we report our experience with the EndoWrist™ One™ Vessel Sealer (Intuitive Surgical Inc., Sunnyvale, CA) during this procedure. The learning curve was evaluated, and the operative times as well as the complications were recorded.

Results: After the first 10 cases, the median console and total (skin-to-skin) operative time dropped significantly from 110 to 60 min and from 158 to 105 min, respectively (p = 0.018 and p = 0.008 respectively). The body mass index (≤ 30 kg/m²), uterine weight (≤ 250 g), and uterine size had no statistical significant effect on the total operative time. Median blood loss during surgery was 63 mL in all cases (range: 0–400 mL). The morbidity was low, and approximately 50% of cases could be discharged from the hospital after one to two days.

Conclusion: Robotic hysterectomy using the Vessel Sealer has, after a short learning curve of 10 cases, similar operative times to other published reports on robotic hysterectomy or laparoscopic hysterectomy using a sealing device for myomatous or large uteri.

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Introduction

Minimal invasive surgery in both benign gynaecology and gynaecological oncology has evolved from laparoscopic surgery in the 1990s to robotic surgery over the past decade [1–4]. Robotic surgery has shown to have a similar morbidity and short hospital stay as laparoscopic surgery, but with the advantage of dexterity during surgical dissection and 3D vision at the console. Some studies have even demonstrated lower blood loss and intra-operative complications during robotic surgery as compared to laparoscopic surgery for radical hysterectomy [5].

A few recent studies on robotic hysterectomy in large uteri have demonstrated low blood loss, low morbidity, minimal risk of conversion and short hospital stay [6,7]. One retrospective study has compared 30 robotic cases with 30 cases by laparotomy for large uteri and showed median operative times of 255 min and 150 min, respectively [7]. The laparotomy group had a much higher median blood loss compared to the robotic group, and the robotic group could be discharged much earlier. A recent randomised trial compared 27 laparoscopic hysterectomies with 26 robotic hysterectomies for benign indications, and they demonstrated significantly longer operative times for the robotic group [8]. However, one recent report showed that robotic hysterectomy was associated with a shorter operative time and reduced blood loss compared to laparoscopic hysterectomy in patients with large uteri [9].

A systematic review has recently shown that in benign gynaecology no significant differences are reported between robotic and laparoscopic surgery, with regard to learning curve and operative time [10].

Sealing devices, which can seal and cut vessels/tissues at the same time, such as the LigaSure™ (Valleylab Inc., Boulder, CO) have been introduced in both open and laparoscopic surgery. The use of the LigaSure in laparoscopic hysterectomy procedures has shown to be effective in decreasing operative time, complication rate and postoperative pain [11,12]. A recent systematic review

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concluded that vessel sealing devices may be considered safe and their use may reduce costs due to reduced blood loss and shorter operative time compared to monopolar or bipolar electrosurgical devices [13]. More recently, the EndoWrist One™ Vessel Sealer (Intuitive Surgical Inc., Sunnyvale, CA) has been introduced for use in one of the robotic arms of the da Vinci Robotic System (Intuitive Surgical Inc., Sunnyvale, CA).

The aim of the present study was to report, in a retrospective cohort study of the first 50 consecutive patients with myomatous uteri undergoing a robotic hysterectomy, our experience with the EndoWrist One Vessel Sealer during this procedure. In addition, we evaluated the learning curve of this technique, and the operative times as well as the surgical outcomes were recorded.

Material and methods

A cohort series of the first 50 patients with myomatous uteri undergoing robotic hysterectomy using the EndoWrist One™ Vessel Sealer, between September 2012 and May 2015 at AZ Sint-Jan Hospital Bruges (Belgium), were included in this study. Patient characteristics (age, body mass index, medical history), the different operative times (total skin-to-skin operative time: incisions, trocar placement, docking robot, console time, undocking and skin closure; console time: hysterectomy and closure (vagina)), uterine weight and size, and intra- and postoperative complications were prospectively recorded. These data were also mentioned, as standard procedure in our centre, in the discharge letter to the referring doctor of each patient. By Belgian Law, no Institutional Review Board approval is required for a retrospective analysis of prospectively collected data for quality control. The primary outcomes were console and total (skin-to-skin) operative time. The secondary outcomes were intra- and postoperative complications.

Statistical methods

Descriptive statistics are presented by median and range, and with number or percentage for categorical variables. For comparison between two groups (operative times between: (i) first cases of the learning curve and subsequent cases, (ii) body mass index ≤30 and >30 kg/m², (iii) uterine weight ≤250 g and >250 g, (iv) uterine size ≤12 weeks and >12 weeks) the Fisher's exact test was used for dichotomous variables and the nonparametric Mann–Whitney U-test for continuous variables without making the assumption that values are normally distributed.

The aim of the learning curve was to achieve a total operative time of 100 min which is equivalent to the reported times, and this was achieved after 10 cases.

Multivariable regression analysis was made in case potential confounders (body mass index, uterine weight or size) have separately a significant effect on the total operative time. All significant tests were two-sided and with a 5% significance level.

Robotic standard surgical procedure

For the robotic surgical procedure we used the 4-arm Robot da Vinci Si system (Intuitive Surgical Inc., Sunnyvale, CA), with side docking. The same surgeon performed all robotic operations at the console (P.V.T.). The 4 trocars were placed above the level of the umbilicus with 8 cm from each other, with the trocar for the camera as highest above the umbilicus (in most cases 3–4 cm above). We used as robotic instruments for arm 1 the EndoWrist One™ Vessel Sealer (Intuitive Surgical Inc., Sunnyvale, CA), for arm 2 the bipolar fenestrated forceps and for arm 3 the Prograsp, besides the 3D camera in the central robot arm. As uterine manipulator we used the VCARE medium retractor/elevator (ConMed®, NY, USA), with the plastic cuff fixed to the exocervix at 3 and 9 o’clock with a Vicryl 0. The vagina was further packed with a dry and wet surgical gauze swab in order not to lose CO₂ during opening of the vagina. The patients’ legs were put in boot-type leg holders, and the patients were placed in 25–30° tendelenburg. The abdominal cavity was insufflated with CO₂ to a maximum of 15 mmHg.

The standard surgical procedure started in each patient with opening of the peritoneum at the pelvic sidewalls by sealing/cutting the round ligament with the Vessel Sealer. The retroperitoneal space was opened with the dissecting Vessel Sealer; the iliac vessels as well as the ureters were identified. The uterine arteries were sealed laterally at their origin, at the internal iliac artery, in order to minimise subsequent bleeding. The distal ureter was lateralised at the region where it crosses and goes under the uterine artery, using the dissecting Vessel Sealer. Both latter procedures took only a few minutes. In most cases the ovaries were preserved by sealing/cutting the ovarian ligament/fallopian tube. With the uterus mobilised posterior and the robot camera above the uterus, the bladder peritoneum was opened and the bladder dissected from the cervix/proximal vagina with the dissecting Vessel Sealer, whilst holding the bladder peritoneum up with the Prograsp. Each uterine artery was sealed/cut with the Vessel Sealer on the cervix, whilst holding the uterus to the contralateral side and holding the ureter laterally at the ipsilateral side. The parametrical tissue was sealed/cut on the cervix. The sacro-uterine ligaments were sealed/cut on the cervix with the Vessel Sealer, whilst holding the uterus up anterior with the Prograsp and the ureters laterally with the fenestrated forceps. The vagina was opened on the VCARE plastic cup with the Vessel Sealer. The uterus was removed vaginally, and in case of large uteri dissected in fragments under vision. The vaginal cuff was closed with 3 or 4 Vicryl 0 cross-stitches after application of Braunol® 7.5%.

Results

The median age of the patients was 43 years (range: 35–67 years); the median body mass index was 27 kg/m² (range: 19–42 kg/m²); 20 patients (40%) had a body mass index >25 kg/m² of which 8 patients with a body mass index >30 kg/m². The median uterine weight was 334 g (range: 74–1169 g). Thirty-two uteri (64%) were more than 250 g and 18 (36%) were less than 250 g. Median uterine size was 13 weeks (range: 8–22 weeks), with 21 cases having a uterine size larger than 12 weeks.

The learning curve was 10 robotic hysterectomies, similar to some previous reports [14,15]. From case 11 onwards we had regularly total operative times of 100 min or less. The median console and total (skin-to-skin) operative time in all cases was 75 min (range: 30–150 min) and 108 min (range: 65–195 min), respectively. The median console and total operative time in the first 10 cases was 110 min (range: 70–150 min) and 158 min (range: 105–185 min), respectively. In the next 40 cases the median console and total operative time dropped significantly, to 60 min (range: 30–150 min) and 105 min (range: 65–195 min), respectively (p = 0.018 and p = 0.008 respectively; Table 1, Figs. 1 and 2). Outliers in operative time were due to extensive adhesions, difficult location of a fibroid (such as in the broad ligament), or when the fibroid was more than 10 cm in diameter. Body mass index (<30 and >30 kg/m²), the uterine weight and uterine size had no statistical significant effect on the total operative time (p = 1, p = 0.37, p = 0.14 respectively; Table 1). Therefore, no multivariable regression analysis was made. Median blood loss during surgery was 63 mL in all cases (range: 0–400 mL). Blood loss dropped from 88 mL, for case 1–10, to 45 mL, for case 11–50 (p = 0.73).
There were 3 intra-operative minor complications: 3 small bladder lesions of 2–3 mm in cases of a morbidly adherent bladder to the uterus due to large anterior fibroids and/or repetitive caesarean sections in the past. These small bladder lesions were repaired by Monocryl 3/0 sutures, and checked with blue dye in 150 mL of physiological water injected in the bladder. The bladder catheter was kept in place for 5–7 days. There were 2 postoperative complications (one urinary tract infection and one haematoma at the vaginal cuff requiring blood transfusion). The haematoma could be managed conservatively with antibiotics and spontaneous drainage/regression of the blood collection via the vagina. The median hospital stay was 3 days (range: 1–6 days), with 23 patients (46%) being discharged after 1–2 days. Follow up, after a minimum of 3 months, revealed no case of vaginal cuff dehiscence.

Discussion

In this retrospective cohort study of the first 50 consecutive patients with myomatous uteri who underwent a robotic hysterectomy, using the robotic EndoWrist One Vessel Sealer, we could clearly find a significant correlation between the learning curve and the total operative time. After the first 10 cases, the median console and total operative time dropped significantly from 110 to 60 min and from 158 to 105 min, respectively. Previous reports on robotic hysterectomy in benign gynaecology showed variable learning curves, from 9 to 50 cases, to achieve stable operative times, but most studies were from the early stages using the robot [14,16–18]. We achieved a similar learning curve of approximately 10 cases as reported by Sendag et al. [14]. In our study, including large uteri, we reached after 10 cases a median total (skin-to-skin) operative time of 105 min, with a few minor peri-operative complications. This total operative time was similar to other published reports on robotic hysterectomy for benign indications such as myomatous or large uteri [3,4,6,7,9]. One report showed a lower total operative time, of 95 min, but this was reached after a learning curve of 50 cases [16]. For benign indications, the total operative time of a total robotic hysterectomy reported in the literature varies from 95 min to 255 min, with several studies reflecting the initial experience with the robot [6–9,14,16,17,19–21]. Previous experience in laparoscopic surgery in gynaecology may have an impact on the (short) learning curve, as observed in our study. Further, the synergy of one single primary surgeon with a dedicated surgical team contributes to increased efficacy. The use of the Vessel Sealer enables 3 surgical movements (dissecting, sealing, and cutting of tissue) almost at the same time, resulting in enhanced efficacy of dissection. We also find the Vessel Sealer useful in lateralising the ureter where it crosses the uterine artery, and this procedure takes only a few minutes on each side. The ureters can be attracted by the presence of lateral uterine fibroids, previous surgery or pelvic infection. Lateralising the distal ureters may help to prevent damage to them in case of bleeding during surgery or when sealing the uterine arteries laterally to the cervix. One recent study reported on short operative times using a tissue sealing device (Enseal), but this is a laparoscopic instrument inserted via the assistant trocar, and therefore not entirely a totally robotic hysterectomy procedure but a hybrid technique [22]. A recent randomised trial showed for laparoscopic hysterectomy procedures using a sealing device (LigaSure™) a total operative time of approximately 100 min, similar as in our robotic group of myomatous uteri [23].

Robotic hysterectomy, in benign gynaecology, shows initially in several reports longer operative times as compared to vaginal, abdominal and conventional laparoscopic hysterectomy. However, robotic operative times improved with experience without altering surgical outcomes such as blood loss and complications [2,20,21,24]. One recent report showed that robotic hysterectomy was associated with a shorter operative time and reduced blood loss compared to laparoscopic hysterectomy in patients with large

Table 1

<table>
<thead>
<tr>
<th>Learning curve</th>
<th>Total operative time (skin-to-skin)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case 1–10</td>
<td>≤100 min (n = 19)</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>&gt;100 min (n = 31)</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>p = 0.008</td>
<td></td>
</tr>
<tr>
<td>Case 11–50</td>
<td>≤30</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>&gt;30</td>
<td>26</td>
</tr>
<tr>
<td></td>
<td>p = 1</td>
<td></td>
</tr>
<tr>
<td>Body mass index</td>
<td>≤250 g</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>&gt;250 g</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>p = 0.37</td>
<td></td>
</tr>
<tr>
<td>Uterine weight</td>
<td>≤12 weeks</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>&gt;12 weeks</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>p = 0.14</td>
<td></td>
</tr>
</tbody>
</table>

Figs. 1 and 2. Box-and-whisker plot, with the median operative times as middle lines within the Box plots, for console (Fig. 1) and total operative time (Fig. 2), for the first 10 cases (learning curve) and the next 40 cases. Robotic hysterectomy using the Vessel Sealer for Myomatous Uteri is a safe and efficient procedure with a short learning curve and low morbidity.
uteri [9]. A recent randomised trial comparing robotic hysterectomy with vaginal and laparoscopic hysterectomy showed less blood loss and fewer complications postoperatively for the robotic group [25]. This trial confirmed the findings of a previous study showing fewer minor complications for the robotic group compared to other methods of minimal invasive surgery [26]. A recent review concluded that in laparoscopic procedures vessel sealing devices may reduce costs due to reduced blood loss and shorter operative time compared to mono- or bipolar devices [13]. However, cost comparison between robotic hysterectomy with and without the Vessel Sealer needs to be clarified in a future randomised trial.

As the study from Nawfal et al. already mentioned, we also found no significant effect of the body mass index on the total operative time [27]. This result stands in contrast to laparoscopic procedures, where operative time increases due to a lack of instrument mobility, precision, dexterity, 3D visualisation and stable view [28]. Median blood loss during surgery was low in our study, confirming previous findings of robotic surgery in benign gynaecology [8,9,18,25]. Approximately 50% of the patients could be discharged from the hospital after one to two days.

In our study we could not demonstrate a significant effect of the uterine weight (≤250 g or >250 g) or size (≤12 weeks or >12 weeks) on the total operative time, confirming the findings of some previous reports [7,16]. Other reports showed a significant increase in the robotic operative time when the uterus was greater than 250 g or 500 g [6,19].

In conclusion, we could demonstrate after a short learning curve comparable or shorter operative times for robotic hysterectomy, using the EndoWrist One Vessel Sealer, than earlier reports on minimal invasive surgery for myomatous uteri. The robotic procedure was associated with low blood loss and low morbidity.

References