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Updates in Hysteroscopy





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3 Chapter

Distension Media, Pressure System, and Electrosurgical Unit in Hysteroscopy

Shashikant Raghuwanshi, Rajesh Gajbhiye, Sandeep Nikhade

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INTRODUCTION

Intrauterine surgery needs proper visualization. Distension of uterus and continuous irrigation is important for panoramic view of uterine cavity. For that, appropriate distension media and pressure systems play a key role. Electrosurgical unit is the core part of the operative hysteroscopy.

DISTENSION MEDIA

Normally the uterine cavity is collapsed, therefore appropriate distension is a must for proper visualization and to perform surgery. In order to achieve this, gaseous (carbon dioxide) and various liquid mediums are tried for distension of uterine cavity.

Ideal distension media has clear visibility, is isotonic, nonhemolytic, nonallergic, and provides ease at instrument use, cleaning, and with minimum impact on body fluids. It is easy to deliver, nonhemolytic, and nonconductive. Such medium in fact does not exist.

Fluid medium is preferably used over gaseous medium during hysteroscopy, as it gives clearer vision due to continuous irrigation and clear transparency.

Understandings of fluid dynamics are important as excessive fluid intravasation during hysteroscopy can lead to significant complications.

Types of distending fluids used are—either electrolyte containing (NS and RL) or nonelectrolyte containing (glycine and sorbitol) and its choice depends upon the type of energy is being used. For mechanical and bipolar current, NS and RL are used while for monopolar current, hypotonic glycine fluid is used. Monopolar current in electrolyte-containing solutions will lead to dispersion of current in media, reducing current density at focal area and hence heat generated will be insufficient to cause tissue effects.

Tissue removal systems refer to operative hysteroscopy that has been designed to simultaneously cut and aspirate tissue from within the uterine cavity. These systems usually incorporate their own fluid monitoring equipment but fluid overload can still occur.

TYPES OF DISTENSION MEDIA

Gaseous Distension Media

Carbon Dioxide

Carbon dioxide is the only gas recommended for uterine distension. It is commonly used in diagnostic hysteroscopy in the office setting. Carbon dioxide is not recommended for operative hysteroscopic procedures as the possibility of gas embolism is greatly increased as raw or ablated tissue provides the direct gas access to the uterine vasculature. CO_2 also mixes with blood to form froth that obscures' visibility of the operative field.

Fluid Distension Media

The advantage of fluid over gas is its ability to symmetrically distend the uterus with fluid and the ability to effectively flush blood, mucous, bubbles, and small tissue fragments out of the visual field giving more clearer visibility of operative field.

Types of liquid distension media are:

- *High-viscosity fluid:* Dextran 70 (Hyskon)
- *Low-viscosity fluids:*

Electrolytes (isotonic)	*Nonelectrolytes*
Normal saline	Glycine 1.5%
Ringer lactate	Sorbitol 3%
	Mannitol 5%
	Cytal—2.8% sorbitol + 0.5% mannitol

High-viscosity Fluid—Dextran 70 (Hyskon)

It is nonelectrolytic, nonconductive, minimally leaks through cervix and tubes providing excellent visibility. It is immiscible with blood. It being hyperosmolar largely expands plasma volume, causing massive fluid overload. It can produce anaphylactic reactions, pulmonary edema, acute respiratory distress syndrome (ARDS), coagulopathies, oliguria, and acute renal failure.

Isotonic Electrolyte-containing Solutions

The electrolyte-containing fluids are used in diagnostic and operative cases with mechanical, laser, or bipolar energy. Electrolytic solutions commonly used are normal saline and ringer lactate. These solutions are crystalloids which help to maintain the osmotic gradient between extravascular and intravascular compartments. While hyponatremia rarely occurs with normal saline or lactated ringer's solution, they more frequently cause isotonic fluid overload when intravasation occurs.

Characteristics of distension media used with procedures during hysteroscopy are given in **Table 1**.

Factors Affecting Fluid Absorption

Absorption of fluid into systemic circulation occurs through retrograde passage through fallopian tube, opening of vascular channels, and through endometrium. Factors that increase absorption are:

- Higher intrauterine pressure
- Longer duration of surgery—longer the procedure more is the time for fluid to get absorbed through various channels
- Deeper myometrial penetration
- Larger endometrial surface area
- General anesthesia is associated with rapid absorption of fluids and subsequent hyponatremia compared to local anesthesia. There might be delay in symptoms recognition in sedated patients.

TABLE 1: Characteristics of distension media used with procedures during hysteroscopy.

Distension media	*Electrolyte containing*	*Osmolality plasma—285 mOsm/L*	*Energy*
Normal saline	Yes	285	Mechanical bipolar
Ringer's lactate	Yes	279	Laser
Glycine 1.5%	No	200	Monopolar
Dextrose 5%	No	Hypo-osmolar	Monopolar
Sorbitol 3%	No	165	Monopolar
Mannitol 5% Dextran 32%	No No	274	Monopolar

Fluid Overload

There is no standard definition of fluid overload as data varies as per patient's age, medical fitness, and fluid deficit calculating systems. Incidence of fluid overload is around 5% in hysteroscopic procedure. Serum sodium drops by 10 mmol/L after absorption of 1,000 mL hypotonic 1.5% glycine. And that is the reason fluid absorption of 1,000 mL of hypotonic solution taken into consideration to define fluid deficit in a medically fit women of reproductive age group. For procedures using isotonic solutions fluid deficit of 2,500 mL is defined as fluid overload as per guidelines. Although upper limit depends upon patient's age and medical fitness. However, for patients with comorbidity such as cardiovascular diseases, renal impairment, lower threshold such as 750 mL for hypotonic and 1,500 mL for isotonic solutions should be used.

Factors impacting serious complications from fluid overload:

- *Osmolality of distension fluid:* Hypotonic electrolyte-free solutions such as glycine, mannitol, and sorbitol can cause hyponatremic hypervolemia. If unrecognized and left untreated, bradycardia and hypertension can develop, rapidly followed by pulmonary edema, cardiovascular collapse, and death.
- *Menopausal status:* Hyponatremia during hysteroscopy is especially problematic for premenopausal women, as they are at 25 time's greater risk for hyponatremic encephalopathy (HE) and permanent brain damage than postmenopausal women. Postmenopausal women developing dilutional hyponatremia are less likely to suffer brain damage because of their low estrogen and progesterone levels which allows there sodium pump to operate freely, as opposed to premenopausal patients, whose sodium pump is inhibited by higher levels of estrogen and progesterone.
- *Cardiovascular and renal disease:* These women are less likely to adapt sudden significant increases in intravascular fluid and land up in complication with lower fluid deficits.
- *How to reduce fluid absorption*

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- *Preoperative gonadotropin releasing hormone (GnRH) analog*
- *Intracervical vasopressin*
- *Low intrauterine pressure*—should be as low as possible for adequate visualization and below mean arterial pressure.
- *Use of suction devices*

Dilution Hyponatremia

More with hypotonic and electrolyte-free distension. Normal serum sodium is 135–142 mEq/L. Serum sodium <135 mEq/L can result in hyponatremia, which is categorized as mild, moderate, or severe. The first signs of hyponatremia can present with fluid deficits of 500 mL of hypotonic solution. Symptoms usually develop when serum sodium concentration drops below 125 mmol/L. In severe cases, permanent brain damage, coma, or death may result.

Slow intravenous (IV) infusion of 3% sodium chloride is given @ 1 mEq/L/h till it reaches to 125 mEq/L. This slow correction corrects cerebral edema and prevents osmotic demyelinating syndrome (central pontine myelinolysis). Hyponatremia below 120 mm/L should be treated with a 100 mL bolus of 3% saline over 10 minutes and this can be repeated up to three times, followed by an infusion as described above. The recommended target increase of the serum sodium is 6 mmol/L over 24 h until 130 mmol/L is reached.

Glycine Toxicity

Glycine by oxidative deamination splits into ammonia and glyoxylic acid. 2.2% glycine is isotonic 290 mosmol/L, risk of hyperammonemia is greater, and 1.5% of hypotonic glycine (200 mosmol/L) is clinically used. Fluid overload by glycine is hypervolemic hypo-osmolar hyponatremia.

Sorbitol Toxicity

Being hypo-osmolar (180 mosmol/L), it causes hypervolemic hyponatremia, hyperglycemia, and hypocalcemia. Myoclonus is presenting symptom. Treatment is with insulin on sliding scale with blood sugar monitoring and correction of hypocalcemia with 3 g calcium gluconate over 10 mins.

Fluid Overload with Isotonic Fluid Media

This medium reduces the risk of hypo-osmolarity and hyponatremia with excessive fluid absorption but does not eliminate the risk of congestive cardiac failure and pulmonary edema. Fluid restriction, diuretics, and monitoring are required.

DISTENSION SYSTEMS IN HYSTEROSCOPY

Intrauterine distension pressure can be maintained using simple gravity, manual, and automated pressure delivery systems.

- *Gravity systems* deliver the distension fluid by hydrostatic pressure. Elevation of the bag will increase the intrauterine pressure and one foot of height will give intrauterine pressure to around 25 mm Hg. When the fluid is maintained at a level of 5 feet above the patient's uterus, the intrauterine pressure will be between 70 and 100 mm Hg **(Fig. 1)**.
- *Manual pressure* systems maintain the necessary intrauterine pressure by using a pressure bag or blood pressure cuff around the fluid bag **(Fig. 2)**.

  The disadvantage of all these systems is that they keep the flow and the pressure at the inflow port constant and therefore if the pressure exceeds the mean arterial pressure, it can lead to excessive fluid absorption. Irrigation of fluid is achieved by opening partially or fully the outflow tap and applying varying amounts of negative pressure like suction from outflow tap.
- *Automated fluid pumps* will keep a constant pre-set pressure at the inflow port, but they will continue



Fig. 1: Gravitation system.

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Fig. 2: Manual pressure system.



Fig. 3: Automated fluid pump.

delivering fluid despite the resistance in the uterine cavity. Other systems will titrate the intrauterine fluid pressure constantly at 70–80 mm Hg and will reduce the fluid flow (inflow and outflow) accordingly. Ideal device which maintains constant intrauterine pressure is more sensitive and limits excessive intrauterine pressures and subsequent intravasation of the distending medium. They are not necessary for short operative or diagnostic procedures but may be beneficial for prolonged, operative cases such as resection of the endometrium or submucosal fibroids where endometrial and myometrial disruptions occur causing bleeding and the formation of intrauterine tissue debris that can compromise visualization of the operative field **(Fig. 3)**.

- *The CO_2 tubal insufflator* delivers CO_2 at 30 mL per minute at pressure not exceeding 150 mm of Hg. The vacuum cannula is not used. Any leakage of gas is controlled by applying a Vulsellum laterally **(Fig. 4)**.

It is important that measurement and maintenance of the intrauterine pressure can be difficult when there is leakage of fluid around the cervix when cervical priming agents were used and when suction is applied at the outflow port of the hysteroscope.

Air or gas embolism is rare but can occur during a hysteroscopy with both gas (CO_2) or fluid distension media and in the outpatient as well as inpatient setting. Air can enter the uterine cavity during insertion of the hysteroscope if the inflow tubing is not primed with fluid or due to air bubbles within the distension medium potentially causing air embolism.



Fig. 4: CO_2 tubal insufflator.

To minimize the risk of air embolism, the hysteroscope and inflow tubing should be primed with the fluid media to eliminate air bubbles before inserting the hysteroscope into the uterine cavity.

ELECTROSURGICAL UNITS IN OPERATIVE HYSTEROSCOPY

To carry out operative hysteroscopy, we need to cut the tissue and control the bleeding. For this, we require energy in the form of electric current. Traditionally monopolar current was used for this **(Fig. 5)**. Here, the entire patient is involved in circuit and current passes through many tissues outside surgeons control, due to which there are greater chances of current diversion to undesirable locations.

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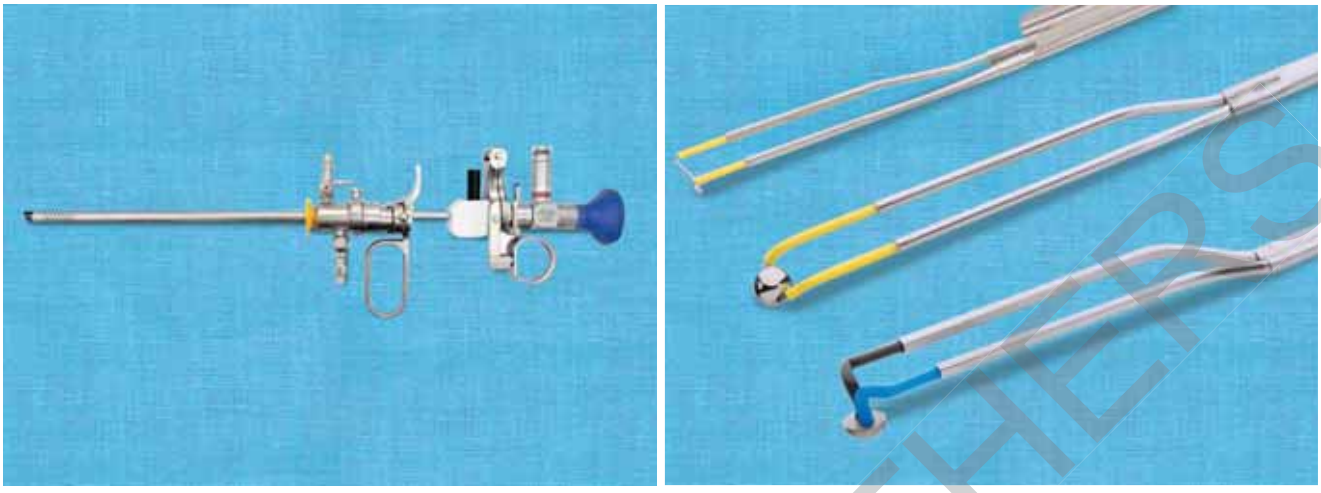

Fig. 5: Monopolar resectoscope with various electrodes.

In bipolar circuit on the other hand, current flows between two electrodes and the circuit is closed by placing tissue between two electrode and there is less chance of diversion. The risk of thermal injuries at distant organs or tissues, by direct contact of instruments, imperfection of insulation or diffusion of the electric current, is reduced in the bipolar technique.

The introduction of bipolar energy in the field of hysteroscopic surgery has meant the beginning of a new age of technology in which the best levels of security and effectiveness will be guaranteed. The main concerns in gynecological conventional monopolar resection are fluid absorption with hyponatremia, hypervolemia, and glycine toxicity. This syndrome is very dangerous for the patient, leading to neurotoxic coma and death in the worst cases. The bipolar hysteroscopic system has eliminated the need to use hypotonic solutions as irrigation medium, with its life-threatening complications. When limiting normal saline solution to 2 L, no serious complications associated with irrigation medium are expected. Most of the morbidities of the overflow syndrome are related to the use of hypotonic nonelectrolyte irrigation fluid. Furthermore, the risk of TUR syndrome is theoretically eliminated by using physiological sodium chloride solution for irrigation.

The bipolar resectoscope presents some advantages in comparison with the monopolar such as—better cut and coagulation by plasma effect of bipolar current, minor risks with the use of saline solution, lower alterations of the tissue, less bleeding during resection, better visibility, and reduced cost. The bipolar system is technically superior, cost-effective, and safer in comparison with the monopolar system.



Fig. 6: *Bipolar resectoscope:* It has a cutting loop similar to traditional resectoscopes.

As active and the return electrodes are placed on the resectoscope, high current densities are achieved locally and complications caused by distant negative effects of the current are theoretically reduced in vivo. High-frequency current generated by a bipolar instrument tends to remain superficial furthermore, the coagulation capacity by itself is extremely more powerful in the bipolar system in comparison with monopolar. This avoids time-consuming recoagulation after resection for coagulation and contributes to close the superficial capillary vascularization, also reducing intravasation.

In bipolar electrodes, active and the return electrodes are placed on the resectoscope **(Figs. 6 and 7)**.

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Fig. 7: Bipolar resectoscopy for myoma. Type II leiomyoma: Dense tissue, vasculature at base.



Fig. 8: Bipolar hook electrode.

Types of bipolar electrodes are spring, twizzle, and ball electrode.

- Spring tip is used for hemostatic vaporization of large areas.
- Ball tip for precise vaporization
- Twizzle tip for hemostatic resection and morcellation of tissue.

Hook electrode and needle type bipolar electrodes are very cost-effective and good for septum resection and intrauterine adhesiolysis **(Fig. 8)**.

Uses:

- Removal of submucous fibroids
- Transection of intrauterine septa
- Removal of polyps
- Endometrial ablation
- Transection of intrauterine adhesions.

CONCLUSION

Thus, bipolar electrodes and resectoscopes have the advantages of using saline as a distension media which prevents major risk associated with glycine toxicity. The bipolar system is technically superior and cost-effective.

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Updates in Hysteroscopy

This book gives insight into all important day-to-day problems in the females which can be cured by hysteroscopy. This manual will be easy to follow for all upcoming Hysteroscopists. All chapters are covering basics to practical aspects. So it will be a practitioner-friendly Hysteroscopy manual. Many renowned Hysteroscopists of the world have contributed to in this manual and simplified the difficult things so that hysteroscopy is really made easy.



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