

The procedure has a low risk of adverse effects

Complications of Operative Hysteroscopy

Bruno J van Herendael

Professor Em Endoscopic Surgery Università degli Studi dell'Insubria Varese
Italy

Consultant Endoscopic Surgery Ziekenhuis Netwerk Antwerpen

Introduction

Operative hysteroscopy is a valuable tool in the treatment of non-malignant conditions of the uterine cavity. As technology progresses some of the complications occur less frequently when small barrel hysteroscopes are used, both in operative out patient procedures and when small barrel resectoscopes are used. The procedure in general has a low risk of adverse effects with an incidence of 0,28% in 13,600 procedures (1). A German study including 21,676 operative procedures found an incidence of 0,24 (2) Indications for endoscopic surgery become wider therefore safety protocols become more important in the prevention of complications. This is particularly important as most complications do occur during the learning curve of the surgeons mastering the technique and in specific procedures i.e. hysteroscopic myomectomy, where the risk of complications can be as high as 10% (3). It is advisable that a surgeon embarking in hysteroscopic surgery should have performed at least 250 diagnostic hysteroscopies. The recommendation is also for hysteroscopic surgery to be graded according to the difficulty. There are different classifications. The author works with the classification issued by the Accreditation Taskforce of the International Society for Gynecologic Endoscopy (ISGE) (Tab 1). It is also advisable to use abdominal ultrasound over a full bladder – liquid covering the uterine fundus – to guide the operator in difficult cases, as there are myomectomy, adenomyosis, uterine septa –to preserve enough fundal myometrium – and severe adhesions. (van Herendael B. personal communication FIGO 2012 Rome). This has two advantages first the uterus is stretched in its longitudinal axis and second the instruments are

visible in the uterine cavity whilst the direction and the thickness of the myometrium can objectively be measured during the intervention.

Complications of Hysteroscopic Surgery

Dilatation of the Cervix

The cervix can be lacerated by the tenaculum used to stabilize the cervix during dilatation. An amount of force is needed to pass the dilators through the cervical canal. The recommendation is always to use two tenacula one at three and one at nine o'clock. To use a 27 Charrière instrument the cervical canal has to be dilated up to Hegar ten at least ten and a half is even better. It is therefore advisable to use *half Hegar's* progressively starting at four up to ten and a half. A certain amount of patience is necessary. Some mechanical dilators, as there are the Pratt dilator, seems to cause fewer traumas.

Pharmacological and mechanical dilators – left in place – are useful to overcome these problems in stenotic cervixes. Laminaria stents are hygroscopic and distend over a few hours by absorption of fluid. There is evidence that the mechanical dilatation is superior for dilatation of the cervix. The problem is that these tend to swell beyond the inner cervix as these have no memory of swelling and hence become difficult remove without trauma. It is advisable to use stents with a memory, as there are Lamicel® (Cabot Medical Corporation, Boston, MA, USA). Here a polyvinyl core is impregnated with less than 500 mg of sodium phosphate (4).

The alternative method is pharmacological dilatation historically using natural prostaglandins i.e. dinoprostone and at this moment synthetic prostaglandin analogues. Historically Sulprostone, the synthetic derivate of prostaglandin E₂, has been used it is more effective at a lower dosage than prostaglandin F₂ α. Its maximum effect is reached within one hour. The administration is by vaginal route by vaginal suppositories, but most women prefer the oral administration – (5). The drug softens the cervix and the effect is enhanced by the contractions it provokes in the myometrium. Doses of 125 – 250 mg given one to two hours before surgery produce cervical dilatation in 80% of the women. Side effects are rare but include nausea, vomiting,

hypertension and hypotension and an occasional cutaneous rash. Recently misoprostol, a prostaglandin analogue, has become the drug of choice with a dosage of 400 µg in vaginal suppositories 12 hrs. before surgery adding vaginal 25 µg estradiol a day for 14 days even does reduce postoperative discomfort in postmenopausal women (6).

As about 50% of complications (Cervical tears, creation of false passage, perforation, bleeding or simply difficulty in entering the internal os) in operative hysteroscopy are related to difficulty with cervical entry it is worthwhile to consider this first step very carefully. There is moderate quality evidence that adding misoprostol to the preoperative ripening scheme is associated with less intraoperative complications (7).

Hazards of Distension Media

Historically carbon dioxide gas (CO₂) has been used also for operative hysteroscopy.

Complication of CO₂ and other gasses

CO₂ is a soluble gas at body temperature 57 ml of CO₂ are absorbed in 100 ml of blood (Lindemann 1972 8). There are no changes in P_{CO2}, P_{O2} or PH if 100 ml of CO₂ are infused into the bloodstream per minute. If 1000 ml are infused per minute an irreversible cardiac shock occurs due to acute CO₂ intoxication of the heart muscle fibres. The flow should therefore never exceed 80 ml per minute and the insufflation pressure should never exceed 200 mm Hg.

The physical properties of CO₂ are that the gas creates bubbles in the bloodstream but also in the mucus of the endocervical canal. The latter makes that its use in operative hysteroscopy or when the patient is bleeding can no longer be recommended as the operating time, compared to fluid distension media, becomes too long, patients discomfort, after the intervention, increases and hence also patients satisfaction (9)

Air and other gasses must never be used to create uterine cavity distension. An air embolism can occur from 30 ml of environmental air in the bloodstream. Baggish and Daniell (1989) (10) reported five fatal cases in instances where room air accidentally had been used to cool the sapphire tips of ND:YAG laser fibres. Fatal accidents have been reported concerning both tubal persufflation and hysteroscopy.

Anaesthesiologists are increasingly worried about so-called CO₂ emboli. Phil Brooks (11) reported that at least three of the incidents have been related to the absorption of room air, confirmed by gas analysis from blood obtained by cardiac puncture. A more recent survey included 12 cases with a mortality rate of nearly 50% (12). This is the reason why at dilatation the last Hegar has to remain in the cervical canal until the vagina is filled with distension fluid. Mechanical dilatation can lacerate vessels in the cervical canal and by removing the Hegar during the time to set up the operative hysteroscopy the negative aspiration of the heart can cause room air to enter the circulation. This consideration is also one of the reasons to operate the patients in slight anti Trendelenburg position as to counter this negative aspiration. It is also recommended to minimize bringing instruments in and out through the cervical canal.

Complications of Liquid Distension Media

The liquid distension media are intravasated into the uterine vessels due to the distension pressure especially when these are transected during resection especially in myoma surgery. The trans tubal intra-abdominal spillage is less important. During concomitant laparoscopy peritoneal spillage is observed but aspiration of the latter does not prevent fluid related complications.

Nonelectrolytic fluids

As most small barrel resectoscopes and the older generation of large barrel resectoscopes still use uni-polar electrical energy nonelectrolytic solutions still have to be used. Here the electrons need to travel from the active electrode incorporated in the scoop to the neutral electrode through the body of the patient. This process needs a nonelectrolytic solution.

High Viscosity fluids

Dextran 70, 32% in 10 % Dextrose (Hyskon) has excellent optical properties and does not conduct electricity. The metabolism of intra-vascular dextran is dependent on its molecular weight. Dextrans of a molecular weight of less than 50000 are filtered through the kidney. Larger molecules are metabolized in the reticuloendothelial system. The main danger is an immediate reaction leading to an anaphylactic shock due to sensitization resulting from oral exposure to sugar beets and cross-reactivity with bacterial agents such as streptococci, pneumococci and salmonella. The incidence is rare 1 in 1,500 – 1 in 300,00 (Leake 1987 13-14). The so-called dextran induced anaphylactic reaction (DIAR) is not predictable and does not depend on the amount administered. Skin testing cannot prevent DIAR (Witz 1993 15). High molecular weight dextran is limited to the intravascular space. Their metabolism is slow so they increase the oncotic pressure significantly. Each gram of dextran 70 can draw 20-27 ml of water into the circulation.

Management consists of treatment of the fluid overload and the pulmonary edema. The treatment consists of respiratory support and diuresis. The increase of the oncotic pressure has to be treated. Because of the molecular weight of over 50 000 dialysis is not effective. Epinephrine (intra tracheal and intravenous) combined with hydrocortisone may be necessary. In certain cases administration of antihistamines is to be considered. Treatment is to be coordinate by the anaesthetist resuscitator.

Other side effects of Dextran

Dextran is associated with coagulation disorders. Disseminated intravascular coagulation has been associated with operative hysteroscopic use of dextran.

A significant prolongation of the clotting time and prothrombin action and a decrease in fibrinogen levels, platelets, hematocrit and factors II, V, VII and VIII were observed following the infusion of high molecular dextran.

Dextran is also very sticky. The product sticks to the scope and the instruments and these have to be rinsed and cleaned immediately after the operation otherwise the scope and instruments will no longer be of use.

Low- Viscosity Fluids

'Post – TURP' syndrome consist of a variety of symptoms due to the absorption of large quantities of distension media. Patients, with this syndrome, present with bradycardia and hypertension, followed by hypotension, nausea, vomiting, headache, visual disturbances, agitation, confusion and lethargy. These are the result of hypervolemia, dilutional hyponatremia – in fact all anions– and decreased osmolarity. These have to be treated by the anaesthetist resuscitator before collapse occurs preferably starting during the operative procedure. If left untreated the syndrome may result in seizures, coma, cardiovascular collapse and death.

Glycine 1,5%

Glycine is a non-essential, simple amino acid present in the human circulation. If mixed with water in a 1,5% solution this solution gives poor electrical conductivity and good visibility, provided a through flow scope is used (Bauman 1990 16).

If large amounts enter into the circulation water intoxication is the result. These large amounts of solution create hypervolemia and hyponatremia. Glycine undergoes an oxidative deamination in the liver and the kidneys to form ammonia and glyoxylic acid.

A hyper concentration of ammonia in the brain does alter the neural amino acid metabolism. The result is the production of false inhibitory

neurotransmitters; in the retina and in the ganglion and horizontal cells which create visual disturbances.

Glyoxylic acid metabolizes to oxalate its metabolic end product, contra indicated in renal failure because it forms crystals in the urine.

Glycine 1,5 solution in an iso-osmotic concentration can induce hemodilution and expansion of the extracellular volume this process causes decrease of the serum sodium. Jacques Donnez (personal communication) reported a loss of 1300 ml in the circulation without adverse effects. *The fluid input should always be actively monitored, with a pump system, during operative hysteroscopy and the intervention should stop when the deficit reaches 1,500 ml.*

The distension fluid gets in the vascular space mainly when large uterine vessels are transected. Hypervolemia decreases the serum sodium. Serum sodium at it associated anions account for the majority of the plasma osmolarity. When serum sodium drops the serum osmolarity drops. Initially the osmotic activity of the glycine molecules will help to maintain serum osmolarity. After some time – glycine's half –life is 85 min – glycine will disappear from the circulation to be absorbed in cells. The result is free water. When this free water is not rapidly eliminated this condition results in hypo-osmolar hyponatremia. Operative stress results in the release of antidiuretic hormone. This process delays the diuresis. The danger is for the hypervolemia to cause irreversible brain damage. The rapid increase of free water causes a decreased osmolarity causing a movement of water into the brain causing cerebral edema. The brain swells and may be injured by the compression against the bony skull. The swelling can cause intra cranial pressure leading to decreased blood flow and hypoxia. The increase of 5% of the brain volume may lead to herniation whilst an increase of 10 % is incompatible with life.

Hyponatremia can be an independent factor causing functional disturbances as sodium influences cardiac and skeletal muscle, nerve impulses, membrane potentials and membrane permeability.

The treatment is based on the removal of the excess fluid and the correction of the anion levels in particular that of sodium. Waiting for spontaneous evolution is not sufficient as these patients with severe hyponatremia – the

easiest to measure parameter – deteriorate rapidly. The treatment has to start immediately the moment the diagnosis is made, preferably when the operation is still on going. To rapid a correction however carries the risk of demyelisation of nerves in the pontine region of the brain called Central Pontine Myelinolysis (CPM).

Treatment consists of intravenous saline infusion and forced diuresis. The drug of choice is furosemide at a dosage of 20 mg intravenous to initiate the diuresis. Serum electrolytes have to be monitored until back to normal with a frequency of once every hour.

Mannitol and Sorbitol

Both are six-carbon alditol isomers.

Sorbitol leaves the circulation and is metabolized in the liver to fructose and glucose. The product should not be used in severe diabetic patients.

Mannitol is inert. A small quantity of absorbed Mannitol – 6-10 % - is metabolized. 90-94 % is filtered by the kidney and excreted in the urine unchanged. The half-life in plasma of Mannitol is 15 min it can therefore be used as an osmotic diuretic hence reducing the risk of hypervolemia.

Large amounts in the circulation may cause nausea, vomiting, headache and finally hyponatremia. As Mannitol is a diuretic the product should not be used in patients with renal failure.

The only known severe complication is fluid overload and water intoxication. The mechanism and treatment are described above.

Electrolytic Fluids

With the appearance of the bi-polar tools both in small barrel and large barrel scopes the same low-viscosity fluids as for diagnostic hysteroscopy can be used for operative hysteroscopy as the electrons have to travel between the two electrodes incorporated in the same scoop. This process needs an ionic, electrolytic solution. Most used are normal saline and Ringer's lactate. Here more fluid can be absorbed as the physiologic osmolarity of these solutions

prevents hyponatremia and hypo-osmolarity. However excessive intravasation of electrolytic fluids will eventually also lead to hyponatremia! With the use of electrolytic fluids the treatment is less difficult and the fluid overload is less dangerous than with nonelectrolytic fluids (AAGL 2013 17) *Surgery should be stopped at a measured loss of 2.500 ml*

Other Complications

Perioperative Complications

Complications related to the patient positioning

The necessary lithotomy position in itself can cause nerve trauma, a direct trauma and acute compartment syndrome (18)

Extreme angulation of the femoral nerve due to the combination of excessive hip flexion, abduction and external hip rotation can cause femoral neuropathy as the nerve gets compressed and damaged. In most cases this injury resolves spontaneously but recovery may take several months. The sciatic notch is located at the level of the neck of the fibula. Here sciatic nerve and peroneal nerves are fixed. When the hip is flexed excessively with straight knees or when a stirrup is fitted too tightly to the fibula nerve damage can occur revealed by a drop foot or paresthesia over the lateral lower extremity.

The acute compartment syndrome occurs when increased pressure in the muscle of an osteofacial compartment compromises local vascular perfusion causing ischemia. The period of ischemia is followed by reperfusion, capillary leakage within the ischemic tissue, and a further increase of edema leading to neuromuscular compromise. This causes rhabdomyolysis and possible serious sequellae including permanent disability (19)

Complications related to instrumentation

Perforation

It is an accepted fact that perforations do occur when dilators and curettes are used. Incidence of perforation varies between 4 to 13 % as reported in literature (20). The same can happen when a hysteroscope is used. Therapy is seldom necessary. If energy is used through a perforation a laparoscopy is mandatory to assess the damages and eventually repair the same. If a perforation occurs the patient should be carefully observed during several hours. A rising pulse and a falling blood pressure indicate a complication. Here also a laparoscopy is mandatory and if necessary a laparotomy to treat the complication. To avoid perforations with the resectoscopes a passive resectoscope should be used allowing passage of the cervix into the uterine cavity under direct vision (21).

Instrumental injuries

The more sophisticated the instrument the more the surgeon has to know about its physical properties.

Cold Loops

Cold loops mounted in a resectoscope do enable the surgeon to convert myoma's grade 2 to myoma's grade 1 enabling one-step myomectomy with speedy recovering of the myometrial lining at follow-up office hysteroscopy (22).

Mechanical Morcellator

Mechanical morcellators can be used in operative hysteroscopy. The main complication is mechanical perforation. The device should never be activated outside the uterine cavity. A clear exposure by adequate expansion of the uterine cavity is mandatory when using the device (23).

Electrical Instruments

If the instrument or the heat generated by the instrument diffuses beyond the uterus-overlying bowel can be damaged. Patients undergoing hysteroscopic surgery have to get better by the half hour after the surgery. If a patient complains of increasing abdominal discomfort or pain a laparoscopy should be performed to estimate the problem. When bowel is damaged the damage has to be repaired, a drain let in place and the patient has to remain in observation to exclude peritonitis.

When a perforation does occur the operation has to be stopped immediately mainly because the fluid intravasation increase with 25% at the moment of the perforation.

Fluid collections in the broad ligament due to a perforation in treating extensive adhesions or large myoma should be left undisturbed until these disappear – this process can take some weeks. Laparoscopic drainage should be considered only when the patient complains of pressure in the iliac fossa or of persistent fever.

Mono Polar devices

Mono polar loops should never be activated when there is no distension of the uterine cavity or when the visibility is bad. The risk of perforation in these circumstances is too important. As the energy requires non-electrolytic distension fluids the risks of fluid overload are increased. A pump system should always be used and intra-operative fluid balance is a must. In treating myoma's grade 2 there is evidence that more procedures have to be done as

two-step procedure because of electrolyte disturbances when working over 30 minutes in myoma's larger than 37,5 mm (24).

Uncommon but problematic sequelae from the use of mono polar resectoscopes are thermal injuries to the vagina and the vulva. To avoid these the scope should always be checked on proper working conditions (25).

Bi Polar Devices

Seem safer that mono polar but the surgeon has to be aware of the fact that exactly the same electrical current is used. Precautions at perforation are the same. The electrolytic solution will mask the symptoms of fluid overload if too much fluid is lost into the patient this means that also in case of use of bipolar devices a strict fluid balance has to be kept during the procedure. A pump system to evaluate in and outs is a must if complicated procedures of more than 30 minutes are performed. Bipolar instruments generate more bubbles due to the return of the electrodes to the return plate incorporated in the same scope (26).

One more pitfall is the tissue penetration of the electrical energy, both monopolar and bipolar, in the tissues. The myometrium is not a homogenous layer. When Adenomyosis crypts infiltrate the myometrium these facilitate the conduction of electricity far deeper than expected. In an unpublished prospective study (Bruno van Herendael, Marianne Stevens and Bettocchi Stefano) of seventy patients over five years after endometrial resection using monopolar electro surgery with a follow-up at three, six, nine and twelve months with hysteroscopy and ultrasound we were able to demonstrate lesions, on ultrasound, up to three mm from the serosa. The hysteroscopic evidence of stabilization of the scar tissue occurs only after nine months, thus explaining the delay in the occurrence of some complications.

Bleeding

The second most common complication during and after hysteroscopic procedures is bleeding. The incidence lies around 2,5 per 1000 procedures

and remains higher with the resection of myoma, especially these with an intramural component (2-3%) (27). Electrocoagulation with the wire loop or roller ball or barrel can stop the bleeding. It is recommended to lower the distension pressure at the end of the procedure to reveal occult bleeding. To stop troublesome bleeding at the end of a procedure a Foley catheter can be inserted into the uterine cavity and filled with 20-30 ml of saline. This procedure is extremely painful for the patient. The catheter can be removed within 2 -24 hours (28). If this treatment fails diluted vasopressin (20 U in 20ml normal saline) can be injected in the cervix to stop bleeding of the lower segment. Misoprostol can be added. If all these treatments fail uterine artery embolization or even hysterectomy have to be considered (29).

Infection

Endometritis following operative hysteroscopy is an extremely rare complication 0,01% to 1,42% except in the removal of IUCD's in postmenopausal patients (Munro 2010) except in the latter routine antibiotic prophylaxis is not recommended for the general population (30). Level B recommendation. If patients present with a history of Pelvic Inflammatory Disease (PID) the use of prophylactic antibiotics may be considered by ACOG and the Society of Obstetricians and Gynecologists of Canada Level C recommendation.

Late Complications

Intrauterine adhesions

Postoperative adhesion formation is a problem in women of reproductive age seeking further pregnancies. One RCT on the effectiveness of preoperative treatment claims that the incidence of postoperative adhesions is of 3,6% after polyp removal, 6,7 after resection of uterine septa, 31,3% after removal of a single fibroid and 45,5 % after resection of multiple fibroids (31). When little

endometrium or small patches of endometrium remain after extensive lysis of adhesion the risk of reformation of adhesive bands is extremely likely.

Haematometra

Haematometra is a very unlikely complication and occurs only when the resection encloses the isthmus of the uterus causing occluding adhesions its incidence is 1-2% (32).

Most cases can be treated with dilatation of the cervical canal except for strong adhesions in the cornu. These need a repeat operative procedure. When endometrial patches remain in the cornu these can create a post ablation tubal sterilization syndrome with symptoms of uni lateral, bilateral cramping cyclic pelvic pains and vaginal spotting.

Unplanned Pregnancy

An unplanned pregnancy may occur after hysteroscopic sterilization although the modern methods are very uncommon with the newer generation devices. Unplanned pregnancy may occur in post endometrial ablation patients. In 2002 Cook et al reported 43 pregnancies and 17 over 20 weeks gestation (33). In 2005 Hare et al reviewing the literature did find 70 reported pregnancies of which 31 viable with 12.9% perinatal mortality , a degree of 42% of prematurity, morbidly adherent placenta in 26% and a 17 % of Caesarean Sections for 31% of malpresentations (34). The conclusion is that pregnancies after operative hysteroscopy have to be treated as high-risk pregnancies

Dissemination of cancer cells

Recently a systematic review and meta-analysis did demonstrate a significant higher occurrence of malignant peritoneal cytology following hysteroscopy versus no hysteroscopy performed in women where the diagnosis of endometrial carcinoma had been made. (Odds ratio (OR) 1,8 at 95% confidence interval (CI) 1.1 -2.8 $P = 0.013$, 9 studies, 1015 women). There was an higher rate of disease upstaging compared with no hysteroscopy (OR 2.6,

95% CI 1.5- 4.6, $P = 0.001$, 9 studies, 1015 women). When normal saline is used there is an increase in the rate of malignant peritoneal cytology (OR 2.9, 95 % 1.5-5.6, $P = 0.002$, 9 studies, 1015 women) The increase of the appearance of malignant cells in the peritoneal fluid does not seem to increase with increasing intra uterine pressure up to 100 mm HG (OR 3.2, 95% CI 0.94- 11, $P = 0.06$) (35).

On the other hand from earlier studies it has been proven that there is not only the tubal passage and hence the intrauterine pressure to be aware of but also other passageways for cancer cells as in some patients with previous blockage of the tubes cancer cells have been found in the peritoneal fluid (36).

Anaesthesia

The main problems are anxiety, vasovagal reaction and pain. The patient is anxious when she walks into the examining room. It is the surgeon who will have to decide what patient is suitable for hysteroscopy without or with anaesthesia. The surgeon should have the knowledge of the possible complications and should be able to treat these on the spot. If more advanced procedures are tackled, the necessary monitoring equipment should be available (37).

Local anaesthesia complications are very rare if the indicated maximum dosages are respected (Tab. 2).

There are three main complications:

1. The inhibiting effect on the conductive system of the heart can result in arrhythmia, followed by hypotension and cardiac arrest.
2. Drowsiness, respiratory arrest, epileptic convulsions and collapse followed by cardiac arrest.
3. Allergic reactions (mostly due to the stabilizers used). The first two are related to rapid absorption, allergic reactions are independent from the dosage.

It is important to know what has caused the complications. Allergic reactions can be treated with adrenaline 0.5 mg IMI stat. Other problems with assisted ventilation 4-6 lit oxygen per minute and atropine 0.5 -1.0 ml IV (of a 1:1000 solution) and respiratory and cardiac resuscitation.

General anaesthesia

The anaesthetist should be familiar with operative hysteroscopy. The fact that fluid will be infused into the patient because of the uterine dilatation does mean that this patient should not be hydrated IV before the surgery.

As fluid overload can appear within a few minutes it is mandatory that patients undergoing operative hysteroscopy should be intubated or at least have an endotracheal mask (AAGL 2013)

Operative phase

There is evidence that injecting diluted vasopressin into the cervix immediately prior to the operative hysteroscopy does decrease the incidence of serious fluid intravasation (Evidence level A) (38). However large systemic doses of vasopressin result in cardiovascular collapse, myocardial infarction and death. Therefore the AAGL guidelines do not recommend using vasopressin in concentrations that exceed 0.4 U/ml

During the procedure it is recommended to maintain the intrauterine pressure at the lowest level possible and always below the systolic blood pressure (AAGL 2013)

Post Operative Phase

If serious complications occur it is mandatory for the patient to be monitored in an intensive care unit under the surveillance of a team with adequate knowledge of the pathophysiology and the treatment of the same.

When these patients return home they should be briefed to seek immediate assistance whenever they feel uncomfortable.

References

1. Jansen F.W., Vredevoogd C.B., van Ulzen K. 'Complications of hysteroscopy: a prospective multicentre study' *Obstet Gynecol* 200;96:266-270

2. Aydeniz B., Walwiener D., Rimbach S. 'Co-administration of ethanol to the distension medium in surgical hysteroscopy a screening method to prevent fluid overload? A prospective randomized comparative study of ablative versus non-ablative hysteroscopy and various ethanol concentrations' *Gynäkol Geburtshilfliche Rundsch* 1995;35:108-112
3. Propst A.M., Liberman R.F., Harlow B.L. 'Complications of hysteroscopic surgery: predicting patients at risk.' *Obstet Gynecol* 2000;96:517-520
4. Karakus S., Akkar O.B., Yildiz C., Yenicesu G.I.Cetin M., Cetin A. Comparison of Effectiveness of Laminaria versus Vaginal Misoprostol for Cervical Preparation Before Operative Hysteroscopy in women of reproductive age: a prospective randomized. *J Minim Invasive Gynecol* 2016;23(1):46-52.
5. Song T, Kim MK, Kim ML, Jung YW, Yoon BS, Seong SJ Effectiveness of different routes of misoprostol administration before operative hysteroscopy: a randomized controlled trial *Fertil Steril* 2014 Aug;102(2):519-24.
6. Casadei I, Piccolo E, Manicuti CL, Cardinale S, Collamarini M, Piccione E. Role of vaginal estradiol pre-treatment combined with vaginal misoprostol for cervical ripening before operative hysteroscopy in postmenopausal women *Obstet Gynecol Sci* 2016;59(3):220-226.
7. Al-Fozan H., Firwana B., AlKadri H., Hassan S., Tulandi T. *Cochrane Database Syst Rev* 2015 Apr 23;(4):CD005998.
8. Lindemann HJ "The use of CO₂ in the uterine cavity for hysteroscopy". *International J Fertil* 1972; 17:221.
9. Pellicano M., Guida M., Zullo F. 'Carbon dioxide versus normal saline as uterine distension medium for diagnostic hysteroscopy in infertile patients: a prospective randomized multicentre study.' *Fertil Steril* 2003; 79:418-421.
10. Baggish M.S., Daniell J.F. 'Death caused by air embolism with ND:YAG laser surgery and artificial sapphire tips.' *Am Journal Obstet Gynecol* 1989;161:877-878.
11. Brooks P.G. " Venous air embolism during operative hysteroscopy". *J Am Assoc Gynecol Laparosc* 1997; 4:309-4229.
12. Groenman F.A., Peters L.W., Rademaker P.B.M., Bakkum E.A.," Embolism of air and gas in hysteroscopic procedures: pathophysiology and implication for daily practice". *JMIG* 2008; 15:241-247.
13. Leake J.F., Murphy A.A, Zacur H.A. 'Non –cardiogenic pulmonary oedema: a complication of operative hysteroscopy. *Obstet Gynecol* 1987; 48:497.
14. McLucas 1991 McLucas B. 'Hyskon complications in hysteroscopic surgery.' *Obstet Gynecol Survey* 1991; 46:196-200.

15. Witz C.A., Silverberb K.M., Burns W.N., Schenken R.S., Olive D.C. 'Complications associated with the absorption of hysteroscopic fluid media.' *Fertil Steril* 1993; 60:745-756.
16. Bauman R, Magos A, Kay JDS,Turnbull AC. Absorption of glycine irrigating solution during trans-cervical resection of the endometrium. *Brit Med Jour* 1990; 300:304-305.
17. AAGL Practice Report: Practice guidelines for the management of hysteroscopic distending media. *JMIG* 2013; 20:137-148.
18. Munro M.G. 'Complications of hysteroscopic and uterine resectoscopic surgery'. *Obstet Gynecol Clin North Am* 2010; 37:399-425.
19. Dua R.S., Bankes M.J., Dowd G.S. 'Compartment syndrome following pelvic surgery in the lithotomy position'. *Ann R Coll Surg Engle* 2002; 84:170-171.
20. Grames D.A. "Diagnostic dilatation and curettage a reappraisal". *Am J Obstet Gynecol* 1982; 142:1-6.
21. DeCherney A., Diamond M.P., Lavy G., Polan M.L. "Endometrial ablation for intractable uterine bleeding". *Obstet Gynecol* 1987; 70:668-670.
22. Di Spezio Sardo A., Calagna G., Di Carlo C., Guida M., Perina A., Nappi C. ' Cold loops applied to bipolar resectoscope: a safe "one-step" myomectomy for treatment od submucosal myomas with intramural development". *J Obstet Gynecol Res.* 2015 Dec; 41(12):1935-41.
23. Noventa M., Ancona E., Quaranta M., Vitagliano A., Cosmi E., D'Antona D;, Gizzo S. " Intrauterine Morcellator Device: The Icon of Hysteroscopic Future or Merely a Marketing Image? A Systematic Review Regarding Safety, Efficacy, Advantages and Contraindications".*Reprod Sci* 2015 Oct;22(10):1289-96.
24. Litta P., Leggieri C., Conte L., Dalla Toffola A., Multinu F., Angioni S. 'Monopolar vesus bipolar device: safety, feasibility, limits and perioperative complications in performing hysteroscopic myomectomy'. *Clin Exp Obstet Gynecol.* 2014; 41:335-8.
25. Munro M.G., Christianson L.A. " Complications of Hysteroscopic and Uterine Resectoscopic Surgery". *Clin Obstet Gynecol* 2015 Dec; 58(4):765-97.
26. Tamman A.E., Ahmed H.H., Abdella A.H., Taha S.A. " Comparative Study between Monopolar Electrodes and Bipolar Electrodes in Hysteroscopic Surgery". *Journal Clinical Diagnostic Research* 2015Nov; 9(11):QC11-QC13.
27. Loffer F.D. "Removing intrauterine lesions: Myomectomy and Polypectomy". In Bieber E.J., Loffer F.D. (Eds) *The gynecologic resectoscope.* Cambridge Blackwell Scientific. 1994:186-194.
28. Goldrath M.U. "Uterine tamponade for the control of acute uterine bleeding". *Am J Obstet Gynecol* 1983; 147:869-872.

29. Cooper J.M, Bradley R.M. "Intraoperative and early postoperative complications of operative hysteroscopy". *Obstet Gynecol Clin North Am* 2000; 27:347-366.
30. American College of Obstetricians and Gynecologists (ACOG). Antibiotic prophylaxis for gynecologic procedures. Washington (DC) 2009 ACOG Practice Bulletin n° 14.
31. Taskin O., Sadi S., Onoglu A."Role of endometrial suppression on the frequency of intra uterine adhesion after resectoscopic surgery". *J Am Assoc Gynecol Laparosc* 2000; 7:351-354.
32. Hill D, Maher P., Wood C. " Complications of operative hysteroscopy". *Gynaecol Endosc* 1992; 1:185-189.
33. Cook J.R, Semal I.E. "Pregnancy Following Endometrial Ablation: Case History and Literature Review" *Obstetrical and Gynecological Survey* 2003; 58-8:551-558.
34. Hare A.A, Olah K.S "Pregnancy following endometrial ablation: a review article. *Journal Obstetrics and gynaecology* 2009; 25:108-114.
35. Polyzos M.P., Mauri D., Tsioras S. "Intraperitoneal dissemination of endometrial cancer cells after hysteroscopy. A systematic review and meta-analysis". *Int J Gynecol Cancer* 2010; 20:231-267.
36. Creasman WT, Lukerman J." Role of the fallopian tube dissemination of malignant cells in corpus cancer." *Cancer* 1972; 29:456-457.
37. Lasters B, van Herendael BJ. " Anaesthesia and monitoring in an outpatient set up in Ambulatory Hysteroscopy Diagnosis and Treatment Bruno J van Herendael, Rafael Valle and Stefano Bettocchi (Eds) Blandon Medical Publishing Oxford 2004;22:152-160.
38. Corson SL, Brooks PG, Serden SP, Batzer FR, Godal B."Effect of vasopressin administration during hysteroscopic surgery". *J Reprod Med* 1994; 39:419-423.

Tab 1

International Society for Gynecologic Endoscopy (ISGE)
 Classification of operative difficulty in hysteroscopy

Classification of operative difficulty
Minor Hysteroscopic Surgery Level I
Diagnostic Hysteroscopy including vaginoscopy
Eye – Directed Biopsy
Intermediate Hysteroscopic Surgery Level II a
Cannulation of the tubal ostia
Sterilization
Non – embedded intrauterine contraceptive device (IUCD) non pregnant
Uterine Metroplasty on partial septum
Endometrial Ablation
Polypectomy
Myomectomy grade O-I
Advanced Hysteroscopic Surgery Level II b
Myomectomy grade II
Large Polyps
Resection of Uterine Septum Total Septum including Vaginal Septum
IUCD removal in Pregnancy
Extensive Adhesiolysis

Tab 2

Recommended doses of commonly used local anaesthetics.

Local Anaesthetic	Maximum Doses without Vasoconstrictor	Maximum Doses with Vasoconstrictor
Lidocaine® (1-2%) (Xylocaine)	200 mg	500 mg
Mepivacaine® (1-2%) (Scandicaine, Carbocaine)	300 mg	500 mg
Prilocaine® (1-2%) (Citanest)	400 mg	600 mg
Xylocaine, Scandicaine, Carbocaine and Citanest are manufactured by AstraZeneca Cambridge UK		

