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ORIGINAL ARTICLE

Concurrent use of a robotic uterine manipulator and a robotic laparoscope holder to achieve assistant-less solo laparoscopy: the double ViKY

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Abstract Three patients requiring gynecological surgery had uterine manipulation using a VCare® controlled by a ViKY® at the same time as having a ViKY® robotic arm controlling the laparoscope. The setup time for each varied from 6–9 min for the uterine manipulator and 3–5 min for the laparoscope holder. In all cases (one endometriosis and two dermoid cysts) the operative field was good. Two patients were discharged within 24 h of surgery. One patient required an extra day in hospital after she went into acute urinary retention once the catheter was removed. This work demonstrated that assistant-less solo gynecological surgery is feasible using two ViKY robotic arms for both uterine manipulation and laparoscope holding.

Keywords Laparoscopy · Camera holder · Uterine manipulator

Introduction

Straight stick laparoscopic procedures in gynecology often require two assistants. One to provide uterine manipulation and another to hold the laparoscope and camera. Inevitably, loss of concentration or unsteadiness from either of the assistants can produce an operative field or video picture that is suboptimal. We have demonstrated the feasibility of using a parallel system of robotic arms with two Visual Control Endoscopy systems (ViKY®–Trumpf GmbH, Munich, Germany) to achieve an assistant-less solo laparoscopic setup.

Methods

Three patients who required operative procedures for gynecological conditions are included in this report. Each patient was prepared as per usual protocol, anesthetized, intubated, and placed in the Lloyd–Davis position on the operating table.

At the start of each procedure and after each patient was prepared with antiseptic solution, catheterized and draped, a VCare® (ConMed, Utica, NY) uterine manipulator was inserted trans-vaginally into the endometrial cavity [1]. After the cavity was sounded and the length measured, the VCare® was inserted and 7 mm of air injected into the endometrial balloon. The back-guard of the VCare® was then pushed forward to ensure that the amount of the probe that projected into the uterus was locked at 1 cm less than the total uterine cavity length to prevent perforation. The first ViKY® device was then connected to the VCare®. This involved attaching the connection arm to the operating table on the patients' right at the level of the buttocks and fastening the ViKY® motor ring to the arm. The ViKY® motor ring was then angled downwards at 30 degrees to the horizontal between the patients leg. The VCare® was then inserted into the specially designed adaptor of the ViKY® ring. The ViKY® robot responsible for uterine manipulation was then calibrated and controlled by the surgeon during the operation using the foot pedal. This allowed the surgeon to provide both ante- and retro-version of the uterus; angular movement of the womb to the left and right; and advancement and retraction of the uterus within the pelvic.

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Once the uterine manipulation was secured the second ViKY® device was assembled by attaching the connecting arm to the operating table on the patients' right at the level of the shoulders. The patients' abdomens were then insufflated using a Veress needle at Palmer's point. Afterwards, an optical 10-mm trocar was placed in the umbilicus. The second ViKY® motor apparatus was then attached to the arm and placed over the umbilical trocar so that the port was centralized within the ring. The laparoscope was attached to the second ViKY® motor system using the specially designed adaptor and calibrated. The second ViKY system holding and moving the laparoscope was operated by the surgeon using voice recognition and a Bluetooth™ control system with a personal speaker and microphone placed over the surgeons left ear. The secondary trocars were 5 mm in diameter and were place suprapubically and in the left iliac fossa avoiding the epigastric artery.

Once both ViKY® robot arms were assembled a single surgeon performed the laparoscopic procedure as normal using instruments down each 5-mm port, controlling the laparoscope by voice, and positioning the uterine manipulator with a foot pedal. The operative setup is shown in Fig. 1.

Results

The demographics of the three patients are detailed in Table 1. Two had dermoid cysts removed and one had deep infiltrative endometriosis excised. All three patients had their operation on an evening operating list and two were discharged the next morning. One spent an additional night in hospital having gone into acute urinary retention after removal of the urinary catheter. That patient was re-catheterized and had normal voiding function after the catheter was removed the next morning.

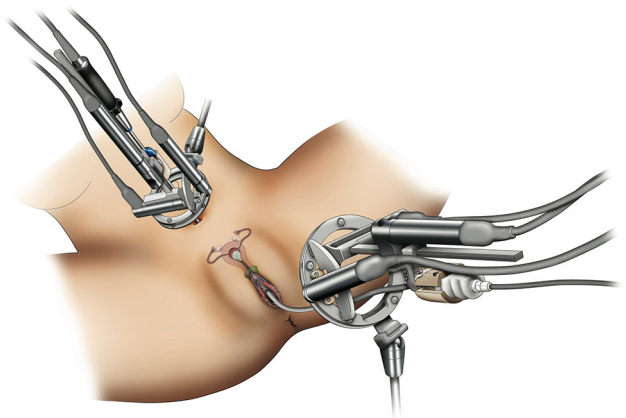

Fig. 1 Diagram demonstrating two ViKY® devices. One being used as a camera holding robot and the other controlling the uterine manipulator

The setup time was relatively quick for each of the robot arms with the uterine setup taking slightly longer (Table 1).

Discussion

This work demonstrates that solo gynecologic laparoscopic surgery is feasible when using two ViKY® devices. In this example, a VCare® was used as a uterine manipulator although it is feasible that the system could be adapted for other manipulators. The use of robotic camera holding arms is well reported in the literature using a variety of devices in numerous surgical situations [2–7]. The ViKY® is a compact device compared to some of the other systems and requires no additional consumable items for its use. It has already been demonstrated as a suitable camera holder [8] and a controller for a uterine manipulator [9]. This is the first time that two ViKY®s have been reported as being used at the same time for both purposes.

The value of robotic arms compared to human assistants has been discussed before and are summarized in Table 2. When used to allow solo surgery the system is cheaper as it requires only a one-off cost and is not salaried. The system is relatively robust but could theoretically malfunction. A human assistant has an increased likelihood of fatigue; decreased steadiness; and decreased reliability due to illness, vacation, and other reasons. The disadvantage of a robotic arm is that it is non-intelligent and does not provide advice and feedback that sometimes comes from a human assistant. Furthermore, it does not recognize a malposition on its own where as a human might. In one comparative study [10], a robotic assistant did not alter the operative time, duration of hospitalization or outcomes in biliary and colonic surgery. A review demonstrated that robot assistants were able to provide surgeons with complete control of the surgical field, outperformed human assistants, and were cheaper [11].

Although a double ViKY® removes the need for another surgeon in theatre it does not take away any benefits from training. A robotic camera system allows the surgical student to disconnect from assisting duties. This allows a trainer to stand behind a student giving them more hands on instruction. Therefore, in addition to benefiting non-teaching institutions in terms of cost and reliability, it has a value in teaching hospitals also.

One perceived disadvantage is that the surgeon has to perform three tasks rather than one. He/she has to perform the surgery, manipulate the camera, and move the uterus. Although this could perhaps create some difficulties, none were encountered in these cases. The template of the laparoscope-holding robot on the patients' abdomens could possibly interfere with the surgery but this was not encountered in these cases either.

Table 1 Outcomes of three patients who had laparoscopic procedures with a solo surgeon and double ViKY®s for uterine manipulation and laparoscopic camera holding

	Subject 1	Subject 2	Subject 3
Diagnosis	Deep endometriosis	8 cm dermoid cyst	6 cm dermoid cyst
Age (years)	41	30	37
Durations of uterine manipulation setup (min)	6	7	9
Duration of laparoscopic setup (min)	3	3	5
Total operative time (min)	76	46	41
Complications	Urinary retention	None	None
Inpatient nights (nights)	2	1	1

Table 2 Comparison of robotic (ViKY®) compared to human assistants

Robot assistant	Human assistant
One-off cost, no consumable costs	Salaried
Takes a few minutes to set up	Less setup time
Might malfunction	Might be sick or on other leave
Steady	Less steady
Non-intelligent	Recognizes an incorrect position
Allows hands on teaching	Student normally assisting
Does not tire	Susceptible to fatigue
No feedback	Provides feedback

We have demonstrated that using dual ViKY® systems in gynecological surgery is feasible and relatively straight forward. This may improve surgery by providing a more stable operative field and aid teaching by allowing the trainer to stand behind the student surgeon.

Compliance with ethical standards

Conflict of interest Thomas Ind and Manish Maheshwari declare that they have no conflict of interest.

Statement of consent All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2000 (5). Informed consent was obtained from all patients included in the study.

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