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New Approaches to Hysterectomy by Minimal Invasive Surgery (MIS)

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1. Introduction

The most significant advancement in reducing surgical morbidity in gynaecology over the last two decades has been an increased application of minimal invasive surgical techniques for both benign and malignant gynaecological disease requiring a subtotal, simple, or radical hysterectomy. ^{1,2,3,4,5,6.}

Many variations of the procedures of laparoscopic assisted hysterectomy have been described, that vary principally by the extent of surgery performed via the laparoscopic route. The training and skill of the surgeon and equipment available may influence the extent of surgery performed via the laparoscope. This in turn has the potential impact on the clinical outcomes, such as perioperative complication rate and resource utilization outcomes such as readmission rate and post-surgical care.

Several attempts have been made to standardize the extent of surgery by minimal access approach by using a system of classification ^{7,8.} Unfortunately the clinical results published on this topic, in the literature seldom adhere to these classifications when describing their outcomes. The reluctance to adhere to these classifications may be due to the complexity of the classifications, with numerous subgroups in each type of the main four Types described by AAGL. Besides, this classification does not extend to more radical hysterectomies required for malignant conditions such as endometrial and cervical cancers.

Simplifying the classification described by AAGL for both subtotal and total hysterectomies by MIS and extending the classification to include pelvic and Para aortic lymphadenectomy and Piver's ⁹ classification of radical hysterectomy may be more useful to standardize and compare surgical outcomes by MIS in future. It is essential that surgeons have advanced laparoscopic skill recognised by their national or international governing body for training, before undertaking these procedures in the interest of their patients. The National Institute for Health and Clinical Excellence (NICE) of U.K. has recently issued the guidance on laparoscopic radical hysterectomy for early cervical cancer and emphasised the importance of adequate higher training in MIS for surgeons undertaking these procedures. (2010)^{10.}

2. Laparoscopic assisted hysterectomy for benign gynaecological disease

In the past two decades there has been a vast number of publications on laparoscopic hysterectomy: prospective, retrospective, randomised studies and met-analysis evaluating the complications, benefits to patients, cost to health services and quality of life. There are equal numbers of proponents of this surgical technique as there are for conventional hysterectomy by laparotomy and vaginal hysterectomy. The complication rates reported in earlier multicentre studies showed a higher complication rate ^{2, 11,12, 13} similar rates ^{3, 14}, and lower complications with laparoscopic approach ¹⁵.

3. Laparoscopic hysterectomy with pelvic lymphadenectomy

Childers and Surwit proposed laparoscopic staging as an alternative for early endometrial cancer ¹⁶. Several studies since have shown that this approach is associated with a shorter hospitalisation, faster recovery, lower complications when compared to open surgery. ^{5, 17, 18}. Meta analysis of 17 prospective and retrospective studies showed that laparoscopic approach to surgical treatment for women with endometrial cancer had lower complications and no significant difference in recurrent rates or disease free survival ^{19,20}.

4. Laparoscopic radical hysterectomy with pelvic lymphadenectomy

Over a thousand laparoscopic radical hysterectomies have been performed to-date, ^{21,22,23,24}. However, laparoscopic surgery has not gained popularity amongst gynaecological oncologists. Many gynaecologists have been slow to adopt laparoscopic approach to radical hysterectomy largely due to prolonged learning curve, complexity of the procedure, technical challenges leading to prolonged operating time and surgeon's fatigue. The disadvantages of the laparoscopic approach which includes, two dimensional view, decreased range of movements, reduced degree of freedom of instruments and dependents on the skill of assistants. Wattiez et al ²⁵ in a series of 1,647 cases showed the learning curve for total laparoscopic hysterectomy is prolonged and the technique requires a high level of expertise and training as recommended by NICE ¹⁰. The complications with laparoscopic hysterectomy have been reported to be higher when performed by less experienced surgeons. Although patients treated with laparoscopic approach have been shown to experience less intraoperative blood loss, less post-operative pain and ileus, and short hospital stay than those who had conventional open hysterectomy ²⁶, minimal invasive surgery (MIS) is still an exception and not the rule in most gynaecologist practice.

5. Surgical robot – de Vinci surgical system (intuitive surgical inc.) (Fig 1.)

This robotic system was introduced in 1999 which is comprised of three components, the patient side surgical cart, the vision system, and the surgical console (fig 2). The surgeon's console is located remotely from the patient. The surgeon is seated at the console to control the robotic arms which hold the instruments within the patient's abdomen. With the aid of stereoscopic viewer, hand manipulators and foot pedals, the surgeon is able to conduct the surgery with greater precision and ease. The second component is the de Vinci 3D optics which consists of a sophisticated stereoscopic digital camera through a 12 mm endoscope (fig 3).



Fig. 1. da Vinci robot



Fig. 2. Console



Fig. 3. 3D optics

The camera consists of two high definition units which recreate a true 3D colour image which is viewed by the surgeon at the console. The camera allows for up to 12 x magnification of the operating field, opening up the possibility of performing microsurgical procedures as well as spotting and managing small blood vessels to reduce bleeding and performing nerve sparing surgical dissection (fig 4). Three cameras are available for use on the de Vinci system, one straight and two angled cameras (up and down pointed), which allows the surgeon the options of viewing all nooks and corners of the pelvis and abdomen.



Fig. 4. Products

The third component is the surgical cart which is composed of three to four arms for controlling the 3D camera and two to three surgical instruments. The robotic instruments are “wristed”, thereby providing 7 degrees of freedom (*df*) compared with 4 *df* with traditional laparoscopy (fig 5). The robotic instruments are controlled by the principal surgeon who sits away from the patient at the surgical console via two “masters”. The movements of the surgeon’s arms and legs are translating in real time to the robotic instruments inside the patient’s abdomen and are processed and scaled to reduce any tremor and thus enhance precision of movements and avoid tissue trauma.



Fig. 5. Instruments

The surgical instruments and a stereoscopic video camera all work in unison during surgery. The hand-like surgical instruments move with 7 (*df*) and two degrees of axial rotation (fig 5). The surgical masters are placed in line with the surgeon’s field of vision in order to restore a more intuitive eye-hand coordination than that experienced with traditional laparoscopy. The foot controlled pedals on the surgical console enable the surgeon to control and zoom the camera which gives complete control over the surgical field, unlike the traditional laparoscopy where the surgeon relies on the assistant to control the camera.

6. Robotic-assisted total hysterectomy technique

The steps of surgical technique are similar to those in an open or laparoscopic surgical approach, which include careful preparation of the vascular pedicles prior to ligation by bipolar, mono-polar energy sources or other energy sources (Harmonic scalpel, En seal,

Ligasure) for vessel sealing as described earlier ²⁷. There has been an increase in the use of robotic assisted technique over laparoscopic approach for minimal invasive surgery and hysterectomy in the past five years in the United states . This popularity of robotic approach may be attributed to greater degrees of freedom of movement, 3D viewing and ease of intra-corporal suturing and less steep learning curve when compared to laparoscopic approach. Laparoscopic hysterectomy has been shown to have a longer operative time compared to robotic surgery, with comparable blood loss, length of hospital stay and post-operative complications ²⁸. Others have shown that robotic surgery has a lower operating time when compared to laparoscopic surgery and decreased hospital stay, less blood loss and lower conversion to open surgery ²⁹.

7. Robotic assisted hysterectomy & radical hysterectomy with pelvic +/- para-aortic lymphadenectomy in gynaecological oncology

Patients with endometrial cancer often are obese, elderly with increased incidents of medical comorbidities including diabetes and cardiovascular disease. The advantages of laparoscopic minimal invasive surgery in women with endometrial cancer have been shown by several studies, in the reduction of hospital stay, quicker recovery, lower incidents of thromboembolic complications and post-operative infections ^{5,30,31,32,33}.

Since 2005 the use of robotic assisted MIS has gained popularity in gynaecological oncology. Robotic assisted surgery offers 3D, high definition visualisation in a stable field, more intuitive instrument control, better ergonomics and increased dexterity ^{4,34,35}.

Unlike laparoscopic technique, once the patient is docked to the robot, the Trendelenburg position cannot be reversed without undocking the patient. At 30 degrees steep Trendelenburg position, there is a hypothetical risk of higher inspiratory pressure due to reduced ventilatory compliance which may compromise the advantages of MIS in obese and elderly women, which is frequently to co-morbidity in women with endometrial cancer. However, studies this far have not shown any increased risk using robotic assisted surgery in these high risk women with endometrial cancer, when compared to laparoscopic or open surgery. Table 1 shows comparison between open laparoscopic and robotic surgery in women with endometrial cancer ^{36, 39,40,41}. The rate of conversion to laparotomy has been reported between 3% to 16%, ^{36, 37, 38}. Older women had lower risk of surgical complications with laparoscopic vaginal approach ^{43, 44} yet implementation of laparoscopic surgery in these patients is low. In a prospective study Vakin et al showed that using robotic assisted technique in elderly patients with endometrial cancer had similar overall outcomes when compared with younger patients with endometrial cancer, despite having significantly more co-morbidities and more advanced disease ³⁸. Quality of life and patient satisfaction have shown to be superior with robotic assisted approach ³⁸, which could be due to lower post-operative pain hence reduce intake of narcotic analgesics.

In 2006 Sert et al ⁴⁵ described the first robotic assisted radical hysterectomy for early stage cervical cancer (stage IB1). They performed type III robotic assisted radical hysterectomy with estimated blood loss of 200 ml with no intra-operative or post-operative complications. The patient was discharged home four days later. Over the past five years several reports have been published on the robotic assisted radical hysterectomy ^{46,47,48,49,50}. Table II shows

| Author | Cardenas et al | Jung et al | Bell et al | Bogges et al |
|-------------------|----------------|------------|------------|--------------------------|
| Year | (2010) | (2010) | (2008) | (2008) |
| No of patients | (N=257) | (N=109) | (N=110) | (N=322) |
| Operating Time | R > L | R=L=A | R=L>A | A<R<L |
| Blood Loss | R < L | R=L<A | R=L<A | R< L or A |
| LN Yield | R = L | R=A>L | R=L=A | R> L or A |
| Hospital Stay | - | R=L<A | R=L<A | R< L or A |
| Complication rate | R = L | R=L<A | R<A<L | R<L (Conversion: R=L) |

(R = robotic, L = laparoscopic, A = abdominal surgery, LN = Lymph nodes)

Table 1. Outcomes of robotics hysterectomy and pelvic lymphadenectomy

| Study | No of cases | Op. Time | Blood loss (ml) | Lymph node(mean) | Hosp. Stay (days) | Complications |
|-----------|-------------|--------------|-----------------|------------------|-------------------|--|
| Maggioni | 40 | 272 | 78 | 20.4 | 3.7 | Nerve injury (2) Bowel injury (1) Transfusion (3) Vaginal dehiscence (3) Hernia (1) Recurrence (5) DOD (1) |
| Lowe | 42 | 215 (median) | 50 (median) | 25 (median) | 1 (median) | Conversion (1) Ureteric injury (1) Bladder injury (1) Infection (3) DVT (1) |
| Persson | 64 | 262 | 150 | 26 (median) | - | Vaginal dehiscence (5) Pelvic abscess (7) Lymphoedema (13) Ureteric stenosis (1) Nerve injury (9) Hernia (3) DVT (2) |
| Canterell | 63 | 213 (median) | 50 (median) | 29 (median) | 1 (median) | Vaginal dehiscence (1) Nodal metastases (5) Positive margins (1) Recurrence (1) |

Table 2. Outcomes of Robotic Radical Hysterectomy

some of the reported series with their outcomes. Although the recurrence rates seem to be equivalent to those after laparotomy and laparoscopic hysterectomies, long term follow up

is still necessary. The intra-operative and post-operative morbidity of robotic assisted total hysterectomy are similar or sometimes less than those reported following open and laparoscopic hysterectomies.

To date, there are no randomised trials comparing the robotic assisted approach to radical hysterectomy, laparoscopy and laparotomy. There is an on-going phase III randomised clinical trial comparing the three techniques of radical hysterectomy in women with early stage cervical cancer, developed and designed by the Gynaecology Oncology Committee from American Association of Gynaecologic Laparoscopists⁵¹. The outcome of this trial may shed more light on the future approach to radical hysterectomy.

The potential for robotic assisted surgical devices to revolutionize complex surgery by reducing surgical morbidity, improving quality of life, minimising hospital stay which in turn reduced costs to the Health Service, is a high possibility in the near future.

8. Conclusions

Minimal invasive surgery ,both laparoscopic and roboticassisted surgery are alternative techniques to conventional open hysterectomy. However the training required to use these techniques, is an important factor to minimize complications during surgery. The reduced hospital stay., quicker recovery and increased patient satisfaction with these new approaches makes minimal invasive surgery certainly a viable challenge to conventional hysterectomy.

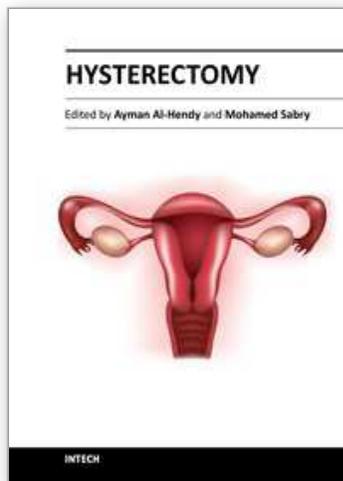
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Hysterectomy

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This book is intended for the general and family practitioners, as well as for gynecologists, specialists in gynecological surgery, general surgeons, urologists and all other surgical specialists that perform procedures in or around the female pelvis, in addition to intensivists and all other specialties and health care professionals who care for women before, during or after hysterectomy. The aim of this book is to review the recent achievements of the research community regarding the field of gynecologic surgery and hysterectomy as well as highlight future directions and where this field is heading. While no single volume can adequately cover the diversity of issues and facets in relation to such a common and important procedure such as hysterectomy, this book will attempt to address the pivotal topics especially in regards to safety, risk management as well as pre- and post-operative care.

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