HealthCareTechnology Series
Number 10

Technologies for the treatment of menorrhagia and uterine myomas

Naarilla A Hirsch

AUSTRALIAN INSTITUTE OF
HEALTH & WELFARE

Australian Institute of Health and Welfare

The Australian Institute of Health and Welfare is an independent federal statistics and research agency, responsible for developing information on Australia's health, and its health and welfare services. It comprises four major research divisions, four external units, and a supporting corporate services division.

Welfare Division
Health Services Division
Health Technology Division
Health Monitoring Division
National Perinatal Statistics Unit
National Injury Surveillance Unit
Dental Statistics and Research Unit
National Reference Centre for Classification in Health
Corporate Services Division

AUSTRALIAN INSTITUTE OF HEALTH AND WELFARE
HEALTH CARE TECHNOLOGY SERIES
Number 10

Technologies for the treatment of menorrhagia and uterine myomas

Naarilla A Hirsch

April 1993

Australian Government Publishing Service
Canberra

This is the tenth publication in the Australian Institute of Health and Welfare's Health Care Technology Series. A complete list of the Institute's publications is available from the Publications Unit, Australian Institute of Health and Welfare, GPO Box 570, Canberra ACT 2601.

National Library of Australia Cataloguing-in-Publication data

Hirsch, N.A. (Naarilla Anne).
Technologies for the treatment of menorrhagia and uterine myomas.

Bibliography
ISBN 0 644 29168 0
ISSN 1034–6481

1. Menorrhagia—Surgery. 2. Uterine fibroids—Surgery. 3. Menorrhagia—Endoscopic surgery. 4. Uterine fibroids—Endoscopic surgery. I. Australian Institute of Health and Welfare. II. Title. (Series: Health care technology series; no. 10).

618.145

Suggested citation

Hirsch, N (1993) *Technologies for the treatment of menorrhagia and uterine myomas.* Australian Institute of Health and Welfare: Health Care Technology Series No. 10, AGPS, Canberra.

Any comments or information relevant to the subject matter of this report would be welcome. Correspondence should be directed to:

The Head
Health Technology Division
Australian Institute of Health and Welfare

Printed in Australia by A. J. LAW, Commonwealth Government Printer, Canberra

Foreword

In recent years there has been a trend to replace open surgery with less traumatic 'minimal access' techniques. In 1992 the (then) Australian Institute of Health published a discussion paper on minimal access surgery which presented the status of this type of surgery and considered its potential impact on the Australian health care system. That paper highlighted several areas of surgery where minimal access techniques were likely to make significant changes, including two areas of gynecology, hysteroscopic endometrial ablation and laparoscopically-assisted hysterectomy.

As the impact of these new procedures will affect the use of one of the most common surgical procedures performed—open hysterectomy—this report has been prepared. It contains an assessment of these technologies from the points of view of safety, efficacy and cost effectiveness; social issues such as the appropriateness and psychological effects of hysterectomy for benign disease are outside its ambit.

Contents

List of tables

Appendixes

Glossary

ablation	extirpate (utterly destroy) tissue
AGES	Australian Gynaecological Endoscopists' Society
amenorrhea	absence of menstrual bleeding
dysmenorrhea	painful menstruation
endometriosis	condition in which tissue resembling endometrium is found in various extrauterine locations, particularly the pelvic cavity
endometrium	inner mucous membrane of the uterus
fibroid	see uterine fibroid
fibromyoma	see uterine fibroid
GnRH	gonadotropin releasing hormone
hematometra	retained blood in the uterus
hypomenorrhagia	menstruation at regular intervals but with significantly reduced flow
hyponatremia	deficiency of sodium in the blood
hysterectomy	excision of the uterus
intramural fibroid	fibroid within the uterine wall
LAH	laparoscopically-assisted hysterectomy
leiomyoma	see uterine fibroid
LHRH	luteinising hormone-releasing hormone
menorrhagia	excessive bleeding at the regular intervals of menstruation
metrorrhagia	unexpected bleeding between menstrual periods
myoma	see uterine fibroid
myomectomy	removal of myoma or fibroid
myometrium	smooth muscle coat of the uterus
NSAID	non-steroidal anti-inflammatory drug
oligomenorrhea	less frequent menstruation, occurring at intervals longer than five to six weeks
oophorectomy	removal of an ovary or ovaries
pneumoperitoneum	presence of gas or air in the peritoneal cavity
RACOG	Royal Australian College of Obstetricians and Gynaecologists
resection	excision of a portion of an organ or other structure
submucous fibroid	fibroid below the mucous membrane of the uterus, i.e. within the uterine cavity
subserosal fibroid	fibroid below the serous membrane of the uterus, i.e. external to the uterus within the pelvic cavity
trocar	sharp pointed cannula (or tube)
uterine fibroid	benign tumour derived from smooth uterine muscle

Summary

- Menorrhagia (excessive menstrual bleeding) and uterine myomas (fibroids) are com mon conditions in women in their reproductive years. Their treatment accounts for 5,300 and 6,500 hysterectomies per year respectively in Australia.
- Hysterectomy (abdominal or vaginal) in Australia is associated with eight to nine days in hospital and recovery periods of several weeks. Estimated financial costs (i.e. costs to health service providers) are $3,550 to $3,739 per patient.

Endometrial resection/ablation

- Endometrial resection/ablation are hysteroscopic techniques that minimise menstrual blood loss by destroying the endometrial lining. This can be done using a diathermy loop (resection) or by ablation with a diathermy ball, a laser or a radiofrequency device. The procedure is successful in most cases, although some patients require a repeat treatment or undergo subsequent hysterectomy.
- Endometrial resection/ablation is generally day surgery or followed by one to three days in hospital, with a recovery period of two to three weeks.
- The financial cost per patient of endometrial resection is estimated at $1,510. Estimated laser and radiofrequency ablation costs are higher at $2,178 and $2,490 per patient respectively, due to higher equipment costs.
- Diathermy resection/ablation has cost advantages and is effective in comparison with abdominal hysterectomy. It is diffusing rapidly throughout Australia.
- Outcomes from laser ablation are similar to those from diathermy resection/ ablation, but costs are higher and its use in Australia is limited to date.
- Little information about outcomes from radiofrequency ablation is available. Given a similar cost to laser ablation, diathermy resection/ablation will remain more cost-effective unless a significantly greater advantage in terms of increased success rates or lower morbidity can be demonstrated for radiofrequency ablation.
- Endometrial ablation by photodynamic therapy is a new technique that is still experimental.

Laparoscopically-assisted hysterectomy

- ***Laparoscopically-assisted hysterectomy*** refers to the use of a laparoscope to ligate some or all of the uterine vessels and ligaments. The uterus is removed through the vagina. The main role of the procedure is to allow an abdominal hysterectomy to be performed vaginally.
- ***Laparoscopic hysterectomy*** refers to the performance of the entire hysterectomy laparoscopically, and is unlikely to become common.
- In comparison with abdominal hysterectomy, laparoscopically-assisted hysterectomy reduces postoperative pain, shortens hospital stays to one to four days and recovery periods to one to four weeks.

- The financial cost of laparoscopically-assisted hysterectomy has been estimated at $2,963 per patient. Of this, about $1,200 is for disposable instruments.

Myomectomy

- Myomectomy provides an alternative to hysterectomy for those women wishing to preserve their fertility. Both open and laparoscopic myomectomy are technically more difficult than hysterectomy, and the laparoscopic approach has very limited application.
- Short-term results of hysteroscopic myomectomy are similar to endometrial resection, but the procedure is technically more difficult.

Medical therapies

- A range of medical therapies are available, but are generally only effective for the duration of therapy and are associated with side effects.
- Preoperative endometrial suppression is useful prior to endometrial resection/ablation. The new gonadotropin-releasing hormone (GnRH) agonists are promising in this application, although more expensive than alternatives.

Conclusions

- Endometrial resection or ablation using diathermy could replace most of the 5,300 abdominal hysterectomies done annually for menorrhagia. Laser and radiofrequency ablation are unlikely to replace the diathermy techniques to any significant extent.
- Laparoscopically-assisted hysterectomy could replace many of the abdominal hysterectomies done annually, including some of those done for myomas. Its effect on vaginal hysterectomy will be less significant.
- Hysteroscopic myomectomy may be performed more commonly in conjunction with endometrial resection/ablation. Otherwise, myomectomy will remain limited to fertility-preserving applications.
- Further information is required about:
  - —long-term retreatment rates for endometrial resection/ablation
  - —success, safety and cost-effectiveness of laparoscopically-assisted hysterectomy compared with abdominal hysterectomy
  - —success and safety of radiofrequency ablation.
- Issues that need addressing include:
  - —suitable training and accreditation processes to ensure safe introduction and use of these new procedures
  - —cost-effectiveness of disposable versus reusable instruments
  - —effects on hospital infrastructure of these new procedures, particularly in terms of decreased bed use and impact on theatre time.

Introduction

Menorrhagia and uterine myomas are two conditions that can afflict women during their reproductive years. Menorrhagia refers to excessively heavy bleeding, and excludes unexpected bleeding between menstrual periods. Uterine myomas, also known as fibroids, fibromyomas or leiomyomas, are benign tumours derived from smooth uterine muscle.

Both conditions account for a significant proportion of the hysterectomies performed annually in Australia, with the abdominal approach being more commonly used to treat them than the vaginal approach. However, in recent years, alternatives to conventional hysterectomy have emerged. Hysteroscopic resection and laser ablation of the endometrium are becoming established, and another hysteroscopic technique, radiofrequency ablation, has been developed. Laparoscopic approaches to hysterectomy have emerged as part of the recent application of laparoscopy to abdominal and pelvic surgery following development and diffusion of laparoscopic cholecystectomy.

In this report, alternative treatments for both conditions (i.e. menorrhagia and uterine myomas) are described, and their safety, effectiveness, costs, and stage of development are discussed. The potential impact of the new modalities on open hysterectomy is then considered.

There has been considerable debate over many years about the appropriateness of hysterectomy for benign disease once childbearing is completed, with its consequential psychological and psychosocial effects on a woman—such as her perception of self. These issues have not been explored in any detail in this report, since it is intended as a technical assessment of complementary and competing technologies.

Nature of menorrhagia and myomas

Menorrhagia is a recurrent menstrual blood loss of more than 80 mL per menstruation. This definition excludes postcoital bleeding and cycle disorders such as metrorrhagia (unexpected bleeding between menstruation). When menstrual blood loss exceeds 80 mL per cycle, the incidence of anemia increases significantly and the loss is considered abnormal.[1] However, 60 mL has also been used as the upper normal limit of menstrual blood loss, since on a normal diet a loss of over 60 mL will result in a negative iron balance.[2] One study reported that 67% of women whose blood loss exceeded 80 mL were anemic.[2] The mean menstrual loss each cycle is about 35 mL.[3]

While menorrhagia may cause medical problems, the social effects are more likely to be of concern to the menorrhagic woman. A common feature of menorrhagia is sanitary towel failure with accidents of flooding of menstrual blood around the pad or tampon. Menorrhagic women can be very concerned with the social embarrassment of their problem, such as staining of clothes or chairs, to the point of restricting normal activities during menstruation. As well as affecting a woman's lifestyle for part of each month, menorrhagia also has an impact on employers through days lost from work.

In clinical practice a diagnosis of menorrhagia is normally made on the basis of the doctor's and patient's assessment of the number and degree of saturation of pads and/or tampons used, the duration of bleeding, the presence or absence of clots and flooding, and similar factors. This assessment is subjective and does not necessarily correlate well with actual blood loss. Studies of blood loss have shown that, for women complaining of menorrhagia, 11% to 76% actually lost more than 80 mL of menstrual blood.[1, 4, 5] In one study, while 59% of women complaining of menorrhagia had blood losses of over 60 mL, another 20% actually had average losses of under 35 mL.[4] Younger women are more likely than older women to regard a moderate loss as very heavy.[4]

In less than half the women suffering from menorrhagia an organic cause can be found; in the remainder, the menorrhagia is said to be dysfunctional.[3] Organic causes can be due to systemic, local or iatrogenic disorders, and are listed in Appendix 1. Myomas are a common cause of menorrhagia, occurring in 23% of all menorrhagic women.[1] In such cases, the underlying organic disorder should be treated to correct the problem.

Dysfunctional uterine bleeding can be either ovulatory or anovulatory, but the majority is ovulatory.[2] Dysfunctional menorrhagia has been ascribed to abnormal endometrial concentrations of prostaglandins.[6] Treatment is aimed at reducing or eliminating menstrual blood loss and may be medical or surgical.

Uterine myomas are the most common solid tumours occurring in women. They occur and increase during the reproductive years, but are rare before puberty and normally atrophy after menopause. Myomas arise in the smooth muscle wall of the uterus and can grow into either the uterine or pelvic cavities. They are classified accordingly as intramural, submucosal or subserosal relative to the uterus, and can also develop in the round and broad ligaments, cervix and vagina. Myomas may be single or multiple.

Their size varies and their growth response to estrogen is greater than normal uterine tissue.[7]

Uterine myomas are common and are thought to occur in 20% to 25% of women over the age of 30 years.[8] Their true prevalence may be higher, since many myomas are asymptomatic and are often not diagnosed. Myomas are significantly more common in black women in the USA, although whether this is due to a high prevalence of pelvic infections or to genetic factors is unknown.[8] Other risk factors reported are those associated with carcinoma of the endometrium and include nullparity and obesity. The cause of myomas is not known, although the evidence suggests a role for estrogens in their pathogenesis.[8, 9]

The location, number and size of the myomas will affect the development and severity of symptoms. Approximately 30% of women with myomas have been reported to have menstrual abnormalities.[8] Menorrhagia is common and is due to submucosal or large intramural myomas. Metrorrhagia and dysmenorrhea (painful periods) can also occur.

Myomas can cause pain, pressure, heaviness, ascites, and urinary and bowel difficulties.[7, 10] Large subserosal and intramural myomas can compress nerves or ureters and obscure ovarian pathology. Sarcomatous change is a rare complication of myomas. Treatment is undertaken for rapidly growing or large tumours or for myoma-related symptoms such as menorrhagia, pelvic pressure (commonly manifesting as urinary frequency) and appreciation of a pelvic–abdominal mass. While myomas occur in both fertile and infertile women, large ones may be a causal factor in infertility, possibly due to cavity or tubal distortion, impairment of blood supply to the endometrium, atrophy or ulceration.[8, 10]

Acute degeneration of intramural myomas tends to occur in pregnancy, causing pain and sometimes nausea and fever. Myomas have also been associated with higher miscarriage rates, preterm delivery, abnormal presentation, outlet obstruction, postpartum hemorrhage and puerperal sepsis. Myomas are now a more important feature in pregnancy as many women are delaying childbearing to the time of greatest risk for myoma growth—their late thirties.

Impact of menorrhagia and myomas in Australia

Menorrhagia has a significant impact on women in their reproductive years. It has been estimated to occur in 9% to 14% of healthy women, and results in an annual consultation rate with general practitioners of 20.4 per 1,000 women.[1, 3]

Menorrhagia and myomas are two major indications for hysterectomy and as such have a significant impact on the health care system. Hysterectomy is one of the most common surgical procedures performed in Australia, with a prevalence of 3.97 per 1,000 female population.[11] In comparison with other countries, Australia's hysterectomy rate is lower than those in North America (Canadian and USA rates are 4.70 and 5.56 respectively), and higher than those of European countries (e.g. Swedish and UK rates are 1.45 and 1.32 respectively). In one Australian study, 16.9% of all women and 34.2% of those in their fifties had had a hysterectomy.[12] An earlier study suggested that at least 40% of women who had private hospital insurance could expect to undergo a hysterectomy during their lifetime.[13]

Hospital morbidity data suggest that approximately 30,000 hysterectomies are performed annually in Australia. Table 1 shows the principal diagnosis recorded for these hysterectomies. In 1988–89 prior to the advent of endometrial resection/ablation, menorrhagia was the principal diagnosis for 17.7% and myomas the principal diagnosis for 21.7%. Other major indications for hysterectomy are uterine prolapse, endometriosis and cancer, the latter accounting for only 6.5% of operations in 1988–89. Together, menorrhagia and myomas accounted for approximately 12,000 hysterectomies, making a significant impact on both the health care system and the community.

Table 1: *Percentage of hospital admissions for hysterectomy by principal diagnosis*

	1987–88		1988–89			1991–92		
Principal diagnosis	**NT**	**ACT**	**NSW**	**Vic**	**SA**	**NSW**	**Vic**	**SA**
Public hospitals								
Malignant uterine neoplasm	0.6	4.4	7.3	9.0	8.5	11.7	10.0	6.8
Uterine leiomyoma	24.1	28.1	21.1	23.6	15.6	22.2	27.4	18.6
Pelvic inflammatory disease	6.0	5.3	5.0	4.2	3.0	4.5	2.7	1.7
Endometriosis	16.3	12.6	9.1	15.3	6.6	11.5	13.7	5.7
Genital prolapse	7.2	11.9	16.6	17.4	17.8	18.5	18.8	21.2
Menorrhagia	13.3	18.2	17.5	11.7	26.5	10.2	10.3	27.4
Other	32.5	19.6	23.4	18.9	22.0	21.5	17.2	18.6
Total number of admissions	*166*	*413*	*6,249*	*4,488*	*1,457*	*6,741*	*4,385*	*1,512*
Private hospitals								
Malignant uterine neoplasm	n.a.	3.0	2.3	n.a.	5.2	3.2	n.a.	4.3
Uterine leiomyoma	n.a.	27.5	22.1	n.a.	20.8	26.2	n.a.	24.9
Pelvic inflammatory disease	n.a.	7.8	3.5	n.a.	2.3	5.0	n.a.	1.9
Endometriosis	n.a.	23.4	12.0	n.a.	9.5	13.2	n.a.	9.8
Genital prolapse	n.a.	11.4	13.0	n.a.	19.8	19.7	n.a.	20.3
Menorrhagia	n.a.	6.0	19.5	n.a.	24.8	10.9	n.a.	23.8
Other	n.a.	20.9	27.5	n.a.	17.4	21.7	n.a.	15.1
Total number of admissions	*167*	*n.a.*	*3,670*	*n.a.*	*1,534*	*4,510*	*n.a.*	*1,777*

Note: Queensland, Western Australia and Tasmanian data were not available for this study.
Source: State and Territory health authority data

Medical treatment

A number of different forms of medical treatment have been investigated as therapies for menorrhagia and myomas. Not only does medical treatment avoid major surgery, until recently the only alternative for these conditions, but it also preserves the patient's fertility, an aspect of increasing importance with the current trend of deferring childbearing until over the age of thirty. Unfortunately, medical treatment has associated side effects and is generally only effective for the duration of the treatment.

Medical treatment of dysfunctional menorrhagia is aimed at reducing menstrual blood loss and making periods more manageable. While all medical treatments work in some cases, no one drug is effective in all cases. Use of a drug is also influenced by factors such as the woman's age and contraceptive needs.

The combined contraceptive pill substantially reduces blood loss in many women, including 60% to 80% of menorrhagic women.[6] A recent study reports a 43% reduction in blood loss in menorrhagic women.[14] However, side effects restrict its use to younger women, in particular, non-smokers.

Non-steroidal anti-inflammatory drugs (NSAIDs) useful in the treatment of menorrhagia include mefenamic acid, naproxen, ibuprofen and flurbiprofen. Some are also prostaglandin inhibitors. As an example, mefenamic acid reduces blood loss in 70% to 80% of women who lose excessive amounts of blood, although it has little effect in those women whose loss is 'normal' (under 80 mL).[6] It reduces blood loss by 20% to 24% and beneficial side effects are reductions in dysmenorrhea and headaches.[15, 16] Adverse effects include nausea, vomiting, diarrhoea, headache, dizziness and rashes, with close to one-third of women affected. Mefenamic acid is only taken during menstruation and its benefits can persist for over a year.[6]

Antifibrinolytic and hemostatic drugs, in particular, tranexamic acid and ethamsylate, have been used for menorrhagia. Both have been reported to halve blood loss.[16, 17] Relatively high doses are needed, and side effects including nausea, headaches, dizziness, vomiting and rashes affect approximately one-third of patients. The possibility of an increased risk of intracranial thrombosis has been raised.[16]

Progestogens such as norethisterone have been used widely for a variety of menstrual disorders including menorrhagia. However, there is little objective evidence demonstrating their efficacy for treatment of menorrhagia. They may be more useful for the anovulatory patient. Side effects include nausea, weight gain, bloating, headaches, mood changes and loss of libido.[16] Progestogen-releasing IUDs have been shown to reduce menstrual blood loss.[18]

As well as being used widely for endometriosis, danazol has been used to treat menorrhagia, reducing blood loss by 50% or more.[14, 16] Side effects are often dose-related and are significant, suggesting caution in its long-term use.[19] They include headaches, weight gain, oily skin, muscle spasms, altered lipid metabolism, rashes, hirsutism and mood changes.

Gonadotropin-releasing hormone (GnRH) agonists provide another therapy for menorrhagia.[20, 21] However, side effects limit their potential use so that as a long-term primary therapy, they are useful only in combination with low dose

estrogen–progestogen replacement therapy for those women in whom other treatments are ineffective or inappropriate.

GnRH agonists emerged in the 1980s as a short-term treatment for myomas.[22, 23] They work by causing a state of temporary menopause or hypo-estrogenism, which leads to myoma shrinkage. Unfortunately, the myoma rapidly regrows in most cases on cessation of therapy. Side effects include hot flushes, vaginal dryness, mood changes and loss of libido. The possibility of the hypo-estrogenic state leading to losses in bone mass and changes in lipid levels is of concern. A suggested treatment option in selected cases is combining GnRH agonists with low dose hormone replacement therapy.[23]

Several other forms of medical treatment for myomas have been investigated. Progestogens were thought to have the potential to decrease myoma size, but this has not been substantiated.[8] Poor results in terms of myoma shrinkage have been obtained with danazol and with gestrinone—a substance with similar properties.[23]

While there are difficulties with long-term medical treatment of menorrhagia and myomas, it is seen as a useful option in the short term. Medical treatment alleviates the immediate problem and allows time for the patient and physician to decide on the most appropriate longer term strategy. For perimenopausal women who wish to avoid surgery it provides a therapy until menopause, when the disease is likely to regress spontaneously.[8, 23]

In the case of myomas, some consider that medical therapy increases a woman's chance of retaining her fertility by decreasing myoma size and thus allowing myomectomy rather than hysterectomy to be performed.[8] It also may, by decreasing myoma size, allow vaginal rather than abdominal hysterectomy to be performed.[23] Medical therapy is used to suppress the endometrium before treatment of menorrhagic women by the new techniques of hysteroscopic endometrial resection or ablation and to shrink myomas before hysteroscopic myomectomy.

Common forms of short-term medical treatment in Australia are danazol and prostaglandin inhibitors such as the contraceptive pill and progestogens. GnRH agonists are not yet being marketed in this country, but are likely to become another useful short-term therapy[21] (Fraser IS, personal communication). For endometrial suppression prior to endometrial resection or ablation, danazol was the most popular therapy in use at the end of 1991, with progestogens also being used at times, as a recent Royal Australian College of Obstetricians and Gynecologists (RACOG) survey indicates.[24]

Abdominal and vaginal surgery

Hysterectomy has been used extensively in the past as a permanent cure for menorrhagia and myomas. Different types of hysterectomy are:

- total hysterectomy, where both uterus and cervix are removed;
- subtotal hysterectomy, where only the uterus is removed;
- radical hysterectomy, where uterus, tubes, ovaries, cervix, surrounding connective tissue in the pelvis and associated lymph nodes are removed.

Radical hysterectomy is usually performed for neoplasms, and subtotal hysterectomy only when the cervix is inaccessible. The majority of hysterectomies, including those for menorrhagia and myomas, are total hysterectomies.

Access to the surgical field for hysterectomy has normally been gained using one of two approaches, abdominal or vaginal. The abdominal approach, like other open surgical procedures, involves a large incision but provides good exposure of the pelvis. The vaginal approach avoids the abdominal incision but does not provide as good exposure to the pelvis, and the anatomy is reversed to that of the abdominal approach. Although prolapse is the major indication for vaginal hysterectomy, some hysterectomies for menorrhagia and myomas are performed using the vaginal approach (Table 2.2, Appendix 2).

Myomectomy refers to the surgical removal of a myoma or myomas. It is an alternative operation for myomas that preserves fertility, and can be performed using abdominal, hysteroscopic or laparoscopic approaches.

Abdominal hysterectomy

Abdominal hysterectomy is considered efficacious in treating a number of benign gynecological conditions since it removes the source of the condition, the uterus. It is also considered a relatively safe operation. For non-neoplastic disease, abdominal hysterectomy has been associated in the USA with crude mortality rates of 5.9 per 10,000 procedures upon discharge and 12.5 per 10,000 procedures at thirty days postoperatively in Denmark.[25, 26] In Australia, hospital morbidity data for 1988–89 give a crude mortality rate at hospital discharge of 8.0 per 10,000 procedures for non-neoplastic abdominal hysterectomy. For 1991–92 the rate was 4.2 per 10,000 procedures. Causes of death from both forms of hysterectomy include acute myocardial infarction, cerebrovascular accidents, infection (including pneumonia), and hemorrhage.[26, 27]

While few hysterectomy patients suffer from major complications, many suffer from minor complications. In the USA, the short-term complication rate following hysterectomy is 42.8%, with 2.8% of patients requiring rehospitalisation after discharge.[28] Fever, infections, urinary retention, atelectasis and hemorrhage requiring transfusion all occur frequently. Less common complications include ileus, pneumonia, deep venous thrombosis, neuropathy and wound dehiscence.

Either intraoperatively or postoperatively, 1.7% of USA patients underwent another unplanned major surgical procedure, in general to control bleeding or to repair ureter,

bowel or bladder trauma. The complication rate of 28.2% reported from a Greek study is lower, but the mortality rate of 20.5 per 10,000 procedures is higher.[29]

Some Australian studies have reported complication rates for abdominal and vaginal hysterectomy combined. In a Queensland private hospital, 18.0% of patients are reported as suffering complications, with 2.7% being considered major complications.[30] In New South Wales 47% of patients reported postoperative problems, with 18% reporting more than one problem and 7.4% being rehospitalised.[31] The New South Wales study included patients treated for neoplastic disease, in whom mortality and complication rates following hysterectomy are higher than in those treated for benign disease.[25]

In the USA, median postoperative hospital stays for abdominal hysterectomy have been reported as seven days.[28] Mean hospital stays in different Australian States and Territories for 1987–88 or 1988–89 are 8.5 to 9.7 days, with little difference between public and private hospitals (Table 2.3, Appendix 2). Hospital stays in 1991–92 tend to be a little shorter (7.9 to 9.0 days). The time taken to return to normal activities following abdominal hysterectomy is 47 days in the USA.[28] The New South Wales study found that 70% of the women undergoing hysterectomy (abdominal or vaginal) felt that complete recovery required up to three months.[31] Of the remainder, half felt that six months or more were needed for full recovery.

Vaginal hysterectomy

Genital prolapse is a major indication for vaginal hysterectomy. Contra-indications include advanced endometriosis and major adnexal pathology.[32, 33, 34] Opinions differ on other contraindications, which include excessive vaginal narrowing, invasive carcinoma of the endometrium and cervix, uterine enlargement of more than 12 to 14 weeks' gestational size and previous surgery.[32, 33] The preoperative use of GnRH agonists to shrink large myomas has been suggested to allow selected patients with uterine enlargement of more than 12 to 14 weeks' gestational size to undergo vaginal hysterectomy.[35]

Vaginal hysterectomy avoids the incision of abdominal hysterectomy. Consequently, postoperative pain is reported to be reduced, and hospital stays and recovery periods are shorter. Median postoperative hospital stays after vaginal hysterectomy have been reported as five to six days in the USA, with recovery periods of 31 to 37 days.[28] Mean hospital stays of 2.2 to 4.2 days have been reported in Australia.[32] However, hospital morbidity data indicates little difference between vaginal and abdominal hysterectomy in terms of length of hospital stay (Tables 2.3 and 2.4, Appendix 2). Vaginal hysterectomy is more likely than abdominal hysterectomy to be used on older women (Tables 2.5 and 2.6, Appendix 2).

For non-neoplastic disease, mortality rates of vaginal hysterectomy differ from those for abdominal hysterectomy. In the USA, reported mortality rates for vaginal hysterectomy for non-neoplastic disease are lower, with a crude mortality rate of 3.2 per 10,000 procedures upon discharge.[25] In Denmark and Greece, crude mortality rates for vaginal hysterectomy are much higher at 58.4 and 60.1 per 10,000 procedures respectively, which may be due to the relatively small number of hysterectomies performed in these countries using this approach.[26, 29] In Australia, hospital morbidity data for 1988–89

give a crude mortality rate before hospital discharge of 9.8 per 10,000 procedures for vaginal hysterectomy for non-neoplastic disease. For 1991–92 the rate was 11.6 per 10,000 procedures.

In the USA, complication rates for vaginal hysterectomy are lower than for abdominal hysterectomy at 24.5%, although those reported for Greece are similar at 27.8%.[28, 29] Infection, atelectasis, ileus, deep venous thrombosis, neuropathy and bleeding requiring transfusion are recorded less frequently for vaginal hysterectomy. However, urinary retention and damage to the urinary tract are more common.[28] Another unintended major surgical procedure to control bleeding or repair bowel or bladder trauma occurs either intraoperatively or postoperatively in 4.0% of cases in the USA. In 0.05% to 1.0% of cases reported in the USA and Vienna, the vaginal approach cannot be completed and a laparotomy is required.[28, 34]

Because an abdominal incision is avoided, vaginal hysterectomy reputedly decreases postoperative analgesic use, morbidity and hospital stays. Recovery can be faster and the procedure is possible with older and frailer patients.[33] However, the operation is not without its difficulties. Compared with abdominal hysterectomy, the view it allows is poor, the anatomy reversed and there is no room to explore the entire abdomen. More assistants in theatre are needed if the operation is to be performed easily.

In Australia in 1988–89, 14% of hysterectomies for menorrhagia and 9% of hysterectomies for myomas were performed using the vaginal approach. Overall, 25% of hysterectomies performed in Australia in 1988–89 and 29% of hysterectomies performed in 1991–92 use the vaginal approach. Variations in vaginal hysterectomy rates occur between States and Territories (see Table 2). The reported incidence of the vaginal approach overseas varies from 15% to 66%.[29, 34, 36] The incidence of vaginal hysterectomy in Australia has increased over the past three years (see Figure 1). However, some argue that it could be used in the majority of women, even in the absence of uterine descent, and have called for adequate training in the technique.[32]

Table 2: ***Percentage of Medicare benefits payments using different approaches to hysterectomy by State and Territory, 1991–92***

State or Territory	Percentage of payments			Total number of payments
	Abdominal	Vaginal	Radical	
NSW	70.0	26.8	3.3	6,381
Vic	67.2	29.1	3.7	4,682
QLD	72.8	25.2	2.0	3,561
WA	63.8	33.2	3.0	2,146
SA	65.5	32.9	1.6	2,089
Tas	63.3	36.2	0.5	624
NT	74.7	22.2	3.0	99
ACT	80.2	18.9	0.9	338
Australia	68.7	28.5	2.8	19,920

Source: Health Insurance Commission

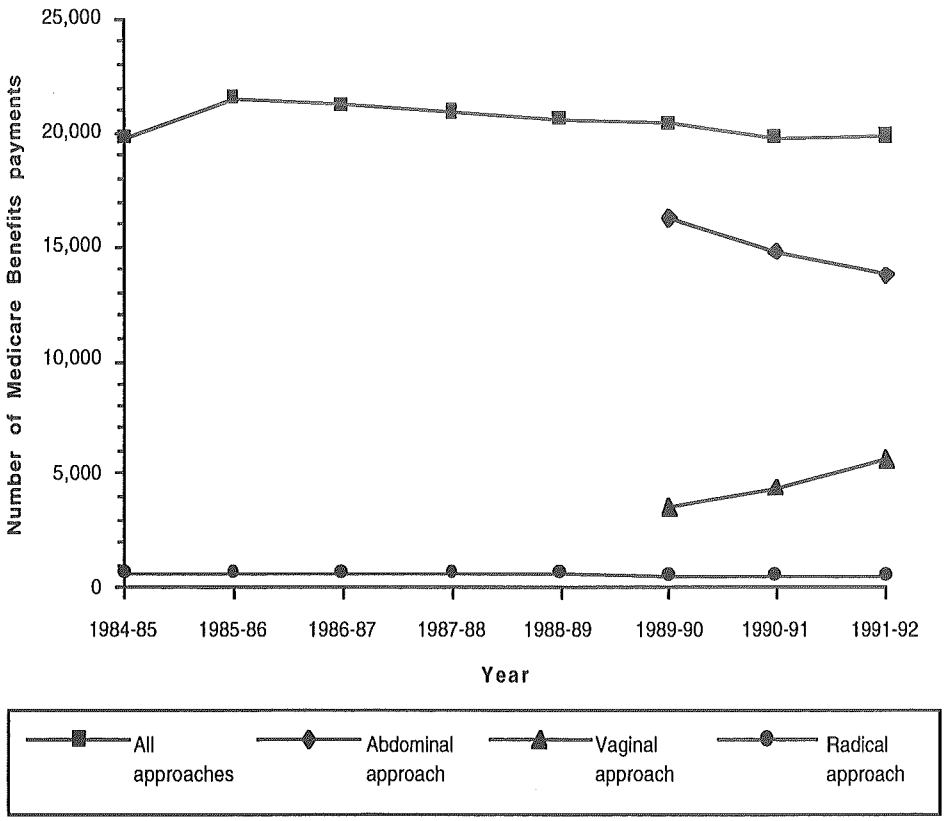


Figure 1: *Number of Medicare benefits payments by year for different hysterectomy approaches*

Long-term effects of hysterectomy

Hysterectomy, whether abdominal or vaginal, can cause long-term problems for the patient. Such problems can be menopausal, sexual or psychological. Others include urinary or bowel dysfunction, fatigue and abdominal pain.[31, 37, 38]

Concurrent oophorectomy is common with abdominal hysterectomy but is not normally performed with vaginal hysterectomy. In the USA, 30% of women aged 35 to 44 have their ovaries removed with abdominal hysterectomy.[39] A number of menopausal symptoms are reported following hysterectomy, such as hot flushes and dry vagina.[31, 37] Premenopausal hysterectomy has been associated with an increased risk of coronary heart disease.[23] Another concern is premature loss of bone mass leading to osteoporosis. On the other hand, preservation of ovaries exposes the patient to the risk of subsequent ovarian disease, particularly cancer. Even when ovaries are retained, premature ovarian failure can occur in a subset of hysterectomised women.[40]

Sexual dysfunction has been reported following hysterectomy, with symptoms including loss of interest in sex, painful sex and less enjoyable sex.[31, 37] On the other hand, women also report improved sexual function after hysterectomy for reasons which include more enjoyable sex and no fear of pregnancy.

Hysterectomy has been associated with psychological disturbances such as depression, mood changes, anxiety and irritability.[31, 37] Symptoms may be menopausal or due to perceived loss of femininity, with cultural factors playing a role. A Canadian study suggests that education, type of family structure, the concept of the feminine role and the stresses of migration play a role in development of psychological morbidity following hysterectomy.[41] However, others suggest that hysterectomy itself does not precipitate adverse psychological sequelae; postoperative outcome in fact reflects preoperative psychological adjustment.[42, 43]

In New South Wales, 59% to 70% of patients report that at least one symptom was either caused or made worse by hysterectomy.[31, 37] However, only 4% of patients considered that the operation caused more problems than it had solved. In general, women were more likely to be satisfied with the outcome when their symptoms were perceived to be serious.

Variations in hysterectomy rates

There is considerable regional and across-country variation in hysterectomy rates which cannot be accounted for by the variations in the incidence of its indications.[13, 39, 44] Patient, professional and health system factors have been suggested as possible reasons for this variation. Some suggest that women with better education and higher occupational status are less likely to have a hysterectomy, whereas others have found that social class only has a modest influence on hysterectomy rates.[12, 45, 46] Similarly, while young women with three or more children have been reported as more likely to have a hysterectomy, a recent British study indicates that hysterectomy rates for myomas fall with parity while rates for menstrual disturbances rise.[45, 47] Those who have undergone a tubal sterilisation are less likely to have a hysterectomy, whereas repeated fetal losses or side effects from an IUD tend to increase the chances of having a hysterectomy.[47]

Public information campaigns have been noted to decrease hysterectomy rates by influencing both patients' and doctors' attitudes.[48] A criteria-based quality assurance process has decreased hysterectomy rates for several indications, including menorrhagia.[49] Health system factors such as the number of gynecologists per region, the nature of their training and availability of hospital beds have also been implicated, although the effect of such factors is not clear.[12] Hysterectomy rates have been reported as lower in Victoria than elsewhere in Australia, with longer waiting lists for public hospital beds and lower availability of acute care hospital beds being possible contributing factors.[47]

Abdominal myomectomy

Myomectomy has been performed via an abdominal incision for many years. Since myomas are often multiple and can be deep in the myometrium, they can be difficult to

reach and remove through one incision.[23] Some are too large to be removed easily. Major technical concerns relating to the procedure are minimisation of blood loss, prevention of postoperative adhesions (which can impact on fertility) and accurate reconstruction of uterine anatomy.[50]

Preoperative treatment with GnRH agonists has been suggested to decrease tumour size and reduce blood loss.[23, 50, 51] However, smaller myomas could shrink to a size that would not be visible during the operation, then grow and cause problems postoperatively. Some consider that lasers offer advantages if used in myomectomy, in particular by improving hemostasis and allowing removal of myomas from previously inaccessible areas.[52] The risk of postoperative adhesion formation is similar for laser and for diathermy techniques.[53]

Myomas can recur after myomectomy; a recurrence rate of 15% has been reported based on several studies, with 10% of patients requiring subsequent treatment.[10] A ten-year study reports a recurrence rate of 27% over this period.[54] Both genetic predisposition and small myomatous lesions being undetected and thus not removed during operations have been suggested as reasons for the appearance of myomas after myomectomy.[54]

For those women who wish to preserve their fertility, myomectomy is an alternative to hysterectomy in the treatment of myomas. The procedure is suggested in women who wish to delay conception and have a myomatous uterus of 10 to 12 weeks' gestational size or larger, or one that is growing rapidly. Abdominal myomectomy is not performed in the majority of women with myomas, due to increased technical difficulty compared with hysterectomy and the possibility of myoma recurrence.

Approximately 800 Medicare Benefits payments are made annually for all myomectomy and hysterotomy in Australia (Table 2.7, Appendix 2), suggesting that the annual caseload for abdominal myomectomy would not exceed 1,500.

Myomas may contribute to infertility in some cases. Pregnancy rates of 40% to 59% following myomectomy have been reported.[10, 52, 55] Neither age of the patient nor number and size of myomas removed appear to influence postoperative pregnancy rates.

Other than those already mentioned, complications of abdominal myomectomy are those of any abdominal surgery and have already been discussed in relation to hysterectomy. Little information is available about its morbidity and mortality. Average lengths of hospital stay of four to five days for myomectomy have been reported as being consistent with most laparotomies.[51, 55]

Treatments using the hysteroscopic approach

Many methods have been proposed to destroy the endometrium by physical means, including freezing, chemicals, heating and ionising radiation. The most recently-developed techniques are more effective, and involve destruction of the endometrium by laser, electrical or radiofrequency energy, or photodynamic therapy. The energy is applied to the endometrium transvaginally under direct control via a hysteroscope. Since no incision is needed to reach the operating field, these hysteroscopic techniques have the advantage of reduced hospital stays and recovery periods compared with open surgery.

An operating hysteroscope consists of an endoscope, a channel for the laser fibre or resectoscope loop, and one or two others for inflow and outflow of the fluid needed to distend the uterus and to provide adequate visualisation of the endometrium. A cold light source and fibre optic cable are used to provide illumination. A video camera, display monitor and beam splitter are attached to display an image of the operating field on the monitor.

Resection

Hysteroscopic resection was first used to treat menorrhagia in the late 1970s and was also used to treat intrauterine adhesions and submucous myomas.[56, 57] The past few years have seen increased use of the procedure and development of new techniques as purpose-designed equipment has become available.

The procedure uses monopolar diathermy. A cutting current is delivered by means of a loop of wire and used to shave off pieces of endometrium, with a coagulation current through the same loop providing hemostasis. Both the basal layer of endometrium and the first few millimetres of myometrium are removed. To reduce the risk of uterine perforation, resection starts in the fundus and moves towards the internal os. Resected tissue is removed throughout the procedure and can be sent for histological analysis.

The cutting loop is also used to remove submucous myomas. Myomas are shaved off either level with or slightly below the surrounding endometrium. Large myomas may need to be debulked using forceps beforehand or fragmented using the cutting loop for easy removal. Where the entire endometrium is to be resected, any myomas present will be removed as well.

With the cutting loop it is difficult to reach the cornual areas of the endometrium. A rollerball electrode has been used instead of the loop to ablate the entire uterine cavity.[58] The rollerball causes thermal damage to 3–4 mm depth, which is deep enough to destroy the basal layer of the endometrium. The rollerball can easily reach into the cornual areas and is potentially safer since uterine perforation is unlikely. The technique is easier to learn and safer to use than the cutting loop, but less effective

without preoperative endometrial suppression and cannot be used to treat any myomas present. The two types of electrodes are often used in combination.

The procedure has been performed under general anesthesia, regional anesthesia and local analgesia.[59, 60, 61] Reported operation times range from 10 minutes to 100 minutes (Table 3.1, Appendix 3). Operations tend to be longer when myomas are present and shorter if pre-treatment with drugs has thinned the endometrium.[59] However, the extent of experience with hysteroscopy has the greatest effect on operation times.

From the results available to date, endometrial resection appears to be successful in treating menorrhagia in the majority of cases. Most studies report amenorrhea or hypomenorrhea in 75% to 90% of cases (Tables 3.1 and 3.2, Appendix 3). Failure rates vary from 3% to 26%. Up to 5% of patients subsequently undergo hysterectomy, and up to 23% undergo a repeat resection. Early results from studies of rollerball resection suggest that higher success rates are likely with this technique or with a combination of the rollerball and cutting loop electrodes. Less improvement in menstrual symptoms and greater chance of retreatment has been reported with partial resection than with complete resection.[59] Adenomyosis has been reported by some as lessening the chance of success, although others disagree.[59, 62] The effectiveness of the technique has been observed to lessen over time, with the possibility of recurrent bleeding from endometrial regeneration or myomas.[63]

Resection of myomas improves menstrual symptoms in 81% to 94% of patients (Table 3.3, Appendix 3). Of those patients presenting for infertility, 33% to 69% deliver live infants following hysteroscopic myomectomy. A higher proportion (10%) subsequently have a hysterectomy following resection of myomas compared with endometrial resection. Up to 12% have a subsequent repeat myomectomy or hysteroscopic ablation. Myomas occurring after hysteroscopic myomectomy can be due to either the original myoma not being completely excised or a new myoma growing in a different location.

Postoperative analgesic use following hysteroscopic resection is considerably reduced compared with that following abdominal hysterectomy.[64] Hospital stays are also shorter (Tables 3.1 to 3.3, Appendix 3). Patients are usually discharged within three days of operation, and some can be discharged the day of operation.[59, 60, 64, 65, 66] Many patients have returned to normal activities within two to three weeks.

Laser ablation

Laser ablation of the endometrium to treat menorrhagia was first reported in 1981.[67] Since then different laser techniques have been investigated and use of the procedure has spread.

The Nd:YAG laser is used for endometrial ablation. The energy from this laser is scattered in tissue and generates heat, resulting in deep coagulation with minimal risk of perforation. The depth of coagulation is controlled by the power level and can extend about 5 mm, which is deep enough to adequately destroy the basal levels of the endometrium while still being contained within the myometrium.

Two different techniques for using the laser have been developed and can be used individually or in combination. With the touch or dragging technique the laser is fired with the fibre tip resting on the endometrial surface. With the non-touch or blanching

technique the laser is fired with the fibre tip 1–5 mm above the endometrial surface. With the touch technique total amenorrhoea is easier to achieve, but the chances of uterine perforation and heat damage to surrounding structures are higher.[68, 69, 70] Laser fibres are also changed more frequently due to charring of the fibre tip.[70] The non-touch technique does not cut blood vessels, so that it is easier to keep the operating field clear of blood and fluid overload is less likely.[68, 71, 72] This technique is also easier and faster to perform.[70, 71] However, it is more difficult in the lower part of the uterus and is more likely to leave patches of endometrium, giving a less satisfactory result.[68, 69, 70]

Laser ablation has been performed under both general and regional anesthesia.[70, 73, 74] Reported operation times range from 10 minutes to 180 minutes (Table 3.4, Appendix 3). The touch technique is slower to perform than the non-touch technique.[71, 75] Operation times are longer when myomectomy is performed before ablation begins.[74]

Again, laser ablation appears to be successful in treating menorrhagia in the majority of cases. Most studies report amenorrhea or hypomenorrhea in 65% to 95% of cases (Table 3.4, Appendix 3). Failure rates generally range from 0% to 22%, although one study reports a 48% failure rate with all failures going to hysterectomy (Table 3.4, Appendix 3). Otherwise, up to 13% of subjects proceed to hysterectomy and up to 16% undergo a repeat ablation. The non-touch technique is considered by some to be less likely to be successful due to the possibility of tufts of endometrium being left behind and possibly regenerating and causing further symptoms.[68, 74, 75, 76] On the other hand, others consider it to be a more effective procedure in inducing amenorrhea as well as being quicker and safer to perform.[71]

A technique for hysteroscopic myomectomy of submucous myomas using the Nd:YAG laser has been described recently.[77] Preoperative treatment with a GnRH agonist was used to reduce myoma size. A postoperative fertility rate of 66% for those patients seeking to become pregnant was achieved (Table 3.5, Appendix 3), but no information was available concerning improvement of menstrual symptoms and subsequent hysterectomies or repeat hysteroscopic surgery. The argon laser has also been used to remove smaller myomas.[78]

Another recent development is coagulation of myomas following preoperative shrinkage using drugs.[79] This technique reduces rather than removes larger myomas, and has been suggested as useful in patients approaching menopause who wish to avoid major abdominal surgery.

Like resection, laser ablation has the advantage of a fast recovery. Postoperative pain following ablation has been reported as negligible compared with that following hysterectomy.[80] Hospital stays are short, with most patients being discharged within two days of operation and many being discharged the day of operation (Table 3.4, Appendix 3). Convalescence times are shorter than for hysterectomy, with an average convalescence of ten days reported.

Radiofrequency ablation

The latest technique developed to destroy the endometrium is radiofrequency ablation, which uses heat to achieve its effect.[81] A probe is used to introduce a high frequency signal into the uterine cavity, with an external belt electrode acting as the return arm of

the circuit. The electrical field leads to a rapid oscillation of charged molecules which causes heating. The temperature is sufficient to destroy the endometrium, but heating beyond the uterine cavity is said to be prevented by the physical characteristics of the electric field, the insulating effect of the myometrium and the myometrial blood supply acting as a heat sink.[81] The probe does not need to be in contact with the endometrium lining for heating to occur, which makes the procedure easier to perform safely. The radiofrequency used is less energetic than microwave radiation, being of a lower frequency, and is non-ionising.

Early results indicate that the technique is quick and successful in most cases (Table 3.6, Appendix 3). The currently reported success rate is 84%. Two of the first 33 patients subsequently had a hysterectomy due to bleeding.[81] Of the first 44 patients, all but two were discharged on the day of operation, with these two being discharged on the day following operation.[82] Patients have experienced moderately severe pain for four to six hours postoperatively that in some has required treatment.

Photodynamic therapy

A recent report describes successful destruction of endometrium by photodynamic therapy in an animal model.[83] This technique involves preferential uptake and retention of photosensitive compounds such as photofrin II by the endometrium. Laser light of an appropriate wavelength provides the activation energy for a toxic photochemical reaction that destroys endometrial tissue but not tissue of surrounding structures. The technique might allow endometrial ablation to be performed without a hysteroscope or fluid irrigation, but its use in humans has not been reported.

Complications

While morbidity following hysteroscopic resection and ablation is generally less than that following abdominal surgery, serious complications and deaths have occurred. The most common complications are uterine perforation, fluid overload and hemorrhage, all of which can have severe consequences.

Uterine perforation can be caused by the hysteroscope, by the resection or ablation probe, or on removal of pieces of myoma or resected tissue.[59, 67, 81, 84, 85, 86] It has been reported in up to 4.2% of cases (Tables 3.1 to 3.5, Appendix 3). Its consequences include serious injury to adjacent pelvic structures (including major trauma to the great vessels of the pelvis, bowel and ureter), fluid overload, and thermal damage to the bowel and bladder.[86, 87, 88, 89, 90] While some patients have an uncomplicated recovery with conservative management of these complications, others undergo subsequent repair by laparotomy or hysterectomy. Lewis reports that emergency hysterectomy may sometimes be necessary and expresses concern that major trauma from uterine perforation is underreported.[90]

Even in the absence of uterine perforation, neighbouring organs can be damaged during resection or ablation. Thermal injury to the bowel and other structures without

prior uterine perforation has occurred using diathermy, laser and radiofrequency techniques.[81, 84, 91]

Such complications may become minimal as techniques and instrumentation are refined. Experience is a factor in occurrence of uterine perforation, with rates being higher with inexperienced operators.[59] Laparoscopy has also been suggested as useful in minimising these complications.[89, 92]

Endometrial resection and laser ablation (but not radiofrequency ablation) use an irrigating fluid which maintains uterine dilation and removes any blood that might interfere with visualisation of the endometrial surface. This irrigation fluid can be absorbed in excessive amounts, causing fluid overload, hyponatremia and other electrolyte disorders, increased central nervous pressure, and pulmonary and tissue edema.[59, 67, 89, 93, 94] Fluid overload and associated complications have been reported in up to 11% of endometrial resection or laser ablation cases (Tables 3.1 to 3.5, Appendix 3). Careful monitoring of fluid inflow and outflow from the uterus is needed to detect the complication when it first occurs. While more expensive, use of irrigation devices that automatically monitor fluid inflow and outflow add to the safety of the procedure (Cutter BG, Hill DJ, personal communications).

Several different irrigating fluids have been used for endometrial resection or ablation, with the technique itself being a major determinate of choice of fluid. Following fatalities from embolism, carbon dioxide gas is no longer used.[80] For diathermy techniques, nonconductive fluids such as glycine, sorbitol and dextran 70 must be used, as opposed to electrolytic fluids such as saline. Either type can be used with laser ablation. Dextran 70 is highly viscous (and thus less likely to be absorbed), and provides good distension and clear visibility, but has been associated with adult respiratory distress syndrome, disseminated intravascular coagulation and anaphylaxis.[95] Low viscosity fluids such as glycine and saline are easy to instil, relatively inexpensive and do not caramelise as does dextran (making equipment easier to clean), but mix more readily with blood.

Hemorrhage is another potentially serious complication of endometrial resection and ablation and has been reported in up to 6% of cases (Tables 3.1 to 3.5, Appendix 3). It can occur when blood vessels cut in the myometrium are too large for coagulation or are not treated long enough to effect coagulation. It may not be apparent until the irrigating fluid is removed and no longer acts as a tamponade to open blood vessels. Problems with hemorrhage can be minimised by operating in the follicar phase of the menstrual cycle, by avoiding deep resection into the myometrium (especially in areas where it is thin) and by pretreatment with drugs to suppress the endometrium.[87]

Other complications and side effects of endometrial resection/ablation can occur. Patients can experience mild to moderate uterine cramping immediately postoperatively and a serosanguinous discharge persisting up to six weeks.[58, 64, 65, 70, 73, 82] While not posing significant problems, infection and hematometra (retained blood in the uterus) have been reported following resection and ablation[67, 96] (Table 3.1 to 3.4, Appendix 3). On the other hand, a positive effect of resection or ablation that has been noticed by some is improvements in other symptoms, such as dysmenorrhoea and premenstrual symptoms.[97, 98]

The mortality rate from hysteroscopic resection or ablation is not yet known. The three major complications of these procedures, fluid overload, hemorrhage and uterine

perforation leading to damage to surrounding structures, have the potential to be life-threatening if unrecognised and untreated.

Long-term effects

The possibility of endometrial resection or ablation increasing the long-term incidence of endometrial cancer has been raised.[65, 92] After resection and laser ablation, especially the latter, synechiae (adhesions) can form in the uterus and obscure small cavities where endometrium could still persist. Diagnosis of neoplasms occurring in such hidden cavities could be delayed, increasing the long-term morbidity and mortality from this condition. Pathologic conditions, including neoplastic changes, have developed subsequent to early methods of endometrial destruction. On the other hand, although it is possible that neoplastic changes in resected or ablated tissue might be more frequent, far fewer endometrial cells are present to undergo such changes. The effect of endometrial resection or ablation on long-term incidence of endometrial cancer will not be known for some years.

Histological analysis of resected myomas is important since in some cases leiosarcoma has been diagnosed.[66] The formation of adhesions following resection of myomas can also impact on later fertility of younger women.[60] While endometrial resection or ablation might reduce or prevent menstrual bleeding, it does not necessarily affect menstrual pain associated with adenomyosis, which may require subsequent treatment[99] (Cutter BG, personal communication).

Women undergoing endometrial resection or ablation are advised that it does not ensure sterility, and either sterilisation or contraceptive measures are needed if pregnancy is not desired. Since tufts of endometrium can remain after the treatment, subsequent pregnancy with a much greater chance of complications is possible.[100]

Training

Like other endoscopic procedures, there is a learning curve associated with hysteroscopic resection and ablation, during which complications such as uterine perforation are more frequent. The operator should be skilled with a fluid technique for diagnostic hysteroscopy before attempting resection or ablation, preferably having performed more than 100 procedures.[101] The first few attempted should be simple cases and be fully supervised.[88, 101, 102] The learning curve using the rollerball electrode is shorter than that using the cutting loop electrode, which is again shorter than that for the Nd:YAG laser[65] (Fraser IS, personal communication). The RACOG suggests that minimum experience in the supervised training phase should be 20 cases for laser, 10 for loop resection and 5 for rollerball resection.[101] In the first reports of the technology, radiofrequency ablation was said to be simpler to perform and requires no

special surgical skills, which might reduce the learning curve for this procedure.[103] However, this is yet to be proven.

Operating room staff also require training in these techniques. In particular, they need adequate training in monitoring fluid inflow and outflow, so that the complication of fluid overload is identified rapidly.

The RACOG has issued guidelines on endometrial ablation, covering training and accreditation.[101]

Patient selection

Endometrial resection or ablation is considered appropriate for women with primary menorrhagia who are considered unfit for hysterectomy.[56, 62, 63, 94, 104] It is being offered to women with primary menorrhagia who are seeking to avoid hysterectomy and do not wish to retain their fertility. While drug treatment carries no apparent risk of death, and resection and ablation do, the latter have been suggested as an option for women who have side effects from or do not wish to use drug treatment.[105] Endometrial resection and ablation are contraindicated in the presence of atypical histology and endometrial abnormalities.[101, 104]

As endometrial resection and ablation become more readily available, indications may extend to women who may not have been prepared to consider major surgery for their menstrual problems.[88] Indications may also extend to postmenopausal women on cyclical hormone replacement therapy who suffer heavy withdrawal bleeding.[88]

Preoperative treatment

Preoperative treatment with drugs prior to endometrial resection or ablation is used to suppress the endometrium, thinning it and making it a more uniform thickness. Advantages suggested for preoperative treatment include decreased operation times and lower complication rates due to reduced fluid absorption and hemorrhage, but the limited results available to date (Table 3.7, Appendix 3) are inconclusive.

Preoperative drug treatment also reduces myoma size—in one study by an average of 45%.[106] Advantages of such preoperative treatment include prevention of excessive blood loss, more limited surgical intervention being required and removal of myomas that would otherwise be too large to be removed using hysteroscopic approaches. Disadvantages are that shrinkage of the uterus may make the operation more difficult and small myomas may shrink to such an extent that they are not visible at operation and hence not excised.[22, 50, 106]

Another form of preoperative treatment is mechanical preparation of the endometrium, where suction curettage is used to denude it immediately prior to resection or ablation. A recent report suggests that this technique might be comparable to preoperative medical treatment.[107]

Impact in Australia

Although endometrial ablation was described in 1981 and endometrial resection shortly afterwards, it is only in the past few years that these techniques have become widely

used. Reasons include difficulty in learning the techniques, limitations of early instruments (some of which were modified urological instruments), low pickup rates of significant abnormalities in some studies and the absence of workshops to teach the techniques.[72] Increasing demand for the procedures as alternatives to hysterectomy has aided their diffusion.

Data on the diffusion of the procedures in Australia are limited. In 1990–91, 2,349 Medicare Benefits Schedule payments were made for endometrial resection or ablation; from 1 June to 31 December 1991, 2,440 payments were made and from 1 January to 30 June 1992, 2,342 payments were made (Health Insurance Commission). A preliminary survey by the RACOG of its members at the end of 1991 indicated that 41% of respondents were at that time already using endometrial resection or ablation, and a further 67% intended to start using the technique within five years.[24]

The same survey indicated that 2% of those using the technique used laser ablation, compared with 96% using resection with either or both of the cutting loop or rollerball electrodes. In keeping with this, glycine is used by most as an irrigating fluid. All respondents considered a hospital stay of two days or less usual, with 52% considering the technique a day procedure.

Endometrial resection/ablation is already making an impact on hysterectomy rates in Australia. Hospital morbidity data for New South Wales indicate a fall by one-third in the number of hysterectomies performed for menorrhagia, in particular abdominal hysterectomies, between 1988–89 and 1991–92 (see Tables 1 and 2.1). However, little impact can be seen on hysterectomies in Victoria or South Australia over the same period.

Treatments using the laparoscopic approach

Laparoscopy has been used by gynecologists since the 1970s. Its main applications in clinical practice in Australia have been for diagnosis, biopsy, tubal sterilisation, aspiration of cysts, division of adhesions and treatment of endometriosis. Other laparoscopic procedures such as myomectomy were developed several years ago, but are not yet in routine clinical use.

The past few years have seen spectacular development of the laparoscopic approach in the area of general surgery. This was made possible by advances in technology, particularly the development of high resolution video cameras with high-powered light sources and specialised clip appliers. Technological change has continued with the development of a wide range of new laparoscopic instruments. In particular, the linear stapler (which simultaneously cuts and staples tissue and thus avoids the difficult and time-consuming task of suturing laparoscopically) is extending the range of procedures that can be performed using this approach. Laparoscopically-assisted hysterectomy is one new procedure that has evolved from these technological advances.

The first step in a laparoscopic procedure is usually the insertion of a Veress needle generally in the region of the umbilicus. Once the surgeon is sure the needle tip is in the appropriate part of the peritoneal cavity, the cavity is insufflated with carbon dioxide, forming a pneumoperitoneum. An alternative being investigated is elevation of the abdominal wall by mechanical means (Hill DJ, personal communication).

A 10 or 11 mm trocar (a sharp pointed cannula) is placed at the needle position and a laparoscope introduced. If necessary, further trocars can then be placed under direct vision. These additional trocars are used to introduce laparoscopic instruments to the abdomen and might be 5 mm or 10–11 mm. Alternatively, the laparoscope might have a channel for instruments, although this decreases the lens size and narrows the field of view.

Instruments used for operative laparoscopy include endo or thermal coagulation (diathermy) and laser probes, specialised laparoscopic forceps and scissors, clip appliers and suturing instruments. Irrigation equipment is used to remove blood and debris throughout the operation. The operating field can be viewed directly through the laparoscope by the surgeon. Alternatively, a video camera with or without beam-splitter is attached to the laparoscope and enables all the operating team to see the operating field on a monitor, and possibly record the operation.

In general terms, laparoscopic surgery has significant advantages over open surgery due to reduced postoperative morbidity and faster recovery. Diagnostic laparoscopy is frequently performed as day surgery. Patients may spend a little more time in hospital after operative laparoscopy, but still considerably less than after the alternative of laparotomy. For example, the average length of stay for operative laparoscopy (MBS item number 4194) in Australian private hospitals in 1985 was 2.5 days, compared with 6.9 days for laparotomy (MBS item numbers 6643 and 6644).[108] Return to normal activity is also rapid, and postoperative pain reduced. Postoperative pain after

laparoscopy is commonly due to carbon dioxide gas remaining within the peritoneal cavity, and can persist for three or more days.[109]

Laparoscopic myomectomy

Laparoscopic myomectomy can be used to remove subserosal and superficial intramural myomas. The operation is easy if the myoma is pedunculated. If not, the peritoneum is incised and coagulated, then the myoma excised. Both diathermy and lasers have been used for cutting and coagulation in this procedure.[79, 110, 111] The myoma is removed through one of the incisions either intact or in pieces. Pretreatment with GnRH agonists before operation has been advocated to reduce uterine size and operative blood loss.[111, 112] Existing laparoscopic techniques for deep intramural myomas are not regarded as satisfactory by some.[112] The difficulty with such myomas is in performing a layered closure of the uterine wall laparoscopically, since without this there may be a greater risk of hematoma formation and uterine rupture during future pregnancies. The latter has been recently reported, with the suggestion that if further studies confirm this, laparoscopic myomectomy may need to be limited to women who do not desire further childbearing.[113]

Limited information is available about the success and morbidity of laparoscopic myomectomy. Single and small myomas are relatively easy to treat, but multiple and large myomas are more difficult to excise and remove from the abdominal cavity, and can cause more bleeding. Thus the procedure can at times be very difficult technically and time-consuming, especially in the presence of pelvic endometriosis and adhesions. On the other hand, hospital stays average one to three days (Table 4.1, Appendix 4), in common with other laparoscopic surgery. Postoperative pain and ileus are reduced compared with open myomectomy.[110]

Since adhesions can impair fertility, their formation following laparoscopic myomectomy is a question that needs to be addressed. The size and number of myomas and use of suture material appear to affect adhesion formation, but the use of lasers instead of diathermy does not[111] (RACOG, personal communication). Comparison of adhesion formation following myomectomy via laparoscopy and via microsurgical laparotomy needs further consideration, as reduced adhesion formation is one of the advantages claimed for laparoscopic surgery. Since the procedure is used mainly for small subserosal myomas which are usually asymptomatic, it is not necessarily useful as a primary treatment at present.[114]

Laparoscopically-assisted hysterectomy

The laparoscopic approach has been applied to total hysterectomy and, more recently, radical hysterectomy for cervical cancer.[115, 116, 117, 118, 119, 120, 121, 122] The laparoscope can be used in a variety of ways at hysterectomy.

First, the laparoscope can assist a vaginal hysterectomy by its use prior to hysterectomy for diagnosis and for dealing with conditions such as pelvic adhesions, endometrosis

and ovarian abnormalities. It can also be used following vaginal hysterectomy to check for hidden bleeding (the major cause for morbidity following this operation).

Second, the laparoscopic approach can be used to ligate some or all of the uterine vessels and ligaments. The remainder of the operation, including removal of the uterus, is performed in the usual vaginal manner.

Third, all of the procedure can be performed laparoscopically, with the uterus removed through one of the 'keyholes'. This approach is regarded by some as a lengthy and technically complicated procedure that does not add much to clinical practice.[123] It is more difficult and unlikely to be common since the uterus is usually easy to remove through the vagina.

The terms laparoscopically-assisted hysterectomy, laparoscopically-assisted vaginal hysterectomy and laparoscopic hysterectomy have been used to refer to some or all of these techniques. Laparoscopically-assisted hysterectomy (LAH) has been used in this report to refer to the second approach, and laparoscopic hysterectomy to the third approach.

The first LAH performed took three hours, although with experience and use of laparoscopic linear staplers shorter times of 80 minutes to 90 minutes have been reported.[115, 116, 117, 118, 121] However, preliminary ureteric dissection to minimise ureteric complication rates increases the operative time by 20 minutes to 60 minutes.[124]

Improved instrumentation may decrease procedure times. Suggested enhancements include hemostatic clips to aid management of uterine vessels, bifunctional forceps (scissors and bipolar diathermy) to eliminate the time required to change instruments, and improvements in bipolar diathermy to eliminate the need to clean probes between coagulations.[115]

Early results appear promising in terms of the success and morbidity of the procedure. Hospital stays of one to four days are reported, with patients returning to normal activity within one to four weeks[117, 119] (Table 4.2, Appendix 4). Postoperative discomfort and pain is reduced in comparison with abdominal hysterectomies, although not necessarily with vaginal hysterectomies.[121, 125] A recent study comparing LAH with vaginal hysterectomy found that, apart from cost, they were comparable.[125]

However, there is clearly a need for further research to be done into the safety and efficacy of LAH in comparison with abdominal and vaginal hysterectomy. Monitoring of advanced operative laparoscopy such as LAH by the RACOG has been suggested to determine morbidity of the procedure and to establish if morbidity is higher during the learning phase.[124] Rapid and widespread diffusion of LAH might be premature until surgical techniques have become standardised, further information about its success and morbidity is obtained and evidence of its benefits compared with the alternative of abdominal hysterectomy is gathered.

Complications and long-term effects

While little published information is available about the complications of laparoscopic myomectomy and LAH, those of laparoscopy in general have been well-documented and are listed in Table 3. Of these, major complications that may lead to death are those

due to anesthesia, bowel injury and intra-abdominal hemorrhage.[126] Infection and gas embolism are relatively rare causes of death. Gasless laparoscopy is being investigated to prevent deaths from gas embolism (Hill DJ, personal communication). Major complication rates are low, and reported as 1.5% in the USA and 2.0% in the Federal Republic of Germany.[127, 128] Mortality rates are respectively reported as 0.005% and 0.024%.

Table 3: ***Complications after gynecological laparoscopy***

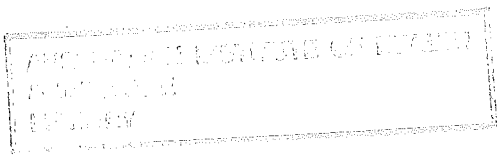
Procedure	Complications
Anesthesia	Cardiorespiratory arrest Cardiac arrhythmia
Laparoscopy	Direct trauma to bowel, urinary tract, pelvic organs, blood vessels
	Hypercapnia and carbon dioxide embolus
	Infection of the wound, pelvis, chest or urinary tract
	Hemorrhage of abdominal or pelvic walls, ovarian vessels, pelvic blood vessels or pelvic tubal mesentery
Electrocautery	Thermal injury to bowel, skin, pelvic organs or blood vessels
Other	Lost foreign body
	Deep vein thrombosis
	Chest pain

Source: References 126, 129

Pneumoperitoneum needle and trocar injuries occur because the needle and first trocar are inserted blindly. They are a frequent cause for conversion of the operation to laparotomy. Such injuries to major blood vessels or the bowel are potentially fatal and can sometimes go unrecognised until a severe drop in blood pressure or peritonitis occurs. They are more likely if adhesions are present; thus, previous abdominal surgery is a relative contraindication. Thromboembolism has been reported and is in part due to the combined effect of a pneumoperitoneum and prolonged anesthesia.[124]

The clips and staples used recently in laparoscopic surgery can cause problems.[130] Complications from the use of clips are clip displacement and inadequate vessel occlusion. While laparoscopic staplers have not been in use long enough to assess their effect, potential long-term complications include lack of strength and security along the staple line, and the possibility of arteriovenous malformations. In LAH they may contribute to an increased risk of ureteric damage.[124, 131]

One uncertainty following laparoscopic myomectomy is the strength of the uterus subsequent to the procedure. While healing of the uterus appears satisfactory after removal of small myomas, indentations have been noted following removal of large myomas without suturing.[111] At present, laparoscopic suturing, when applied, cannot be as



meticulous as microsurgery via laparotomy, raising concerns about the ability of the uterus to withstand the stress of labour and delivery.

Early results indicate a lower complication rate for LAH than for abdominal or vaginal hysterectomy (Table 4.2, Appendix 4). Infection complications constitute the most common complications reported to date. However, ureteric injuries have occurred during LAH due to the proximity of the ureter to the uterine vessels and the use of linear staplers in this area.[131] Differences in uterine positioning make such injuries more difficult to avoid during LAH than during vaginal hysterectomy. Development of narrower and more flexible staple heads may allow safer use of staplers in this area. In common with other forms of hysterectomy, bladder fistula and, in the long-term, vaginal vault prolapse are possible complications of LAH[116] (Hill DJ, personal communication).

Training

Adequate training is an important factor in minimising morbidity and mortality of any laparoscopy. Yuzpe notes that trocar injuries are more common among patients of gynecologists who had not been trained in laparoscopy during their residency than among those who had been.[132] Recognition of uncontrolled bleeding and injury to internal organs, and satisfactory creation of a pneumoperitoneum are important skills in the early stages of learning the technique.

Surgeons also need to learn the manipulative skills and hand–eye coordination involved in laparoscopy, since these are different from the skills required for open operations. There is a progression in these skills from laparoscopic diagnosis and aspiration of ovarian cysts, to laparoscopic sterilisation, to the more complex procedures such as LAH.[110, 130] Following the use of inert models and watching practical demonstrations and video recordings of procedures, 'hands on' training with an experienced surgeon is important.[124, 129] With laparoscopic myomectomy, progression to complex cases involving large lesions has been suggested only after development of skills on small and single myomas.[111]

LAH is a complex procedure requiring advanced laparoscopic skills. Adequate training is a major factor in preventing serious complications following the procedure (Hill DJ, Petrucco OM, personal communications). The Australian Gynaecologic Endoscopist's Society (AGES) and the RACOG are developing guidelines for LAH. Adequate processes for accreditation and credentialling within hospitals would also seem important.

Not only surgeons require training in laparoscopic myomectomy and LAH; theatre staff need suitable training so that they can provide the surgeon with adequate support and technicians require training in maintenance of the video and other equipment.

Patient selection

Table 4 lists general contraindications to laparoscopic surgery.

Outside these contraindications, the indications for laparoscopic myomectomy should be the same as those for open myomectomy.[111] However, open myomectomy is advised for more than four myomas and with myomas over 10 to 15 cm in diameter.[110, 111]

Table 4: *Contraindications to laparoscopic surgery*

Absolute	Relative
Mechanical and paralytic ileus	Multiple abdominal incisions
Large abdominal mass	Abdominal wall sepsis
Generalised peritonitis	Gross obesity
Irreducible external hernia	Hiatus hernia
Cardiac failure	Ischemic heart disease
Recent myocardial infarction	Blood dyscrasias and coagulopathies
Cardiac conduction defects	
Respiratory failure	
Severe obstructive airways disease	
Shock	

Source: Reference 129

As well as general contraindications to laparoscopic surgery, specific contraindications to LAH include very large myomas and inextricable adhesions between uterus and bowel or bladder.[115] Malignant ovarian or uterine neoplasms, initially regarded as a contraindication, may be able to be treated with the newly-developed laparoscopic radical hysterectomy. LAH allows vaginal removal of the uterus in patients for whom vaginal hysterectomy was in the past contraindicated, such as those with adhesions, endometriosis, pelvic inflammatory disease or poor uterine mobility. LAH is considered an alternative to abdominal hysterectomy, rather than a procedure to be used on those patients who would in the past have had a vaginal hysterectomy (Hill DJ, Petrucco OM, personal communications).

Impact in Australia

Laparoscopic myomectomy and LAH are not in general use in Australia. The latter in particular is still developing and further information about its safety, success rate, morbidity, cost-effectiveness and long-term effects is needed. If LAH does become widespread along with similar changes in general surgery, the effect upon the health care system will be significant. The impact of this change and issues arising from it have been addressed in general terms elsewhere[110] and will not be covered in detail here. These issues include:

- availability of suitable equipment;
- reluctance to convert a laparoscopic procedure to an open one;
- better design of reusable instruments;
- compatibility of instruments from different suppliers;
- compatibility of video equipment within a hospital.

Cost implications of the different treatments

One of the main advantages frequently cited for minimally invasive therapies is their lower overall cost compared with those of open surgery. In general, the per procedure financial costs (estimated as the cost to service providers) are lower for minimally invasive therapies due to the much shorter hospital stays, although costs of the equipment and instruments needed to perform these therapies are usually higher (Table 5). Estimates of these costs for the hysteroscopic and laparoscopic treatments discussed in this report have been calculated to assess their value relative to that of similar costs for open surgery (Appendix 5).

Neither the hysteroscopic nor the laparoscopic approaches to treating menorrhagia or myomas require large capital expenditure on equipment, although hospitals may need to purchase smaller items such as hysteroscopes and high flow insufflators. Purchase prices of the more expensive items are listed in Table 5.1 (Appendix 5). Some of these items, such as diathermy units, are already available in hospitals since they are used in other applications.

In terms of the prices of capital equipment, the choice between diathermy on the one hand and laser or radiofrequency ablation on the other makes a significant difference. Equipment for endometrial resection costs between $32,000 and $75,000 depending on the options selected with the equipment. In comparison, equipment for endometrial laser ablation costs between $165,000 and $200,000, with the laser being the major component of this cost at an average price of $140,000. Radiofrequency ablation equipment is also expensive at $132,000. For laparoscopic procedures, the cost of equipment when diathermy is used is from $42,500 to $98,000. Equipment costs using lasers have not been estimated since lasers appear to offer no particular advantage over diathermy in this application.

Irrigation devices that monitor fluid inflow and outflow add to the safety of endometrial resection and laser ablation by making detection of fluid overload much easier. These devices are the most expensive of the irrigation devices available (about $12,000 compared with up to $6,000 for irrigation devices lacking this facility). The additional cost per patient ($25 at a throughput of 50 cases annually) is not large and might be offset by reductions in the incidence of fluid overload as a complication.

Details of financial costs per patient episode for the hospital component of the different procedures, together with assumptions made in estimating these costs, are provided in Appendix 5. Estimated cost to service providers for abdominal hysterectomy is $3,739 per patient. Vaginal hysterectomy and open myomectomy are comparable, at $3,550 and $3,825 per patient respectively.

Table 5: *Summary of cost[1] per patient episode of different procedure*

	Hysterectomy			Endometrial resection/ablation			Myomectomy		
Item	Abdominal	Vaginal	Laparo-scopically assisted	Diathermy	Laser	Radio-frequency	Open	Laparo-scopic	Hystero-scopic
Specialists' fees	534	534	566	470	470	470	439	566	373
Equipment and instrument costs	..	..	1,513	243	833	975	..	625	243
Hospital costs	3,205	3,016	641	415	415	415	3,016	452	415
Cost of further treatment	..	..	243	279	357	527	370	471	363
Preoperative drug costs	..	..	..	103	103	103	..	103	103
Total	**3,739**	**3,550**	**2,963**	**1,510**	**2,178**	**2,490**	**3,825**	**2,217**	**1,497**

(1) Assumptions made in deriving costs and source of the data are detailed in Appendix 5.
.. not applicable

Not surprisingly in view of the much shorter average hospital stays, per patient costs for endometrial resection and ablation are much lower than those of hysterectomy. The per patient cost of endometrial resection is estimated as $1,510, which is 40% of that of abdominal hysterectomy costs. Endometrial laser ablation costs are higher due to the higher equipment prices, at $2,178 per patient. Radiofrequency ablation costs are higher again, at $2,490 per patient, due to both the higher equipment prices and a price of $365 for the disposable probe and belt electrode needed. The cost of radiofrequency ablation might be up to $300 lower if the rate of repeat ablation is similar to that for laser ablation rather than the 20% quoted in early reports. Similar cost advantages have been found elsewhere; Sculpher and associates report costs for endometrial resection being 53% of those for abdominal hysterectomy.[133] They also point out that this cost advantage will be eroded if, wif the rate of repeat ablation is similar to that for laser ablation rather than the 20% quoted in early reports. Similar cost advantages have been found elsewhere; Sculpher and associates report costs for endometrial resection being 53% of those for abdominal hysterectomy.[133] They also point out that this cost advantage will be eroded if, with long-term follow up, subsequent retreatment and hysterectomy rates are higher than have been found to date.

Hysteroscopic myomectomy costs are similar to those for endometrial resection ($1,497 per patient) and offer a similar advantage over costs for abdominal hysterectomy.

In terms of financial costs to service providers, LAH offers a smaller advantage of $580 to $770 over abdominal or vaginal hysterectomy. The cost per patient has been estimated as $2,963, of which almost $1,200 is for disposable instruments. This estimate is based on quite a short average hospital stay of 1.7 days obtained from the limited studies reported to date (Appendix 4). Average hospital stays could easily be a day or so longer, in which case the additional bed-day cost of $377 will further erode the direct cost advantage of this procedure.

Some savings to the cost of disposable instruments might be possible. Use of reusable rather than disposable trocars for all but the first incision could reduce the procedure cost by up to $200 without affecting safety of the procedure. Another possibility for surgeons experienced in the technique is the use of laparoscopic scissors and bipolar diathermy instead of the disposable stapling device. While this might reduce instrument costs by up to $750 per patient, operation times would be longer (requiring additional use of operating theatres) and higher complication rates might occur, possibly offsetting the savings made in instrument costs (Petrucco OM, personal communication).

Careful evaluation of the true cost of disposable and reusable alternatives is needed. Not only are disposable instruments expensive to purchase on a per patient basis, but they also attract costs in their disposal. As Baggish points out, this waste is non biodegradable, requiring packing in special containers and burial in suitable landfill sitess[134] Risk of contamination by HIV or other viruses is transferred from the patient and operating room staff to others less equipped to deal with it. On the other hand, reusable instruments need to be cleaned. Added to cleaning costs are the costs of morbidity subsequent to infection from inadequately cleaned instruments. With

disposable instruments operations are shorter (requiring less theatre time) and the procedure is safer and easier to learn.

Laparoscopy at the end of vaginal hysterectomy has been suggested as a possible tool for decreasing morbidity (Hill DJ, personal communication). Complications from hidden bleeding might be preventable, offsetting some or all of the additional costs of such laparoscopy with shorter hospital stays and fewer complications requiring treatment.

Costs for laparoscopic myomectomy are lower, at $2,217 per patient, and compare favourably with those for abdominal hysterectomy. However, use of operating theatres would often be longer.

As well as financial costs, there are a number of other factors that influence cost differentials between the different techniques. These are difficult to measure and some will not be known until there is long-term follow up of the new techniques.

The most obvious of these are the savings to the community and employers. Both the hysteroscopic and laparoscopic approaches considerably reduce the postoperative recovery period, by three to four weeks. If a significant number of abdominal hysterectomies are replaced by these approaches, the resultant savings in terms of days not lost from work are considerable.

Another factor is the cost of complications—both directly to patients and the health care system, and indirectly to employers. The additional costs of major complications for each approach cannot be easily estimated. Minor complications following open surgery are common and are an additional cost associated with this approach compared to the hysteroscopic and laparoscopic alternatives.

Other factors affecting overall cost savings are less easy to define. Additional costs associated with hysterectomy include morbidity from premature cardiovascular disease and hormone replacement therapy (when the ovaries are removed or fail prematurely). On the other hand, hysterectomy considerably reduces costs associated with treating cervical and uterine cancers. Additional costs associated with endometrial resection/ablation include those of contraception or sterilisation, and morbidity associated with possibly undetected endometrial cancer. Less invasive methods of treating menorrhagia and myomas may also lead to treatment of a wider range of cases and an associated increase in direct costs to the health care system.

Comparison of the different treatments

Current use of the different treatments for menorrhagia and myomas depends on a number of factors, including short and long-term effectiveness, morbidity, availability, and stage of development of each technology.

Medical treatment

Medical treatment can give good results but can be associated with side effects. However, on cessation of treatment, its effect is short-lived, lasting at most for a year, after which the presenting problem often recurs. When this occurs, a more permanent solution may be sought by women who are some years from menopause. Medical treatment has a role to play for young women wishing to retain their fertility or perimenopausal women wishing to avoid surgery. It has also been suggested as a preoperative treatment before vaginal hysterectomy, myomectomy and endometrial resection/ablation.

Hysterectomy

Abdominal hysterectomy is followed by stays in Australian hospitals of eight to nine days and a recovery period of about six weeks. The procedure is relatively safe, with little major morbidity, although many patients suffer from minor complications.

In comparison, vaginal hysterectomy is reported to be followed by less pain and morbidity, shorter hospital stays and faster recovery periods. However, analysis of Australian hospital morbidity data indicates that at least some of these benefits do not always accrue. The procedure is also more difficult to perform and its use to date for menorrhagia and, in particular, myomas is somewhat limited.

Techniques for LAH are still developing and information about the long-term safety and effectiveness of the procedure is still limited. Early results indicate that, in comparison with abdominal hysterectomy, postoperative pain is reduced following LAH and hospital stays (one to four days) and recovery periods (one to four weeks) are much shorter. LAH has similar advantages over vaginal hysterectomy, although the difference is not nearly as marked. In terms of estimated financial costs to service providers, LAH has only a slight advantage over abdominal and vaginal hysterectomy, due mainly to the costs of disposable instruments. However, LAH does promise considerable benefits to patients, their families and employers with the reduced recovery period.

Endometrial resection or ablation

Abdominal hysterectomy has been the primary surgical treatment for menorrhagia for some time, but endometrial resection/ablation is becoming a popular alternative. By removing the uterus, abdominal hysterectomy successfully prevents further menstrual bleeding, excessive or otherwise. However, it is associated with considerable

postoperative pain and morbidity, long hospital stays and recovery periods, and a mortality rate, albeit small. Other problems associated with loss of the uterus, such as psychological ones, may also occur.

On the other hand, endometrial resection/ablation is followed by significantly reduced postoperative pain, hospital stays and recovery periods. Instead of hospital stays of eight to nine days, stays of one to two days or even day surgery are usual. Recovery periods are reduced from six weeks to one to two weeks. Financial costs to service providers are consequently lower, with estimates of hospital costs being less than half of those of abdominal hysterectomy, with an additional advantage being the savings to employees due to the much shorter recovery period. Overall, complication rates are lower. Complications can be major, even life-threatening, and their incidence compared with similarly severe complications following abdominal hysterectomy is not yet clear. Long-term consequences such as the effect of endometrial resection/ablation on incidence of endometrial cancer will not be known for some time.

One disadvantage of endometrial resection/ablation compared with abdominal hysterectomy is that, in some cases, the treatment fails and further treatment or even hysterectomy may be necessary. Another is that some form of sterilisation or contraception is needed; pregnancy is unlikely, but if it occurs, the risk of complications is higher. Endometrial resection/ablation is contraindicated in some cases, such as markedly retroverted uterus or endometriosis, so that hysterectomy remains the choice of surgery in these instances. On the other hand, it can be used for a number of those cases that are unfit for hysterectomy, and avoids possible menopausal and psychological effects of hysterectomy.

While a number of studies of endometrial resection/ablation have been reported and the procedures are diffusing rapidly, further information about their safety and efficacy in routine clinical practice is needed. As de Wit points out, most studies are retrospective case series rather than randomised trials comparing the procedures with each other or with hysterectomy, and follow up was generally short.[135] Given the capacity of the endometrium to regenerate, effectiveness of the procedures over a long period needs to be shown.

In comparing the resectoscope with the laser, the former is much cheaper and more readily available in hospitals. It is faster to use, with a shorter learning curve and fewer complications, and is more robust[56, 65, 136] (Fraser IS, personal communication). With lasers, the depth of tissue destruction is directly related to the power used, although this can be difficult to control.[137] They require a suitable room with features such as no reflecting surfaces and signed and alarmed doors.[137, 138] Safety rules must be instituted for their use. While it has been argued that lasers and the roller ball resectoscope destroy tissue utterly and do not provide a sample for pathological examination, this difficulty can be avoided by hysteroscopic examination and curettage during the diagnostic process and by using the loop to remove a sample prior to ablation. Success rates of the two modalities appear comparable, as do other indicators such as lengths of hospital stays and morbidity.

Radiofrequency ablation is a new technique; therefore, information about its morbidity and success is very limited. It is reported to be simpler to perform, needing no special surgical skills, less time-consuming and possibly safer.[103] It avoids the complication of

fluid overload, but additional complications from burns occur. Like laser ablation, equipment prices for radiofrequency ablation are higher than for endometrial resection.

Endometrial ablation by photodynamic therapy is still experimental.

Myomas have recently been resected with a laser as well as the older technique of resection using a diathermy loop. The diathermy loop is difficult to use in the cornual areas of the uterus.[72] On the other hand, laser resection of myomas has an increased risk of uterine perforation and needs more than one application for large myomas.[72, 137] The procedure is technically more difficult than endometrial resection/ablation.

Myomectomy

The different forms of myomectomy are alternatives to hysterectomy in the treatment of myomas. They have the advantage of preserving fertility, but myomas can recur and the procedures are technically more difficult. Open myomectomy is similar to abdominal hysterectomy in terms of morbidity and recovery. Because it is more difficult to perform, it is generally restricted to those women wishing to retain their fertility.

Laparoscopic myomectomy is also difficult and time-consuming to perform, especially in the presence of large and multiple myomas. On the other hand, in common with other laparoscopic procedures, postoperative pain is reduced, recovery is much faster and consequently, costs are lower than for open myomectomy or abdominal hysterectomy. At present, it is most useful with small and single subserosal myomas which generally do not cause problems. As a result, the procedure may remain of limited usefulness, especially in view of concerns about later strength of the uterine wall and limited benefits in terms of adhesion formation compared with open myomectomy.

Hysteroscopic myomectomy can also be performed on a subset of myomas—submucous myomas. It has similar advantages to endometrial resection/ablation, but again is technically more difficult than these procedures. As expertise in endometrial resection/ablation grows, use of hysteroscopic myomectomy is likely to increase, especially since menorrhagia frequently occurs in the presence of myomas. The possibility of recurrence and consequential later treatment does decrease the cost-effectiveness of this approach.

Potential impact of the different treatments

In 1988–89, approximately 13,500 Australian patients with menorrhagia or myomas proceeded to surgery—12,000 had a hysterectomy and the remainder had a myomectomy. Many of these procedures were associated with considerable postoperative pain and morbidity, long hospital stays and recovery periods, and high costs to hospitals, patients, their families and employers.

Like other minimally invasive techniques, the new hysteroscopic and laparoscopic techniques promise to make a significant impact by reducing postoperative pain, dramatically shortening hospital stays and recovery periods, and reducing costs.

This process has already begun in the recent diffusion of endometrial resection/ablation. Approximately 4,000 Medicare Benefits payments were made for this procedure in 1991–92; in the same period the rate of hysterectomy for menorrhagia in public hospitals declined by one-third. Approximately 5,300 of the annual hysterectomy caseload are performed for a principal diagnosis of menorrhagia. If 80% of these were replaced by endometrial resection/ablation, the health care system could be saved an estimated $9M, and employers could be saved 240 man-years not lost to sick leave or equivalent.

However, such estimated savings assume a constant caseload and no increase in retreatment rates subsequent to operation. If long-term retreatment rates are higher than those reported to date, some of the advantages of endometrial resection/ablation will be eroded. With the availability of a less invasive procedure, more women might be treated for menorrhagia, a distinct possibility in view of the subjective nature of diagnosis of this complaint. Subsequent to childbearing, some women might consider requesting endometrial resection/ablation in the absence of diagnosed menorrhagia, simply to reduce or eliminate the discomfort and inconvenience of normal menstruation.

Another factor is the increasing use of hormone replacement therapy in postmenopausal women. Effects of hormone replacement therapy include heavy withdrawal bleeding and continued occurrence of myomas. Whether either problem will be significant in terms of many menopausal women needing treatment is not yet clear.

The impact of LAH is likely to be in replacing abdominal rather than vaginal hysterectomies; LAH basically allows an abdominal hysterectomy to be done vaginally, with consequential reductions in postoperative pain, lengths of hospital stays and recovery periods. Its impact on hysterectomies done for menorrhagia is not likely to be large, since endometrial resection/ablation is more likely to replace abdominal hysterectomies (and even vaginal hysterectomies) performed for this indication. Its impact on abdominal hysterectomy performed for myomas should be more significant, although in some cases myoma size will preclude this approach.

The major impact of LAH will be in decreased discomfort to the patient and a faster recovery, reducing time lost from work or other activities. Cost savings to the health

care system depend on the lengths of hospital stays and are less marked than for endometrial resection. If only 50% of the 5,920 abdominal hysterectomies performed annually for myomas were replaced by LAH and hospital stays remain the length in early reports, the health care system could be saved an estimated $2M a year. Given that the recovery period following LAH is shortened by two to four weeks, the effect of this procedure will be significant on employers and on patients with regard to postoperative home care, leisure activities and expenses.

LAH could replace abdominal hysterectomy for a number of indications other than menorrhagia and myomas. Given the large number of hysterectomies performed annually, savings to employers and the community are likely to be significant. The effect on hospital costs are difficult to assess precisely without detailed economic analysis, but the change will affect other aspects of hospital care as well.

Adoption of minimally invasive procedures such as endometrial resection/ablation and LAH will lead to significant changes in hospital infrastructure. Fewer beds will be needed in normal hospital wards, but more day surgery facilities will be needed. Faster patient throughput will impose additional costs on hospital administrations. Where patients are discharged shortly following surgery, they may need to be contacted the next day to check for complications. Since operating times are shorter for endometrial resection/ablation compared with abdominal hysterectomy, theatre use will be less. The reverse is true of LAH. All of these changes are not unique to gynecological surgery, but are part of a larger trend towards minimally and non-invasive surgery replacing open surgery.

Laparoscopic myomectomy is unlikely to have a large impact on hysterectomy or myomectomy rates, with its use being limited to a subset of those women with myomas who also wish to preserve their fertility. Since submucous myomas sometimes occur in conjunction with menorrhagia, hysteroscopic myomectomy may be performed along with endometrial resection, thus avoiding hysterectomy. However, myomectomy in general is not likely to impact on hysterectomy rates, since the procedures are technically more difficult and the problem of myoma recurrence remains.

While the new GnRH agonists, like other drug therapies, are not effective in all cases, they could replace current drugs in treatment of a number of patients. Due to side effects their use is limited to short-term medical therapy or to endometrial suppression prior to endometrial resection/ablation. In Australia, these drugs are over two times more expensive than other drugs such as danazol.

Conclusions

As an alternative to hysterectomy in the treatment of menorrhagia, endometrial resection is effective and has cost advantages. It is diffusing throughout Australia. However, its long-term effects, retreatment rates and subsequent hysterectomy rates need to be assessed. Laser ablation offers no advantage over endometrial resection in terms of success or morbidity rates, and is more expensive due to the cost of the laser. Little information is available about radiofrequency ablation. However, its cost is similar to that of laser ablation, and therefore it would need to demonstrate significant advantages in success or morbidity to replace endometrial resection in the Australian health care system.

LAH is a new procedure that may replace a number, but not all, of abdominal hysterectomies performed for myomas. It is also likely to replace abdominal hysterectomies performed for other indications. LAH promises advantages to patients in terms of reduced pain and faster recovery, and to employers in terms of faster return to work. Much of the advantage for hospitals of reduced bed usage is offset by increased theatre time, higher administrative costs per bed-day and much higher instrument costs.

However, the procedure is still developing and little information about its safety and efficacy is available. There is clearly a need for further research to be done into the safety, efficacy and cost-effectiveness of LAH in comparison with abdominal and vaginal hysterectomy. Rapid and widespread diffusion of LAH might be premature until surgical techniques have become standardised, further information about its success and morbidity is obtained, and evidence of its benefits compared with the alternative of abdominal hysterectomy is gathered.

Myomectomy in general is technically more difficult than alternatives. Abdominal myomectomy is used primarily for women who wish to retain their fertility. Present techniques of laparoscopic myomectomy have limited application and are unlikely to replace many abdominal myomectomies. Hysteroscopic myomectomy can only be used with a small proportion of myomas, but since these often occur in conjunction with menorrhagia, use of the technique prior to endometrial resection is likely to increase.

Serious complications can potentially occur with endometrial resection/ablation and LAH. Adequate training is an important factor in minimising morbidity and mortality from these techniques, as are suitable equipment and instrumentation.

Endometrial resection/ablation and LAH are part of the current trend towards minimal access surgery. As such they promise enormous benefits to patients, the health care system and the community as a whole. Even though some initiatives are underway, previous calls for continuing dialogue between interested parties and for continuing research and assessment of these new technologies remain relevant if their full potential is to be realised.[103, 139]

Appendix 1

Organic causes of menorrhagia

The organic causes of menorrhagia are as follows:[1, 2, 3, 140, 141]

Systemic

- Blood dyscrasias
  —thrombocytopenia
  —thrombocytopathia
  —afibrinogenia
  —Von Willebrand's disease
  —macroglobulinemia
  —deficiencies in factors II, V, VII, X or XI
  —hemophilia carrier
  —leukemia
  —lymphoma
  —platelet disorders
- General medical disease
  —hypothyroidism
  —chronic liver disease
  —chronic renal failure
  —congestive cardiac failure
  —systemic lupus erythematosus
  —anovulation
  —diabetes mellitus
  —adrenal disease
  —obesity

Local

- Pregnancy
  —threatened abortion
  —inevitable abortion
  —ectopic pregnancy
- Pelvic disease
  —myomas
  —endometriosis
  —adenomyosis
  —chronic pelvic inflammatory disease
  —carcinoma of endometrium
  —carcinoma of cervix
  —ovarian tumours

—functmetrial hyperplasia
—endometrial hemangioma
—pelvic arteriovenous malformations
—inadequate corpus luteumthelial neoplasia
—myometrial hyperplasia
—endometrial hemangioma
—pelvic arteriovenous malformations
—inadequate corpus luteum

Iatrogenic

—intrauterine contraceptive devices
—poor control of anticoagulation treatment
—steroidal hormone therapy
—chemotherapy

Appendix 2

Australian data for hysterectomy and myomectomy

Australian data for hysterectomy were available from hospital morbidity files held by the State health authorities and Medicare Benefits data held by the Health Insurance Commission. State health authority data are collected on the basis of discharges from hospitals. Tables 2.1 and 2.2 summarise public and private hospital admissions data for abdominal and vaginal hysterectomy by principal diagnosis. Tables 2.3 to 2.6 present similar data by length of hospital stay and the patient's age.

These data were coded using the IDC-9-CM coding system. The procedure codes used were:

abdominal hysterectomy—68.3, 68.4, 68.6

vaginal hysterectomy—68.5, 68.7.

The diagnosis codes used were:

malignant neoplasm—179–184

uterine leiomyoma—218

pelvic inflammatory disease—614–616

endometriosis—617

genital prolapse—618

menorrhagia—626.2.

The Medicare Benefits data cover payments made to private patients in either private or public hospitals, and do not include:

- services rendered free of charge in recognised hospitals;
- services covered by third party or workers compensation provisions or services rendered to repatriation beneficiaries or defence personnel;
- services to `non-eligible' persons such as foreign diplomats and their families.

In relation to the Medicare Benefits data, `State' refers to the State of origin of the patient.

Table 2.7 presents Medicare Benefits payments data for abdominal myomectomy (using Medicare Benefits item 35649).

The symbol n.a. used in tables in this Appendix means the data were not available for this study.

Table 2.1: *Percentage of hospital admissions for abdominal hysterectomy in selected States by principal diagnosis and year*

	1988–89			1991–92		
Principal diagnosis	**NSW**	**Vic**	**SA**	**NSW**	**Vic**	**SA**
Public hospitals						
Malignant uterine neoplasm	9.5	11.5	11.1	12.5	13.4	9.7
Uterine leiomyoma	25.7	28.6	20.0	28.3	33.5	23.2
Pelvic inflammatory disease	5.9	4.8	3.1	5.7	3.1	2.1
Endometriosis	10.7	17.9	8.2	14.1	16.1	7.4
Genital prolapse	1.5	1.8	1.8	1.6	1.4	1.6
Menorrhagia	19.0	14.0	30.7	11.7	12.5	32.6
Other	27.7	21.4	25.2	26.0	20.0	23.3
Total number of admissions	*4,571*	*3,440*	*1,092*	*4,658*	*3,204*	*1,050*
Private hospitals						
Malignant uterine neoplasm	3.0	n.a.	7.0	4.1	n.a.	6.4
Uterine leiomyoma	27.2	n.a.	25.4	33.3	n.a.	30.7
Pelvic inflammatory disease	4.4	n.a.	3.0	6.3	n.a.	2.7
Endometriosis	13.9	n.a.	12.0	15.3	n.a.	11.4
Genital prolapse	1.1	n.a.	2.4	2.3	n.a.	2.2
Menorrhagia	20.9	n.a.	30.1	12.6	n.a.	28.6
Other	29.5	n.a.	20.0	26.1	n.a.	18.0
Total number of admissions	*2,696*	n.a.	*1,135*	*3,105*	n.a.	*1,145*

Source: State health authority data

Table 2.2: *Percentage of hospital admissions for vaginal hysterectomy in selected States by principal diagnosis and year*

Principal diagnosis	1988–89			1991–92		
	NSW	Vic	SA	NSW	Vic	SA
Public hospitals						
Malignant uterine neoplasm	1.2	0.8	0.8	0.8	0.8	0.2
Uterine leiomyoma	8.7	7.3	2.5	9.6	10.8	8.0
Pelvic inflammatory disease	2.3	2.1	2.5	2.0	1.8	0.6
Endometriosis	4.7	6.7	1.9	6.1	6.9	1.7
Genital prolapse	58.0	68.4	65.8	62.7	65.9	65.8
Menorrhagia	13.2	4.2	14.0	7.6	4.3	15.8
Other	12.0	10.6	12.6	11.2	9.6	7.8
Total number of admissions	*1,677*	*1,048*	*365*	*1,866*	*1,181*	*462*
Private hospitals						
Malignant uterine neoplasm	0.3	n.a.	0.3	0.3	n.a.	0.5
Uterine leiomyoma	8.1	n.a.	7.8	10.6	n.a.	14.6
Pelvic inflammatory disease	1.0	n.a.	0.5	2.1	n.a.	0.3
Endometriosis	6.8	n.a.	2.3	8.5	n.a.	6.8
Genital prolapse	45.9	n.a.	69.4	58.8	n.a.	53.0
Menorrhagia	15.8	n.a.	9.5	7.4	n.a.	15.0
Other	22.1	n.a.	10.0	12.1	n.a.	9.8
Total number of admissions	*975*	n.a.	*399*	*1,389*	n.a.	*632*

Source: State health authority data

Table 2.3: *Percentage of hospital admissions for abdominal hysterectomy in selected States by length of hospital stay and year*

	1988–89			1991–92		
Length of hospital stay (days)	**NSW**	**Vic**	**SA**	**NSW**	**Vic**	**SA**
Public hospitals						
5 or less	6.2	3.9	5.6	11.3	9.1	11.3
6	10.7	7.1	10.1	17.7	14.4	17.1
7	23.5	15.4	20.5	24.5	21.9	24.2
8	19.5	21.2	24.5	15.0	18.4	19.5
9	14.3	18.1	14.8	10.1	10.5	10.9
10	7.3	10.9	8.4	6.2	6.6	5.7
11 to 14	11.9	16.1	10.5	9.4	11.7	6.9
15 or more	6.5	7.4	5.5	5.8	7.4	4.4
Average	9.0	9.7	9.2	8.5	9.0	8.2
Range	1–121	1–153	1–377	1–107	1–218	n.a.
Private hospitals						
5 or less	6.7	n.a.	3.2	11.3	n.a.	4.4
6	11.1	n.a.	4.4	15.8	n.a.	5.7
7	19.9	n.a.	14.0	23.1	n.a.	14.8
8	26.0	n.a.	21.0	21.6	n.a.	21.7
9	15.4	n.a.	20.8	12.0	n.a.	19.9
10	8.5	n.a.	16.6	6.4	n.a.	16.0
11 to 14	9.5	n.a.	16.1	7.0	n.a.	14.4
15 or more	3.0	n.a.	3.9	2.9	n.a.	3.2
Average	8.7	n.a.	9.3	7.9	n.a.	9.0
Range	1–313	n.a.	1–101	1–94	n.a.	n.a.

Source: State health authority data

Table 2.4: *Percentage of hospital admissions for vaginal hysterectomy in selected States by length of hospital stay and year*

Length of hospital stay (days)	1988–89			1991–92		
	NSW	Vic	SA	NSW	Vic	SA
Public hospitals						
5 or less	13.9	5.6	5.5	21.1	15.1	19.0
6	11.8	7.9	16.4	19.8	15.1	17.1
7	19.3	16.7	16.4	21.1	22.4	16.2
8	15.4	16.0	18.6	12.1	16.2	14.5
9	11.4	15.8	13.7	7.2	8.7	8.2
10	5.4	9.6	11.5	4.7	6.6	6.9
11 to 14	15.4	19.6	10.9	9.4	10.2	10.2
15 or more	7.5	8.6	6.9	4.7	5.8	7.8
Average	8.9	9.7	8.9	7.7	8.3	8.3
Range	1–72	1–83	4–43	1–93	1–72	n.a.
Private hospitals						
5 or less	15.6	n.a.	7.3	22.1	n.a.	24.2
6	14.7	n.a.	11.8	16.8	n.a.	13.4
7	16.0	n.a.	12.0	17.7	n.a.	14.1
8	16.0	n.a.	16.5	15.0	n.a.	11.6
9	13.9	n.a.	14.5	9.1	n.a.	10.3
10	8.8	n.a.	13.0	5.5	n.a.	9.7
11 to 14	10.9	n.a.	20.1	10.0	n.a.	12.8
15 or more	4.2	n.a.	4.8	3.8	n.a.	4.0
Average	8.5	n.a.	9.0	7.7	n.a.	8.5
Range	1–95	n.a.	1–20	1–32	n.a.	n.a.

Source: State health authority data

Table 2.5: *Percentage of hospital admissions for abdominal hysterectomy in selected States by patients' age and year*

Patients' age (years)	1988–89			1991–92		
	NSW	Vic	SA	NSW	Vic	SA
Public hospitals						
Under 30	5.2	4.2	6.4	4.5	2.9	4.8
30–34	10.9	9.7	9.8	9.6	8.6	10.7
35–39	19.2	18.0	18.3	17.4	15.7	15.4
40–44	23.2	25.2	22.3	22.9	25.0	23.2
45–49	19.1	19.2	19.6	19.4	20.2	19.0
50–54	8.5	9.2	8.8	9.4	9.4	10.7
55–59	3.1	3.6	2.9	4.0	4.7	4.0
60–64	3.2	3.3	3.5	3.4	4.0	3.9
65–69	3.0	2.7	3.1	3.3	3.7	3.2
70 and over	4.6	4.9	5.2	6.0	5.7	5.1
Mean age (years)	44.7	44.9	n.a.	46.0	46.3	n.a.
Private hospitals						
Under 30	3.5	n.a.	3.2	1.6	n.a.	1.3
30–34	9.1	n.a.	9.3	6.5	n.a.	6.3
35–39	21.0	n.a.	18.9	16.2	n.a.	15.4
40–44	27.0	n.a.	27.4	27.1	n.a.	25.3
45–49	22.4	n.a.	21.3	26.3	n.a.	26.7
50–54	9.9	n.a.	9.2	12.4	n.a.	12.4
55–59	2.5	n.a.	3.9	3.4	n.a.	4.3
60–64	1.8	n.a.	1.9	2.4	n.a.	2.9
65–69	1.3	n.a.	2.0	2.0	n.a.	3.1
70 and over	1.5	n.a.	2.9	2.1	n.a.	2.3
Mean age (years)	43.6	n.a.	n.a.	45.4	n.a.	n.a.

Source: State health authority data

Table 2.6: *Percentage of hospital admissions for vaginal hysterectomy in selected States by patients' age and year*

Patients' age (years)	1988–89			1991–92		
	NSW	Vic	SA	NSW	Vic	SA
Public hospitals						
Under 30	3.2	1.2	1.4	2.5	1.4	1.3
30–34	7.0	5.5	4.4	7.1	4.9	8.0
35–39	12.1	10.0	7.4	10.9	9.2	9.3
40–44	14.7	13.8	12.9	13.6	12.1	15.6
45–49	12.6	10.0	11.0	11.8	11.3	9.3
50–54	7.1	8.5	7.4	7.4	8.6	7.6
55–59	7.5	4.8	8.2	5.4	6.6	8.0
60–64	7.7	8.4	11.2	9.0	8.3	11.3
65–69	9.9	12.9	14.0	10.6	12.9	9.1
70 and over	18.3	24.8	22.2	21.8	24.6	20.6
Mean age (years)	53.3	56.3	n.a.	54.7	56.5	n.a.
Private hospitals						
Under 30	2.4	n.a.	3.5	1.0	n.a.	1.1
30–34	7.6	n.a.	6.5	5.2	n.a.	4.4
35–39	12.0	n.a.	13.8	8.7	n.a.	15.2
40–44	17.7	n.a.	17.3	16.4	n.a.	19.6
45–49	17.7	n.a.	12.0	15.7	n.a.	16.5
50–54	10.9	n.a.	13.0	11.8	n.a.	12.3
55–59	7.2	n.a.	6.8	8.0	n.a.	6.6
60–64	7.7	n.a.	7.0	8.4	n.a.	6.0
65–69	9.2	n.a.	8.3	9.4	n.a.	6.8
70 and over	7.7	n.a.	11.8	15.4	n.a.	11.4
Mean age (years)	50.0	n.a.	n.a.	53.7	n.a.	n.a.

Source: State health authority data

Table 2.7: *Number of Medicare benefits payments for myomectomy*[1] *by year*

Year	Number of payments
1984–85	712
1985–86	749
1986–87	735
1987–88	746
1988–89	706
1989–90	723
1990–91	817
1991–92	827

Source: Health Insurance Commission

(1) Medicare Benefits item 35649 was used; this item also includes payments for hysterotomy.

Appendix 3

Summary of studies on hysteroscopic endometrial resection and ablation

This appendix summarises many of the studies of hysteroscopic endometrial resection and ablation. When comparing studies, the following points should be born in mind:

- definitions, for example, of hypomenorrhea and failure, vary between studies;
- satisfaction with results varies from patient to patient. Some are satisfied with a reduction of blood loss to normal levels, whereas others are not satisfied if amenorrhagia is not achieved;
- in some cases, myomas were present and were resected before the endometrial ablation or resection was performed. In these cases, operation times will be longer;
- time of follow up varied both within and between studies, although a minimum of three months follow up is generally considered necessary and patients are often excluded from results of success rates if the follow up time is less. Success rates may vary depending on the follow up time: one study reported an 8.8 percent failure rate occurring between six and twelve months post-resection.[88]

Table 3.1 summarises studies of endometrial resection using the cutting loop; in some cases, a combination of the cutting loop and rollerball electrodes were used. Table 3.2 summarises studies of endometrial resection using the rollerball. In both tables, some resections in some studies were partial rather than complete. Table 3.3 summarises studies of resection of myomas only.

Table 3.4 summarises results of studies of laser ablation of the endometrium. Some studies used the touch technique, some the non-touch technique, and others a combination of the two. Table 3.5 summarises results from laser resection of myomas; in this case pretreatment with GnRH agonists to reduce myoma size was used. Table 3.6 summarises results of radiofrequency ablation.

Preoperative drug treatment was used in a number of the above studies to thin the endometrium before endometrial resection or ablation. However, some studies have been designed to determine the effect of preoperative treatment and are summarised in Table 3.7.

The symbol n.a. used in tables in this Appendix means information is not available in the report of the study.

Table 3.1: *Results of studies on endometrial resection using a diathermy loop*

Characteristics	de Cherney et al.[142]	Maher & Hill[87]	Derman et al.[63]	Gannon et al.[64]	Magos et al.[59]	Petrucco & Gillespie[89]	Pyper & Haeri[88]	Serden & Brooks[143]	Sculpher et al.[133]	Rankin & Steinberg[144]
Number of patients in study	21	100	62	25	234	40	80	82	99	[4]400
Results[1] (%)										
amenorrhagic	86	21	n.a.	64	27–42	37	8	50	n.a.	n.a.
hypomenorrhagic	4.8	66	n.a.	16	n.a.	40	49	26	n.a.	n.a.
failure	4.8	3.0	22.5	16.0	n.a.	12.5	26.0	7.0	11.1	15.0
Further treatment (%)										
hysterectomy	n.a.	0	4.8	0	4.0	2.5	5.0	n.a.	7.1	6.8
repeat resection	4.8	5.0	3.2	16.0	6.8	22.5	18.8	n.a.	5.1	7.8
Complications (%)										
perforation	0	1.0	n.a.	0	1.6	2.5	3.8	0	4.0	0.5
fluid overload	0	0	0	0	2.8	n.a.	2.5	n.a.	1.0	0
hemorrhage	0	5.0	0	0	0.4	n.a.	2.5	n.a.	1.0	1.2
infection	n.a.	2.0	n.a.	n.a.	n.a.	n.a.	0	n.a.	2.0	n.a.
Operation time (mins)	15–30	30–90	n.a.	20–47	10–100	n.a.	n.a.	n.a.	49–53	n.a.
Average length of hospital stay (days)	n.a.	n.a.	2.1	1.4	[2]0.8	n.a.	n.a.	n.a.	2.1	[5]
Average time to return to normal activities (weeks)	n.a.	[3]0.4	n.a.	2.1	2.1	n.a.	n.a.	n.a.	n.a.	n.a.

(1) Follow up varies within as well as between studies, from three months to five years.
(2) Postoperative.
(3) Post-discharge
(4) Rollerball also used in recent half of cases.
(5) 370 patients treated as day patients; the remainder had an average hospital stay of 1.8 days.

Source: References 59, 63, 64, 87, 88, 89, 133, 142, 143, 144

Table 3.2: *Results of studies on endometrial resection using a rollerball electrode*

Characteristics	Vancaille[58]	McLucas[146]	Townsend et al.[65]	Gimpelson & Kaigh[99]	Daniell et al.[136]	Fraser et al.[98]
Number of patients in study	15	12	50	[1]143	64	77
Results[2] (%)						
amenorrhagic	67	67	[3]40	38	30	25
hypomenorrhagic	27	33	[3]60	45	61	59
failure	7	0	0	n.a.	10	6
Further treatment (%)						
hysterectomy	7	0	n.a.	4.9	6	4
repeat resection	0	0	n.a.	11.2	11	6
Complications (%)						
perforation	0	0	0	n.a.	1.5	1.3
fluid overload	0	0	2.0	n.a.	0	0
hemorrhage	0	0	6.0	n.a.	0	0
infection	0	0	n.a.	n.a.	0	2.6
Operation time (mins)	15–30	20–60	20–90	n.a.	[4]32	12–55
Average length of hospital stay (days)	0.3	n.a.	0.3	n.a.	n.a.	[5]
Average time to return to normal activities (weeks)	n.a.	n.a.	0.6	n.a.	n.a.	<1.0

(1) Most recent ablations done with a rollerball electrode, most early ablations done with a laser.
(2) Follow up varies within as well as between studies, from four to eighteen months.
(3) Percentage of half the patients. The remainder were treated postoperatively with medroxyprogesterone to evaluate its effect on postoperative discharge and spotting.
(4) Average.
(5) All but four cases were day cases.

Source: References 58, 65, 98, 99, 136, 146

Table 3.3: *Results of studies on hysteroscopic resection of fibroids*

Characteristics	Neuwirth[144]	Hallez et al.[60]	Loffer[85]	Corson & Brooks[66]	Derman et al.[63]	Serden & Brooks[143]
Number of patients in study	28	61	53	92	94	84
Results[1] (%)						
improvement of menstrual symptoms	61	94	[2]93	81	n.a.	92
fertility rate[3]	n.a.	64	58	69	[4]15	n.a.
failure	32	n.a.	n.a.	n.a.	n.a.	8.0
Further treatment (%)						
hysterectomy	25.0	n.a.	9.4	5.4	[5]8.5	n.a.
repeat resection or ablation	7.1	n.a.	3.8	12.0	7.4	4.8
Complications (%)						
perforation	0	1.6	1.9	3.2	n.a.	1.2
fluid overload	0	n.a.	3.8	0	n.a.	n.a.
hemorrhage	0	0	0	1.1	n.a.	0
infection	3.4	0	0	n.a.	n.a.	n.a.
Operation time (mins)	60	3–60	n.a.	n.a.	n.a.	n.a.
Average length of hospital stay (days)	3.0	0.8	n.a.	0	n.a.	n.a.
Average time to return to normal activities (weeks)	1.0	0.6	n.a.	n.a.	n.a.	n.a.

(1) Follow up varies within as well as between studies, from three months to seven years.
(2) Percentage of 43 patients with follow up of over twelve months.
(3) Percentage of patients delivering live-born infants or pregnant at time of reporting, of those patients presenting with infertility.
(4) Percentage of all patients. A further 5.3 per cent had voluntary term pregnancies.
(5) Includes one abdominal myomectomy.

Source: References 60, 63, 66, 85, 143, 144

Table 3.4: *Results of studies on endometrial laser ablation*

Characteristics	Goldrath et al. (148)	Daniell et al. (70)	Lomano (76)	Baggish & Loffer (68)	Baltoyannis (73)	Gimpelson (74)	Bent & Davis (75)	Ostergard (94)	Goldfarb (69)	Garry (80)	Indman (147)	Petrucco & Gillespie (89)	Lefler & Lefler (97)	Donnez & Nisolle (149)
Number of patients in study	216	18	10	36	14	23	25	45	35	859	13	24	64	(1)250
Results(2) (%)														
amenorrhagic	(3)94.0	39	20	(4)33	71	39	12	33	60	60	69	33	31	8
hypomenorrhagic		33	60	(4)39	21	26	40	31	31	32	30	25	55	86
failure	4.6	22	n.a.	5.6	7.1	0	48	19	8.6	8.1	0	13	n.a.	2.8
Further treatment (%)														
hysterectomy	4.2	0	10	2.8	7.1	n.a.	48	13.3	5.7	2.7	0	4.2	9.3	n.a.
repeat resection	1.9	0	0	0	0	4.3	16	n.a.	2.9	4.8	0	4.2	4.0	n.a.
Complications (%)														
perforation	0.5	0	0	0	0	0	n.a.	n.a.	n.a.	0.3	0	4.2	n.a.	n.a.
fluid overload	n.a.	0	0	0	7.1	4.3	n.a.	11.1	5.7	0.5	0	n.a.	n.a.	1.2
hemorrhage	0.5	0	0	0	n.a.	4.3	0	n.a.	n.a.	0	0	n.a.	n.a.	0
infection	1.9	0	0	0	n.a.	0	4.0	n.a.	n.a.	0.5	0	n.a.	n.a.	n.a.
Operation time (mins)	(5)30–40	n.a.	20–45	46–110	40–120	30–93	45–120	35–180	n.a.	11–90	17–65	n.a.	n.a.	n.a.
Average length of hospital stay (days)	(5)	n.a.	0	n.a.	1	n.a.	<2	n.a.	n.a.	1	0	n.a.	n.a.	n.a.
Average time to return to normal activities (weeks)	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	1.4	n.a.	n.a.	n.a.	n.a.

(1) 200 patients treated with partial ablation only.
(2) Follow up varies within as well as between studies, from two months to six years.
(3) For amenorrhagic and hypomenorrhagic results combined.
(4) Three patients were not followed up.
(5) In normal sized uterus.
(6) Most patients discharged the day following surgery.

Source: References 68, 69, 70, 73, 74, 75, 76, 80, 89, 94, 97, 147, 148, 149.

Table 3.5: *Results of studies on hysteroscopic laser resection of myomas*

Characteristics	Donnez et al.[77]
Number of patients in study	60
Results (%)	
improvement of menstrual symptoms	n.a.
fertility rate[1]	66
failure	0
Further treatment (%)	
hysterectomy	n.a.
repeat resection	n.a.
Complications (%)	
perforation	n.a.
fluid overload	0
hemorrhage	1.7
infection	n.a.
Operation time (mins)	10–50
Average length of hospital stay (days)	n.a.
Average time to return to normal activities (weeks)	n.a.

(1) Percentage of patients delivering live-born infants or pregnant at time of reporting, of those patients presenting with infertility.

Source: Reference 77

Table 3.6: *Results of studies on radiofrequency ablation of the endometrium*

Characteristics	Prior et al.[103] phase I[1]	Prior et al.[103] phase II[1]	Phipps et al.[150]
Number of patients in study	20	32	15
Results (%)			
amenorrhagic	0	31	47
hypomenorrhagic	45	53	47
failure	55	16	7
Further treatment (%)			
hysterectomy	n.a.	na.	7
repeat resection	20	n.a.	0
Complications (%)			
perforation	n.a.	n.a.	n.a.
hemorrhage	n.a.	n.a.	n.a.
infection	n.a.	n.a.	n.a.
fistula	10	0	n.a.
Operation time (mins)	[2]10–15	[2]20	15
Average length of hospital stay (days)	n.a.	n.a.	n.a.
Average time to return to normal activities (weeks)	n.a.	n.a.	n.a.

(1) Phase I patients treated for 10 to 15 minutes; phase II patients for 20 minutes.
(2) Actual ablation time rather than total operation time.
Source: References 103, 150

Table 3.7: *Results of studies on preoperative drug treatment for endometrial resection or ablation*

Characteristics	Goldrath (152)	Petrucco & Fraser[20]			Serden & Brooks [151]			
		Group I	Group II	Group III	Group I	Group II	Group III	Group IV
Number of patients in study	324	76	10	14	26	19	56	46
Type of pretreatment	danazol	danazol	goserelin	none	danazol	progestin	GnRH agonist	none
Type of treatment	laser	diathermy	diathermy	diathermy	diathermy	diathermy	diathermy	diathermy
Results[1] (%)								
amenorrhagic	50	47	60	36	46	61	65	48
hypomenorrhagic	n.a.	38	20	14	44	15	23	41
failure	3.0	7.9	10.0	36.0	2	18	4	8
Further treatment (%)								
hysterectomy	5.9	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
repeat resection	3.4	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Complications (%)								
perforation	0.3	3.9	0	0	n.a.	n.a.	n.a.	n.a.
fluid overload	1.5	3.9	0	21.4	n.a.	n.a.	n.a.	n.a.
hemorrhage	4.3	1.3	0	0	n.a.	n.a.	n.a.	n.a.
infection	0.9	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Operation time (mins)	n.a.	[2]20	[2]21	[2]38	n.a.	n.a.	n.a.	n.a.
Average length of hospital stay (days)	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Average time to return to normal activities (weeks)	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

(1) Follow up varies within as well as between studies, from three months to three years.
(2) Average.
Source: References 20, 151, 152

Appendix 4

Summary of studies on laparoscopic approaches to myomectomy and hysterectomy

Only limited data on laparoscopic myomectomy and LAH are available to date. This appendix summarises much of the available data, with myomectomy studies in Table 4.1 and hysterectomy studies in Table 4.2. As noted in the previous appendix, definitions vary between studies.

Table 4.1: *Results of studies on laparoscopic myomectomy*

Characteristics	Dubuisson et al.[110]	Daniell & Gurley[112]	Nezhat et al.[111]	Goldfarb[79]
Number of patients in study[1]	43	17	154	75
Number of myomas removed	92	>20	347	[2]
Results (%)				
fertility rate[3]	14.0	[4]	[5]2.6	n.a.
Further treatment (%)				
hysterectomy	n.a.	0.0	1.3	[6]0.0
Complications (%)				
hemorrhage	0	0	0.6	0
other	0	0	[7]5.2	1.3
Operation time (mins)	25–240	30–180	50–190	25–30
Average length of hospital stay (days)	2.8	<1.0	0.8	n.a.

(1) Follow up varies within as well as between studies, from two months to three years.

(2) Rather than being resected, myomas were preoperatively shrunk by drug treatment, then coagulated with an Nd:YAG laser. Total shrinkage was 50% to 90%.

(3) Percentage of patients delivering live-born infants or pregnant at time of reporting, of those patients presenting with infertility.

(4) The only patient attempting to conceive has done so.

(5) Percentage of all patients; a further 0.6 percent had voluntary term pregnancies.

(6) One patient subsequently underwent endometrial ablation for menorrhagia.

(7) Complication probably due to concurrent hysteroscopy in one patient. Most complications were minor.

Source: References 79, 110, 111, 112

Table 4.2: *Results of studies on laparoscopically-assisted hysterectomy*

Characteristics	Minelli et al.[115]	Maher et al.[116]	Liu[121]	Summitt et al.[125]
Number of patients in study	7	17	72	29
Complications (%)				
infection	n.a.	5.9	1.4	3.4
other	n.a.	0	1.4	6.9
Operation time (mins)	90–180	90–220	80–195	50–245
Average length of hospital stay (days)	3	3.1	1.2	(1)
Average time to return to normal activities (weeks)	n.a.	2.3	(2)1	n.a.

(1) Most patients discharged the day of surgery.

(2) Excluding much physical labour.

Source: References 115, 116, 121, 125

Appendix 5

Cost estimates

Financial costs to service providers (i.e. hospitals and government health services) for each procedure have been estimated on a per patient episode basis. Costs include the hospital component of the procedure but exclude preoperative and postdischarge consultations, since these are similar in all cases. Costs were estimated as follows:

- hospital costs were estimated on a *per diem* basis for all public hospitals, adjusted to exclude fees for visiting medical officers;
- hospital costs were calculated from the cost per bed-day (obtained for the Hospital Utilisation and Costs Study) and the average length of stay;
- medical fees were added separately and were taken from the Medicare Benefits Schedule, using the 75% rebate of the Schedule fee since this is the cost to government and all procedures would normally be performed in a hospital or day care facility;
- hospital and medical costs do not include the cost of training surgeons and theatre staff in the new procedures;
- capital costs for larger items of equipment and costs of disposable instruments were added separately;
- since retreatment rates and rates of conversion of endoscopic procedures to open procedures can be significant, the costs of these were included to derive a cost per patient rather than a cost per procedure;
- the cost of complications is likely to be different for the different procedures, but has not been included due to insufficient information being available to allow these costs to be estimated accurately.

Prices for equipment and instruments are as at November 1992, and were derived from information supplied by the following organisations:

Australian Centre for Medical Laser Technology Inc.

Auto Suture, Australia

Endovision Pty Ltd

Johnson & Johnson Medical Pty Ltd

N Stenning and Co.

Promedica Pty Ltd

Selby Scientific and Medical Pty Ltd

Valleylab (Australia) Pty Ltd

William A Cook Australia Pty Ltd

Table 5.1: *Purchase price of equipment for hysteroscopic and laparoscopic surgery*

Description of equipment	Purchase price ($)[1]
Nd:YAG laser	140,000
Radiofrequency device	132,000
Diathermy unit	7,000–15,000
Insufflator (for laparoscopy)	10,000–17,000
Irrigation device (for hysteroscopy)	3,000–12,500
Video camera and monitor	12,000–33,000
Light source	2,000–18,000
Laparoscope plus instruments[2]	11,500–15,000
Hysteroscope plus instruments[2]	8,000–11,000
Totals for:	
endometrial laser ablation	165,000-200,000
endometrial resection	32,000–75,000
radiofrequency ablation	132,000
laparoscopic hysterectomy or myomectomy	42,500–98,000

(1) Cost at November 1992.
(2) Instruments such as graspers and scissors, suitable for use with the appropriate telescope.

Table 5.2: *Cost of open surgery*[1]

Item	Cost per patient episode ($)		
	Abdominal hysterectomy	Vaginal hysterectomy	Open myomectomy
Surgeon's fee[2]	356	356	285
Assistant's fee[2]	71	71	57
Anesthetists fee[2]	107	107	97
Hospital costs[3, 4]	3,205	3,016	3,016
Retreatment rate[5]	0	0	370
Total	**3,739**	**3,550**	**3,825**

(1) Only the hospital procedure was costed. Preoperative and postdischarge consultations are common to all procedures and have been excluded.

(2) Estimated as 75% of fees from the Medicare Benefits Schedule.[153] Item numbers used were 35653, 35657, 35649 and 51303.

(3) Hospital costs were calculated from the cost per bed-day and the average length of stay. A cost per bed-day of $377 was used, derived from average bed-day costs for public hospitals from the *Hospital utilisation and costs study 1989–90* and brought to 1991–92 prices using health expenditure deflators.[154, 155] This cost excludes fees for visiting medical officers but includes salaries and wages for other medical staff as well as for non-medical staff. It also includes non-salary recurrent expenditure such as surgical and drug supplies. This makes the assumption that surgical and drug supplies used in each procedure are constant (which may not be the case). Larger capital items are excluded.

(4) Average length of stay obtained from a weighted average of the 1991-92 State data in Tables 2.3 and 2.4.

(5) 10% of myomectomy patients require further treatment.[10]

Table 5.3: *Cost of hysteroscopic procedures*[1]

Item	Cost per patient episode ($)			
	Endometrial resection	Endometrial laser ablation	Endometrial radio-frequency ablation	Hysteroscopic myomectomy
Surgeon's fee[2]	319	319	319	229
Assistant's fee[2]	64	64	64	46
Anesthetist's fee[2]	87	87	87	98
Equipment costs[3]	243	833	610	243
Instrument costs[4]	0	0	365	0
Hospital costs[5, 6]	415	415	415	415
Repeat treatment[7]				
—hysterectomy	176	220	194	279
—hysteroscopic surgery	103	137	393	84
Preoperative drug treatment[8]	103	103	103	103
Total	**1,510**	**2,178**	**2,490**	**1,497**

(1) See footnote 1, Table 5.2. Cost of concurrent sterilisation also not included

(2) Estimated as 75% of fees from the Medicare Benefits Schedule.[153] Item numbers used were 35625, 35636 and 51303. Radiofrequency ablation has not been included in the Schedule at this stage, so as an estimate the rebate for laser ablation (item number 35625) was used.

(3) Equipment was assumed to be dedicated and was annuitised with a 5% discount rate on a five-year basis with a patient throughput of 50 per year. Average costs for each type of equipment were used.

(4) The cost of surgical instruments is included in the hospital costs item. In addition, radiofrequency ablation uses a probe and belt, which is included under this item.

(5) See footnote 3, Table 5.2.

(6) Average length of stay was obtained for all hysteroscopic procedures as a weighted average of lengths of stays reported in those studies from 1990 onwards in Appendix 3.

(7) Rates of repeat treatment were obtained for each hysteroscopic procedure as a weighted average of rates of repeat treatment reported in those studies from 1990 onwards in Appendix 3.

(8) Daily dose of 400mg of danazol for six weeks. This is administered prior to hospital admission, but has been included as it is an additional cost to these procedures but not to the alternative treatments.

Table 5.4: *Cost of laparoscopic procedures*[1]

Item	Cost per patient episode ($)	
	LAH	Laparoscopic myomectomy
Surgeon's fee[2]	375	375
Assistant's fee[2]	75	75
Anesthetist's fee[2]	116	116
Equipment costs[3]	315	315
Instrument costs[4]	1,198	310
Hospital costs[5, 6]	641	452
Repeat treatment[7]	0	374
Conversion to laparotomy	243	97
Preoperative drug treatment[8]	0	103
Total	**2,963**	**2,217**

(1) See footnote 1, Table 5.2.

(2) Estimated as 75% of fees from the Medicare Benefits Schedule.[153] Item numbers used were 35638 and 51303. LAH has not been included in the Schedule at this stage, so as an estimate the rebate for complicated laparoscopy (item number 35638) was used.

(3) See footnote 3, Table 5.3.

(4) Costs of disposable laparoscopic instruments. Assumes all trocars used are disposable. Costs of other instruments are included in the hospital costs items.

(5) See footnote 3, Table 5.2.

(6) Average length of stay was obtained for all hysteroscopic procedures as a weighted average of lengths of stays reported in those studies from 1990 onwards in Appendix 4.

(7) Rates of repeat treatment were obtained for each hysteroscopic procedure as a weighted average of rates of repeat treatment reported in those studies from 1990 onwards in Appendix 4.

(8) See footnote 8, Table 5.3.

References

1. Van Eijkeren MA, Christiaens GCML, Sixma JJ et al. Menorrhagia: a review. *Obstetrical and Gynecological Survey* 1989; 44:421–429.
2. Jakubowicz DL. Another look at menorrhagia. *Current Therapeutics* 1988; 3:59–81.
3. Rees M. Menorrhagia. British Medical Journal 1987; 294:759–762.
4. Fraser IS, McCarron G, Markham R. A preliminary study of factors influencing perception of menstrual blood loss volume. *American Journal of Gynecology and Obstetrics* 1984; 149:788–793.
5. Haynes PJ, Hodgson H, Anderson ABM et al. Measurement of menstrual blood loss in patients complaining of menorrhagia. *British Journal of Obstetrics and Gynaecology* 1977; 84:763–768.
6. Fraser I. Prostaglandins, prostaglandin inhibitors and menstrual disorders part II: menorrhagia and premenstrual syndrome. *Healthright* 1988; 8:31–35.
7. Marut EL. Etiology and pathophysiology of fibroid tumour disease: diagnosis and current medical and surgical treatment alternatives. *Obstetrical and Gynecological Survey* 1989; 44:308–310.
8. Vollhoven BJ, Lawrence AS, Healy DL. Uterine fibroids: a clinical review. *British Journal of Obstetrics and Gynecology* 1990; 97:285–298.
9. Kessel B, Berga S, Liu J et al. Treatment of uterine fibroids with agonist analogs of gonadotropin-releasing hormone. *Fertility and Sterility* 1988; 49:538–541.
10. Buttram VC, Reiter RC. Uterine leiomyomata: etiology, symptomatology, and management. *Fertility and Sterility* 1981; 36:433–445.
11. Renwick M, Sadkowsky K. *Variations in surgery rates.* Australian Institute of Health, Health Services series, no. 2, AGPS, Canberra, 1991.
12. Schofield MJ, Hennrikus DJ, Redman S et al. Prevalence and characteristics of women who have had a hysterectomy in a community survey. *Australian & New Zealand Journal of Obstetrics and Gynaecology* 1991; 31:153–158.
13. Selwood T, Wood C. Incidence of hysterectomy in Australia. *Medical Journal of Australia* 1978; 2:201–204.
14. Fraser IS, McCarron G. Randomized trial of 2 hormonal and 2 prostaglandin-inhibiting agents in women with a complaint of menorrhagia. *Australian & New Zealand Obstetrics and Gynaecology* 1991; 31:66–70.
15. Dockeray CJ, Sheppard BL, Bonnar J. Comparison between mefenamic acid and danazol in the treatment of established menorrhagia. *British Journal of Obstetrics and Gynaecology* 1989; 96:840–844.
16. Higham JM. The medical management of menorrhagia. *British Journal of Hospital Medicine* 1991; 45:19–21.
17. Andersch B, Milsom I, Rybo G. An objective evaluation of fluribiprofen and tranexamic acid in the treatment of idiopathic menorrhagia. *Acta Obstetrics and Gynecology Scandinavia* 1988; 67:645–648.

18. Milsom I, Andersson K, Andersch B et al. A comparison of flurbiprofen, tranexamic acid, and a levonorgestrel-releasing intrauterine contraceptive device in the treatment of idiopathic menorrhagia. *American Journal of Obstetrics and Gynecology* 1991;164:879–883.

19. Macdonald R. Modern treatment of menorrhagia. *British Journal of Obstetrics and Gynaecology* 1990;97:3–7.

20. Petrucco OM, Fraser IS. The potential for the use of GnRH agonists for treatment of dysfunctional uterine bleeding. *British Journal of Obstetrics and Gynaecology* 1992; 99:34–36.

21. Brooks PG. Hysteroscopic surgery using the resectoscope: myomas, ablation, septae and synechiae. Does pre-operative medication help? *Clinical Obstetrics and Gynecology* 1992; 35:249–255.

22. Healy DL, Vollenhoven BJ. The role of GnRH agonists in the treatment of uterine fibroids. *British Journal of Obstetrics and Gynaecology* 1992; 99:23–26.

23. Maheux R. Treatment of uterine leiomyomata: past, present and future. *Hormone Research* 1989; 39 suppl. 1:125–133.

24. Royal Australian College of Obstetricians and Gynaecologists. The Quality Assurance in Endometrial Ablation Project. RACOG *Bulletin* 1992; May:16–19.

25. Wingo PA, Huezo CM, Rubin GL et al. The mortality risk associated with hysterectomy. *American Journal of Obstetrics and Gynecology* 1985; 152:803–808.

26. Loft A, Andersen TF, Bronnum-Hansen H et al. Early postoperative mortality following hysterectomy: a Danish population based study, 1977–1981. *British Journal of Obstetrics and Gynecology* 1991; 98:147–154.

27. Amirikia H, Evans TN. Ten-year review of hysterectomies: trends, indications and risks. *American Journal of Obstetrics and Gynecology* 1979; 134:431–437.

28. Dicker RC, Greenspan JR, Strauss LT et al. Complications of abdominal and vaginal hysterectomy among women of reproductive age in the United States. *American Journal of Obstetrics and Gynecology* 1982; 144;841–848

29. Chryssikopoulos A, Loghis C. Indications and results of total hysterectomy. *International Surgery* 1986; 71:188–194.

30. Brunello LP. A survey of hysterectomy for benign disease at a private Queensland hospital. *Australian Clinical Review* 1990; 10:4–6.

31. Opit LJ, Gadiel D. *Hysterectomy in New South Wales: an evaluation of its use and outcome.* Office of Health Care Finance, Sydney, 1982.

32. Browne DS, Frazer MI. Hysterectomy revisited. *Australian & New Zealand Journal of Obstetrics and Gynaecology* 1991; 31:148–152.

33. Gitsch E, Vytisha-Birstorfer E, Skodler W. Various effects of abdominal and vaginal hysterectomy in benign diseases. *European Journal of Obstetrics, Gynecology and Reproductive Biology* 1990; 36:259–263.

34. Gitsch G, Berger E, Tatra G. Trends in thirty years of vaginal hysterectomy. *Surgery* 1991; 172:207–210.

35. Stovall TG, Ling FW, Henry LC et al. A randomized trial evaluating leuprolide acetate before hysterecomy as treatment for leiomyomas. *American Journal of Obstetrics and Gynecology* 1991; 164:1420–1423.

36. Grant JM. An audit of abdominal hysterectomy over a decade in a district hospital. *British Journal of Obstetrics and Gynaecology* 1984; 91:73–77.

37. Schofield MJ, Bennett A, Redman S et al. Self-reported long-term outcomes of hysterectomy. *British Journal of Obstetrics and Gynaecology* 1991; 98:1129–1136.

38. Taylor T, Smith AN, Fulton PM. Effect of hysterectomy on bowel function. *British Medical Journal* 1989; 299:300–301.

39. Dicker RC, Scally MJ, Greenspan JR et al. Hysterectomy among women of reproductive age: trends in the United States, 1970–1978. *Journal of the American Medical Association* 1982; 248:323–327.

40. Siddle N, Sarrel P, Whitehead M. The effect of hysterectomy on the age at ovarian failure: identification of a subgroup of women with premature loss of ovarian function and literature review. *Fertility and Sterility* 1987; 47:94–100.

41. Lalinec-Michard M, Engelsmann F. Cultural factors and reaction to hysterectomy. *Social Psychiatry and Psychiatric Epidemiology* 1989; 24:165–171.

42. Ryan MM, Dennerstein L, Pepperell R. Psychological aspects of hysterectomy: a prospective study. *British Journal of Psychiatry* 1989; 154:516–522.

43. Iles S, Gath D. Psychological problems and uterine bleeding. *Bailliere's Clinical Obstetrics and Gynaecology* 1989; 3:375–389.

44. Westphalen JB, Fraser S, Rea EE et al. Medical audit of hysterectomy in the Hunter area of New South Wales. *Australian Clinical Review* 1992; 12:125–129.

45. Vessey MP, Villard-Mackintosh L, McPherson K et al. The epidemiology of hysterectomy: findings in a large cohort study. *British Journal of Obstetrics and Gynaecology* 1992; 99:402–407.

46. Kjerulff K, Langenberg P, Guzinski G. The socioeconomic correlates of hysterectomies in the United States. *American Journal of Public Health* 1993; 83:106–108.

47. Stantow G, Bracher M. Correlates of hysterectomy in Australia. *Social Science in Medicine* 1992; 34:929–942.

48. Domenighetti G, Luraschi P, Casabianca A et al. Effect of information campaign by the mass media on hysterectomy rates. *Lancet* 1988; 1470–1473.

49. Gambone JC, Reiter RC, Lench JB et al. The impact of a quality assurance process on the freuency and confirmation rate of hysterectomy. *American Journal of Obstetrics and Gynecology* 1990; 163:545–550.

50. Benagiano G, Morini A, Primiero FM. Fibroids: overview of current and future treatment options. *British Journal of Obstetrics and Gynaecology* 1992; 99 suppl. 7:18–22.

51. Hutchins FL. Myomectomy after selective preoperative treatment with a gonadotropin releasing hormone analog. *Journal of Reproductive Medicine* 1992; 37:699–702.

52. Starks GC. CO_2 laser myomectomy in an infertile population. *Journal of Reproductive Medicine* 1988; 33:184–186.

53. Dankiw W, Hailey D, Angel A. *Lasers in medicine.* Australian Institute of Health and Welfare, Canberra 1993.

54. Candiani GB, Fedele L, Parazzini F et al. Risk of recurrence after myomectomy. *British Journal of Obstetrics and Gynaecology* 1991; 98:385–389.

55. Smith DC, Uhlir JK. Myomectomy as a reproductive procedure. *American Journal of Obstetrics and Gynecology* 1990; 162:1476–1482.

56. De Cherney A, Polan ML. Hysteroscopic management of intrauterine lesions and intractable uterine bleeding. *Obstetrics and Gynecology* 1983; 61:392–397.

57. Neuwirth RS, Hussein AR, Schiffman BM et al. Hysteroscopic resection of intrauterine scars using a new technique. *Obstetrics and Gynecology* 1982; 60:111–113.

58. Vancaillie TG. Electrocoaulation of the endometrium with the ball-end resectoscope. *Obstetrics and Gynecology* 1989; 74:425–427.

59. Magos AL, Baumann R, Lockwood GM et al. Experience with the first 250 endometrial resections for menorrhagia. *Lancet* 1991; 337:1074–1078.

60. Hallez J-P, Netter A, Cartier R. Methodical intrauterine resection. *American Journal of Obstetrics and Gynecology* 1987; 156:1080–1084.

61. Hill DJ, Maher PJ, Lloyd D. Endometrial ablation under local analgesia. *Australian and New Zealand Journal of Obstetrics and Gynaecology* 1992; 32:284–285.

62. Wood C. Indications for endometrial resection. *Medical Journal of Australia* 1992; 156:157–159.

63. Derman SG, Rehnstrom J, Neuwirth RS. The long-term effectiveness of hysteroscopic treatment of menorrhagia and leiomyomas. *Obstetrics and Gynecology* 1991; 77:591–594.

64. Gannon MJ, Holt EM, Fairbank J et al. A randomised trial comparing endometrial resection and abdominal hysterectomy for the treatment of menorrhagia. *British Medical Journal* 1991; 303:1362–1364.

65. Townsend DE, Richart RM, Paskowitz RA. `Rollerball' coagulation of the endometrium. *Obstetrics and Gynecology* 1990; 76:310–313.

66. Corson SL, Brooks PG. Resectoscopic myomectomy. *Fertility and Sterility* 1991; 55:1041–1044.

67. Goldrath MH, Fuller TA, Segal S. Laser photocoagulation of endometrium for the treatment of menorrhagia. *American Journal of Obstetrics and Gynecology* 1981; 140:14–19.

68. Loffer FD. Hysteroscopic endometrial ablation with the Nd:YAG laser using a nontouch technique. *Obstetrics and Gynecology* 1987; 69:679–682.

69. Goldfarb HA. A review of 35 endometrial ablations using the Nd:YAG laser for recurrent menometrorrhagia. *Obstetrics and Gynecology* 1990; 76:833–835.

70. Daniell J, Tosh R, Meisels S. Photodynamic ablation of the endometrium with the Nd:YAG laser hysteroscopically as a treatment of menorrhagia. *Colposcopy and Gynecologic Laser Surgery* 1986; 2:43–46.

71. Lomano JM. Dragging technique versus blanching technique for endometrial ablation with the Nd:YAG laser in the treatment of chronic menorrhagia. *American Journal of Obstetrics and Gynecology* 1988; 159:152–155.

72. Downing BG, Wood C. Intrauterine surgery—a new era. Australian & New Zealand Journal of Obstetrics and Gynecology 1991; 31:71–75.

73. Baggish MS, Baltoyannis P. New techniques for laser ablation of the endometrium in high-risk patients. *American Journal of Obstetrics and Gynecology* 1988; 159:287–292.

74. Gimpelson RJ. Hysteroscopic Nd:YAG laser ablation of the endometrium. *Journal of Reproductive Medicine* 1988; 33:872–876.

75. Davis JA. Hysteroscopic endometrial ablation with the neodymium-YAG laser. *British Journal of Obstetrics and Gynaecology* 1989; 96:928–932.

76. Lomano JM. Photocoagulation of the endometrium with the Nd:YAG laser for the treatment of menorrhagia: a report of ten cases. *Journal of Reproductive Medicine* 1986; 31:148–150.

77. Donnez J, Cerckx F, Gillerot S et al. Neodymium:YAG laser hysteroscopy in large submucous fibroids. *Fertility and Sterility* 1990; 54:999–1003.

78. Grainger DA, deCherney AH. Hysteroscopic management of uterine bleeding. *Bailliere's Clinical Obstetrics and Gynaecology* 89; 3:403–414.

79. Goldfarb HA. Nd:YAG laser laparoscopic coagulation of symptomatic myomas. *Journal of Reproductive Medicine* 1992; 37:636–638.

80. Garry R, Erian J, Grochmal SA. A multi-centre collaborative study into the treatment of menorrhagia by Nd-YAG laser ablation of the endometrium. *British Journal of Obstetrics and Gynecology* 1991; 98:357–362.

81. Phipps JH, Lewis BV, Prior MV et al. Experimental and clinical studies with radiofrequency-induced thermal endometrial ablation for functional menorrhagia. *Obstetrics and Gynecology* 1990; 76:876–881.

82. Phipps JH, Lewis BV, Roberts T et al. Treatment of functional menorrhagia by radiofrequency-induced thermal endometrial ablation. *Lancet* 1990; Feb. 17:374–376.

83. Bhatta N, Anderson RR, Flotte T et al. Endometrial ablation by means of photodynamic therapy with photofin II. *American Journal of Obstetrics and Gynecology* 1992; 167:1856–1863.

84. Perry CP, Daniell JF, Gimpelson RJ. Bowel injury from Nd:YAG endometrial ablation. *Journal of Gynecologic Surgery* 1990; 6:199–203.

85. Loffer FD. Removal of large symptomatic intrauterine growths by the hysteroscopic resectoscope. *Obstetrics and Gynecology* 1990; 76:836–840.

86. Sullivan B, Kenney P, Seibel M. Hysteroscopic resection of fibroid with thermal injury to sigmoid. *Obstetrics and Gynecology* 1992; 80:546–547.

87. Maher PJ, Hill DJ. Transcervical endometrial resection for abnormal uterine bleeding—report of 100 cases and review of the literature. *Australian & New Zealand Journal of Obstetrics and Gynaecology* 1990; 30:357–360.

88. Pyper RJD, Haeri AD. A review of 80 endometrial resections for menorrhagia. *British Journal of Obstetrics and Gynaecology* 1991; 98:1049–1054.

89. Petrucco OM, Gillespie A. The neodymium:YAG laser and the resectoscope for the treatment of menorrhagia. *Medical Journal of Australia* 1991; 154:518–520.

90. Lewis BV. Endometrial ablation. *British Journal of Hospital Medicine* 1992; 47:192–196.

91. Kivnick S, Kanter MH. Bowel injury from rollerball ablation of the endometrium. *Obstetrics and Gynecology* 1992; 79:833–835.

92. McLucas B. Intrauterine applications of the resectoscope. Surgery, *Gynecology and Obstetrics* 1991; 172:425–431.

93. Feinberg BI, Gimpelson RJ, Godier DE. Pulmonary edema after photocoagulation of the endometrium with the Nd:YAG laser: a case report. *Journal of Reproductive Medicine* 1989; 34:431–434.

94. Bent AE, Ostergard DR. Endometrial ablation with the Neodynium:Yag laser. *Obstetrics and Gynecology* 1990; 75:923–925.

95. Ke RW, Taylor PJ. Endometrial ablation to control excessive uterine bleeding. *Human Reproduction* 1991; 6:574–580.

96. Hill DJ, Maher PJ, Davidson GB et al. Haematometra—a complication of endometrial ablation. *Australian and New Zealand Journal of Obstetrics and Gynaecology* 1992; 32:285–286.

97. Lefler HT Jr, Lefler CF. Ablation of the endometrium: three-year follow-up for perimenstrual symptoms. *Journal of Reproductive Medicine* 1992; 37:147–150.

98. Fraser IS, Angsuwathana S, Mahmoud F et al. Short and medium term outcomes after rollerball endometrial ablation for menorrhagia. *Medical Journal of Australia* 1993; 158:454–457.

99. Gimpelson RJ, Kaigh J. Endometrial ablation repeat procedures: case studies. *Journal of Reproductive Medicine* 1992; 37:629–635.

100. Hill DJ, Maher PJ. Pregnancy following endometrial ablation. *Gynaecological Endoscopy* 1992; 1:47–49.

101. Royal Australian College of Obstetricians and Gynaecologists. Guidelines for endometrial ablation. RACOG *Bulletin* 1992; Sep.:25–26.

102. Slade RJ, Ahmed AIH, Gillmer MDG. Problems with endometrial resection [letter]. *Lancet* 1991; 337:1473.

103. Prior MV, Phipps JH, Roberts T et al. Treatment of menorrhagia by radiofrequency heating. *International Journal of Hyperthermia* 1991; 7:213–220.

104. Brooks PG, Loffer FD, Serden SP. Resectoscopic removal of symptomatic intrauterine lesions. *Journal of Reproductive Medicine* 1989; 34:435–437.

105. Erian MM, McLaren GR. Modern surgical alternatives to hysterectomy: what is their role? *Patient Management* 1992; July:57–60.

106. D'Addato F, Repinto A, Andreoli C. Pre-surgical treatment of uterine myomas with LH-RH agonists. *Clinical Experiments in Obstetrics and Gynecology* 1992; 19:45–50.

107. Gimpelson RJ, Kaigh J. Mechanical preparation of the endometrium prior to endometrial ablation. *Journal of Reproductive Medicine* 1992; 37:691–694.

108. Mathers C, Harvey R. *Hospital utilisation and costs study, volume 2: survey of public hospitals and related data*. Australian Institute of Health, Canberra, 1988.

109. Alexander JI, Hull MGR. Abdominal pain after laparoscopy: the value of a gas drain. *British Journal of Obstetrics and Gynaecology* 1987; 94:267–269.

110. Dubuisson JB, Mandelbrot L, Lecuru F et al. Myomectomy by laparoscopy: a preliminary report of 43 cases. *Fertility and Sterility* 1991; 56:827–830.

111. Nezhat C, Nezhat F, Silfer SL et al. Laparoscopic myomectomy. *International Journal of Fertility* 1991; 36:275–280.

112. Daniell JF, Gurley LD. Laparoscopic treatment of clinically significant symptomatic uterine fibroids. *Journal of Gynecologic Surgery* 1991; 7:37–40.

113. Harris WJ. Uterine dehiscence following laparoscopic myomectomy. *Obstetrics and Gynecology* 1992; 80:545–546.

114. Altchek A. Management of fibroids. *Current Opinion in Obstetrics and Gynecology* 1992; 4:463–471.

115. Minelli L, Angiolillo M, Caione C et al. Laparoscopically-assisted vaginal hysterectomy. *Endoscopy* 1991; 23:64–66.

116. Maher PJ, Wood EC, Hill DJ et al. Laparoscopically assisted hysterectomy. *Medical Journal of Australia* 1992; 156:316–318.

117. Reich H, DeCaprio J, McGlynn F. Laparoscopic hysterectomy. *Journal of Gynecologic Surgery* 1989; 5:213–216.

118. Nezhat C, Nezhat F, Silfen SL. Laparoscopic hysterectomy and bilateral salpingo-oophorectomy using Multifire GIA surgical stapler. *Journal of Gynecologic Surgery* 1990; 6:287–288.

119. Pelosi MA, Pelosi MA III. Laparoscopic hysterectomy with bilateral salpingo-oophorectomy using a single umbilical puncture. *New Jersey Medicine* 1991; 88:721–726.

120. Nezhat CR, Burrell MO, Nezhat FR et al. Laparoscopic radical hysterectomy with paraaortic and pelvic node dissection. *American Journal of Obstetrics and Gynecology* 1992; 166:864–865.

121. Liu CY. Laparoscopic hysterectomy: a review of 72 cases. *Journal of Reproductive Medicine* 1992; 37:351–354.

122. First laparoscopic radical vaginal hysterectomy performed. *Oncology* (Williston Park) 1992; 6:62.

123. Fernandez H, Lelaidier C, Frydman R. Laparoscopically assisted vaginal hysterectomy [letter]. *Lancet* 1992; 339:123.

124. Wood C, Maher P, Hill D et al. Hysterectomy: a time of change. *Medical Journal of Australia* 1992; 157:651–653.

125. Summitt RL, Stovall TG, Lipscomb GH et al. Randomized comparison of laparoscopy-assisted vaginal hysterectomy with standard vaginal hysterectomy in an outpatient setting. *Obstetrics and Gynecology* 1992; 80:895–901.

126. Filshie GM. Laparoscopic female sterilization. *Bailliere's Clinical Obstetrics and Gynaecology* 1989; 3:609–624.

127. Peterson HB, Hulka JF, Phillips JM. American Association of Gynecologic Laparoscopists' 1988 Membership Survey on Operative Laparoscopy. *Journal of Reproductive Medicine* 1990; 35:587–589.

128. Riedel H-H, Lehmann-Willenbrock E, Mecke H et al. The frequency distribution of various pelviscopic (laparoscopic) operations, including complications rates—statistics of the Federal Republic of Germany in the years 1983–1985. *Zentralblatt fur Gynakologie* 1989; 111:78–91.

129. Gordon AG, Magos AL. The development of laparoscopic surgery. *Bailliere's Clinical Obstetrics and Gynaecology* 1989; 3:429–449.

130. Hirsch NA, Hailey DM. *Minimal access surgery.* Australian Institute of Health, 1992, Canberra.

131. Woodland MB. Ureter injury during laparoscopy-assisted vaginal hysterectomy with the endoscopic linear stapler. *American Journal of Obstetrics and Gynecology* 1992; 167:756–757.

132. Yuzpe AA. Pneumoperitoneum needle and trocar injuries in laparoscopy: a survey on possible contributing factors and prevention. *Journal of Reproductive Medicine* 1990; 35:485–490.

133. Sculpher MJ, Bryan S, Dwyer N et al. An economic evaluation of transcervical endometrial resection versus abdominal hysterectomy for the treatment of menorrhagia. *British Journal of Obstetrics and Gynaecology* (in press).

134. Baggish MS. The most expensive hysterectomy. *Journal of Gynecologic Surgery* 1992; 57–58.

135. De Wit A. Hysteroscopy: an evolving case of minimally invasive therapy in gynaecology. *Health Policy* 1993; 23:113–124.

136. Daniell JF, Kurtz BR, Ke RW. Hysteroscopic endometrial ablation using the rollerball electrode. *Obstetrics and Gynecology* 1992; 80:329–332.

137. Hill D, Maher P. Treatment of menorrhagia by endometrial ablation. *Medical Journal of Australia* 1990; 152:564–565.

138. Boto TCA, Fowler CG. Surgical alternatives to hysterectomy for intractable menorrhagia. *British Journal of Hospital Medicine* 1990; 44:93–99.

139. Hailey DM, Hirsch NA. Laparoscopic surgery: some unresolved issues. *Medical Journal of Australia* 1992; 157:581–582.

140. Mackay EV, Beischer NA, Cox LW et al. *Illustrated textbook of gynaecology.* WB Saunders Co., Sydney, 1983.

141. Long CA, Gast MJ. Menorrhagia. *Obstetrics and Gynecology Clinics of North America* 1990; 17:343–359

142. DeCherney AH, Diamond MP, Lavy G et al. Endometrial ablation for intractable uterine bleeding: hysteroscopic resection. *Obstetrics and Gynecology* 1987; 70:668–670.

143. Serden SP, Brooks PG. Treatment of abnormal uterine bleeding with the gynecologic resectoscope. *Journal of Reproductive Medicine* 1991; 36:697–699.

144. Neuwirth RS. Hysteroscopic management of submucous fibroids. *Obstetrics and Gynecology* 1993; 62:509–511.

145. Rankin L, Steinberg LH. Transcervical resection of the endometrium: a review of 400 consectuive patients. *British Journal of Obstetrics and Gynaecology* 1992; 99:911–914.

146. McLucas B. Endometrial ablation with the roller ball electrode. *Journal of Reproductive Medicine* 1990; 35:1055–1058.

147. Indman PD. High-power Nd:YAG laser ablation of the endometrium. *Journal of Reproductive Medicine* 1991; 36:501–504.

148. Goldrath MH. Hysteroscopic laser surgery. In *Basic and advanced surgery in gynecology* (ed. MS Baggish). Appleton-Century-Crofts, Norwalk, 1985.

149. Donnez J, Nisolle M. Hysteroscopic surgery. *Current Opinion in Obstetrics and Gynecology* 1992; 4:439–446.

150. Phipps JH, Smith T, Dymek P et al. Validation of a method of treating menorrhagia by endometrial ablation. *Clinical Physiology and Physiological Measurement* 1992; 13:273–280.

151. Serden SP, Brooks PG. Preoperative therapy in preparation for endometrial ablation. *Journal of Reproductive Medicine* 1992; 37:679–681.

152. Goldrath MH. Use of danazol in hysteroscopic surgery for menorrhagia. *Journal of Reproductive Medicine* 1990; 35 suppl.:91–96.

153. Department of Health, Housing and Community Services. *Medicare Benefits Schedule book: operating from 1 November 1992*. AGPS, Canberra.

154. *Health expenditure bulletin no. 8*. Australian Institute of Health and Welfare, Canberra, April 1993.

155. Gillet S, Solon R. *Hospital utilisation and costs study 1989–90: volume 1, a survey of public hospitals and related data*. Australian Institute of Health and Welfare, Health Services series, no. 3, AGPS, Canberra, 1992.

Acknowledgments

The Institute is grateful for the advice and comments from the following:
Health Insurance Commission, Canberra
NSW Department of Health
Health Department, Victoria
South Australian Health Commission
NT Department of Health and Community Services
ACT Board of Health
Dr BG Cutter, John James Medical Centre, Canberra
Professor IS Fraser, University of Sydney
Professor D Healey, Monash Medical Centre, Melbourne
Dr DJ Hill, Glen Waverley, Melbourne
Dr OM Petrucco, University of Adelaide
AutoSuture Co. Australia, Adelaide
Mr M Swan, Endovision Pty Ltd, Melbourne
ICI Australia Hospital Products Pty Ltd, Sydney
Mr S Heald, Johnson and Johnson Medical Pty Ltd, Sydney
Ms G Pitts, N Stenning and Co., Sydney
Mr N Pears, Promedica Pty Ltd, Sydney
Mr P Cochrane, Selby Scientific and Medical Pty Ltd, Melbourne
Ms J van der Helm, Selby Scientific and Medical Pty Ltd, Melbourne
Mr L Devant, Valleylab (Australia) Pty Ltd, Sydney
Mr G Taddeo, William A Cook Australia Pty Ltd, Brisbane
Royal Australian College of Obstetricians and Gynaecologists