Fluid Selection and Management in Hysteroscopy

(An Online Continuing Education Activity)

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Fluid Selection and Management in Hysteroscopy

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OVERVIEW

Hysteroscopy, whether diagnostic or operative, requires adequate visualization of the uterine cavity. This can be accomplished by creating uterine distention by way of insufflation with a gas or fluid media. Both methods will be addressed in this continuing education program, as well as the nursing implications associated with each method. Content will also focus on the potential complications that can occur with carbon dioxide, fluid overload, and dilution hyponatremia.

OBJECTIVES

After completing this continuing nursing education activity, the participant should be able to:

1. Discuss the indications for hysteroscopy and the settings where hysteroscopy may be performed.
2. Differentiate when to use gas, electrolytic and non-electrolytic distention media.
3. Discuss the various methods to calculate intrauterine pressure while using distention media.
4. Describe the care and handling of the various manual methods and machines designed to assist in the management of fluid distention media administration.
5. Identify the nursing interventions that may prevent complications associated with the use of distention media during hysteroscopic surgery.

INTENDED AUDIENCE

This continuing education activity is intended for nurses and other healthcare providers who are interested in learning more about selection and management of uterine distention media used during hysteroscopy.

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PROCEDURE OVERVIEW

Diagnostic and operative hysteroscopy requires uterine distention and irrigation flow to effectively visualize the uterine cavity and remove blood and tissue debris during the procedure. Options for uterine distention include insufflation with carbon dioxide (CO_2) gas, or; instillation with electrolytic or nonelectrolytic liquid distention media. In selected cases, hysteroscopy offers advantages over hysterectomy in that it is less invasive, has lower morbidity, shorter recovery times, lower cost, and fewer side effects.[1]

Complications during hysteroscopic surgery are rare; the incidence and degree of complication can vary by the extent of the procedure. Despite this variance, critical complications in diagnostic or operative hysteroscopy can be: intravasation of fluid when using a fluid distention medium, a gas embolism when using CO_2 for a distention medium, or; an air embolism when room air is introduced into the uterus through the distention media tubing or by the room air pressure itself. The complications can range from minor, with little correction intervention, to severe and even death. It is important for the nurse to understand the various media used during hysteroscopy, preventative measures to avoid complications and recommendations for patient care in the event of a patient complication.

This guide discusses the most common indications for hysteroscopy, the advantages and disadvantages of the most frequently used distention media, key components of a fluid management system and the nursing responsibilities associated with these procedures.

HYSTEROSCOPE OVERVIEW

The uterine cavity is accessed with a hyseroscope through the cervical os via the vaginal canal. The degree of cervical dilatation and vaginal retraction performed during hysteroscopy is the surgeon’s choice and the design of the hysteroscope. A hysteroscope is a type of endoscope that has a double-channeled sheath allowing continuous flow of distention fluid or gas into the uterus through the larger channel, while allowing for less out-flow through the smaller channel. This pressure gradient results in distention of the uterine cavity. With optical improvements, hysteroscopes can be flexible or rigid and have a smaller diameter while still providing for larger and brighter images.

HYSTEROSCOPIC PROCEDURES

Hysteroscopy may be performed in either a physician's office with or without local anesthesia or in the operating room under monitored anesthesia care (MAC), regional or general anesthesia.[2] Hysteroscopy has been shown to be a safe and effective method for the treatment of uterine pathologies, to include:

- Uterine myomas;
- Uterine polyps;
- Uterine adhesions;
- Intrauterine septa; and
- Abnormal uterine bleeding.

INTRAVASATION

Intravasation during hysteroscopy procedures is the absorption of the uterine distention media through the uterine vasculature. Even with the best conditions, the distention medium can enter the patient's circulatory system during the procedure. Factors influencing the amount of intravasation can include:

- Intrauterine pressure;
- Number and size of the vascular openings in the uterus;
- Duration of the procedure; and
- Patient's condition.

Intrauterine pressure must be controlled to maintain a balance between too much pressure, which increases the opportunity for intravasation, and too little pressure, which decreases the physician's visibility of the uterine cavity. The intrauterine pressure should remain below the patient's mean arterial pressure (MAP). Mean arterial pressure (MAP) is the average pressure within an artery over a complete cycle of one heartbeat.[3]

Monitoring equipment in a hospital setting usually provides an automatic calculation of the MAP for the anesthesia personnel who can then report the reading to the operative team. In a physician's office, it may be necessary for the nurse to manually calculate the patient's MAP using data from the automatic blood pressure monitor. The following formula can be used by the nurse to manually calculate a patient's MAP.[4]

MAP Calculation

Mean arterial pressure = diastolic blood pressure + 1/3 pulse pressure

Pulse pressure = systolic – diastolic blood pressure

The risk of intravasation during hysteroscopy can be reduced by:

- Decreasing the length of the procedure, thereby reducing the amount of distention media infused during the procedure;
- Maintaining the intrauterine pressure below the mean arterial pressure[5]; and
- Minimizing the size and depth of the ablated uterine surfaces or surgical intervention of the uterine wall.

Procedures which are subject to higher risk for intravasation include hysteroscopic myomectomy and resection of the uterine septa.[6]

DISTENTION MEDIA

In hysteroscopic procedures it is necessary to fill the uterus with a distention medium to create a large enough space for the surgeon to see and perform any operative procedures. There are several choices of distention media for hysteroscopy. The surgeon chooses a distention medium based on the patient's condition, the procedure to be performed, and the electrosurgical device to be used.

CARBON DIOXIDE DISTENTION MEDIA

Carbon dioxide is the only gas recommended for uterine distention. 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 in cases where raw or ablated tissue provides the gas direct access to the uterine vasculature.[7] The American Association of Gynecologic Laparoscopists (AAGL) has developed guidelines for the use and monitoring of hysteroscopic distention media and defines the use of CO_2 primarily for diagnostic hysteroscopy and limited for operative hysteroscopy.[8]

Insufflation of Carbon Dioxide

Carbon dioxide is easily absorbed into the bloodstream and quickly dissipates during pulmonary ventilation, resulting in a low risk of intravasation. A small amount of CO_2 intravasation is a recognized risk in diagnostic hysteroscopic procedures and usually does not result in danger to the patient. CO_2 embolus is a serious complication which can be avoided if the appropriate flow rates are used (maximum of 100 mL/min) and the Intrauterine Pressure (IUP) is less than or equal to a 100 mm Hg.[9] It is imperative to use the correct equipment to insufflate with CO_2 during hysteroscopy. In some cases, complications have been caused by using a laparoscopic insufflator and not a hysteroscopic insufflator to deliver CO_2 during a hysteroscopy. Laparoscopic insufflators should never be used for hysteroscopy procedures. The laparoscopic insufflator delivers CO_2 at higher flow rates than those designed for hysteroscopy, causing an excessive increase in IUP. The CO_2 intravasation which occurs from these high pressures can result in irreversible brain damage or death.

Air Embolism

Air embolism can also occur during hysteroscopy. While not a common occurrence, air embolism can occur during hysteroscopy when the room air pressure is greater than venous pressure, in which the diastolic pressure creates a negative intravenous pressure. This occurs most often when the patient is in the Trendelenburg position, elevating the uterus above the heart. Steps should be taken to place the patient in as little Trendelenburg as possible in order to minimize the risk of air embolization.[10] Exposure of the dilated cervix to room air may also increase the risk of air embolus. A simple step to minimize exposure of the cervix to room air is to remove the vaginal speculum after the hysteroscope is inserted into the uterus and avoid repeated advances of the hysteroscope into the uterus.[11]

Air embolism may also occur when the CO_2 insufflation tubing is not purged of air prior to the start of the procedure. It is important to prime the entire tubing system with CO_2 prior to the start of the procedure.[12]

Adverse Effects and Treatment

Early indications of gas embolism are changes in cardiac rhythm and end-title CO_2 and a decrease in oxygen saturation, as detected by either the anesthesiologist or the patient who is conscious and under regional or local anesthesia. The patient may report they are experiencing chest pain or shortness of breath. Other signs of gas embolism include: sudden fall in oxygen saturation, hypotension, pulmonary hypertension, hypercarbia, and tachypnea.[13] Gas embolism of any type is an emergency situation requiring swift intervention, as patients may not survive the initial insult of large amounts of air or CO_2 in the vascular system.

If any type of gas embolism is suspected, the surgical procedure must be stopped immediately and the patient placed on mechanical ventilation with 100% oxygen. While providing pulmonary and vascular support, turn the patient onto her left side and in a deep Trendelenburg position to keep the air in the right side of the heart and to avoid passage into the lungs. An intravenous bolus of isotonic sodium chloride solution should also be delivered as a first-line treatment. A central line can help remove the air from the right atrium as well as pericardial thumps, which can help to break up larger air bubbles.[14,15] Room air emboli are more likely to be fatal, and treatment with hyperbaric oxygen should follow if the patient survives the initial event.[16]

LIQUID DISTENTION 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.[17] Liquid distension media for hysteroscopy fall into two categories: electrolyte and nonelectrolyte.

ELECTROLYTIC SOLUTIONS

In 2000, the American Association of Gynecological Laparoscopists (AAGL) recommended the use of electrolyte-containing fluids in diagnostic and operative cases in which mechanical, laser, or bipolar energy is used. Electrolytic solutions include normal saline and Lactated Ringer’s.[18] Both of these solutions are crystalloids which help maintain the osmotic gradient between extravascular and intravascular compartments within the body. They are also plasma-volume expanders due to their sodium concentrations. While hyponatremia cannot occur with normal saline or Lactated Ringer’s, they can cause isotonic fluid overload when intravasation occurs. Fluid overload with electrolytic solutions can lead to pulmonary edema and congestive heart failure; therefore, patients should be strictly monitored when using electrolytic solutions as a distention fluid media.[19]

Electrolytic fluid is capable of conducting electricity and cannot be used with monopolar electrosurgical devices.

NONELETROLYTIC FLUIDS

Nonelectrolytic solutions are poor conductors of electricity and thus are recommended for use with monopolar energy. No one particular nonelectrolytic solution is more ideal then another for use with monopolar electrosurgical devices.

These fluids, however, can increase the patient's risk for hyponatremia and other complications. Nonelectrolytic fluids include: glucose, glycine, dextran (aka Hyskon), mannitol, sorbitol, and mannitol/sorbital mixture (aka Purisol). Until the late 1980's, water was included in this list; however, it is no longer used due to problems with water intoxication and hemolysis.

The chemical composition of nonelectrolytic fluids can also present other problems for the patient besides hyponatremia as well as, for the instruments used for hysteroscopy (see Table 1). Glucose is contraindicated in patients with glucose intolerance. Sorbitol metabolizes to fructose in the liver and should not be used in patients with fructose intolerance. Dextran 70 can present patient complications that can include: coagulation disorders, allergic reactions and adult respiratory distress syndrome (ARDS).[20] Dextran 70 can also ruin operative hysteroscopes if they are not cleaned promptly following the procedure.Glycine metabolizes into ammonia and can cross the blood-brain barrier, causing agitation, dizziness, vomiting, and coma. Glycine can also cause a transient decrease in visual acuity. Mannitol 5% has a diuretic effect and can cause circulatory disturbances, hypotension and circulatory collapse. A mannitol/sorbitol mixture should not be used in fructose intolerant patients and can have a diuretic effect, causing circulatory disturbances, hypotension and circulatory collapse.

Table 1 – Liquid Distention Media Used In Hysteroscopy[21,22]

Electrolytic Solutions are capable of conducting electricity, therefore cannot be used in conjunction with monopolar electrosurgical devices. Electrolytic solutions are recommended by the AAGL for use in diagnostic cases and in operative cases in which mechanical, laser and bipolar energy is used. Per AAGL guidelines; the maximum fluid deficit for a healthy patient should not exceed 2,500 mL. Always consider the patient’s condition and anesthesiologist input for individual maximum fluid deficit.[23]		
Normal Saline Lactated Ringer’s	Isotonic Isotonic	Used for diagnostic hysteroscopy and in operative procedures utilizing lasers, mechanical, bipolar energy.
Nonelectrolytic Solutions eliminate problems with electrical conductivity, but can increase the patient’s risk for hyponatremia and other complications. Use with monopolar energy. Per AAGL guidelines; the maximum fluid deficit for a healthy patient should not exceed 1,000 mL. Always consider the patient’s condition and anesthesiologist input for individual maximum fluid deficit.[24]		
Water		Popular until the 1980’s. Discontinued because of possible water intoxication and hemolysis.
Glucose 5%	Isotonic	Contraindicated for patients with glucose intolerance.
Glycine 1.5%	Hypotonic	Metabolizes into ammonia and glycol, which can cross blood brain barrier. Metabolites cause agitation, dizziness, vomiting and coma. May also cause transient decrease in visual acuity, and transient blindness.
Dextran 70 (*Hyskon)*	Hypertonic	Complications include coagulation disorders, allergic reactions and adult respiratory distress syndrome (ARDS). Can crystallize on instruments, obstructing valves and channels. Low viscosity fluids have replaced Dextran 70, a high viscosity fluid.
Mannitol 5%	Isotonic	Has a diuretic effect; may cause circulatory disturbances, hypotention and circulatory collapse. *Recommended by AAGL instead of glycine or sorbitol when using monopolar energy.*
Sorbitol 2.5%-5%	Hypotonic	Metabolizes to fructose in the liver. Contraindicated for patients with fructose intolerance.
Mannitol/Sorbitol Mixture (*Purisol*)	Hypotonic	Has diuretic effect; may cause circulatory disturbances, hypotension and circulatory collapse. Metabolizes to fructose in the liver; contraindicated for patients with fructose intolerance.

PREVENTION AND MANAGEMENT OF COMPLICATIONS RELATED TO DISTENTION FLUID OVERLOAD

Dilution Hyponatremia

The most common complication resulting from intravasation of large amounts of nonelectrolytic fluid is dilutional hyponatremia, which occurs when the ratio between serum sodium and circulating blood volume dips below normal levels. Normal serum sodium is 135 to 142 mEq/L. Serum sodium less than 135 mEq/L can result in hyponatremia which is categorized as mild, moderate or severe. Patients with mild hyponatremia can deteriorate rapidly, resulting in seizures followed by respiratory arrest in a matter of minutes. Therefore, prompt treatment for hyponatremia is essential.

Intravasation of hypotonic nonelectrolytic fluids can cause the accumulation of free water, causing the body to seek homeostasis through its compensatory mechanisms. One of these mechanisms is osmosis, which moves free water into extracellular and intracellular spaces. This redistribution of free water can result in cerebral edema and increased intracranial pressure. If left untreated, the persistent swelling of the brain exerts pressure against the skull, which can lead to pressure necrosis of the brain. Cerebral herniation can occur if swelling exceeds 5% and immediate preventative steps are not taken. When serum sodium falls below 115 mEq/L, brain stem herniation develops in the swelling brain's attempt to equalize interstitial and intravascular osmotic pressures. Permanent brain damage, coma, or death may result.[25]

Hyponatremia during hysteroscopy is especially problematic for premenopausal women, as they are at 25 times greater risk for hyponatremic encephalopathy (HE) and permanent brain damage than postmenopausal women. Estrogen and progesterone in pre-menopausal women inhibits sodium pump activity, which protects the brain against cerebral edema. The sodium pump serves to move osmotically-active sodium cations from the brain cells, thus reducing swelling. Postmenopausal women developing dilutional hyponatremia are less likely to suffer brain damage because their low estrogen and progesterone levels allows this sodium pump to operate freely, as opposed to premenopausal patients, whose sodium pump is inhibited with higher levels of estrogen and progesterone.[26]

TREATMENT FOR FLUID OVERLOAD OR HYPONATREMIA

The pre-operative nursing assessment is essential to ensure the proper protocols are used to treat patients experiencing hyponatremia or fluid overload. The hospital should have protocols designed for the care and treatment of these conditions.

Treatment for Fluid Overload, Electrolytic Fluids: Fluid overload is the main risk when using isotonic, electrolytic fluid such as, normal saline or Lactated Ringer's solution and can be initially treated with diuretics and fluid restriction. Careful monitoring and prompt treatment can avoid more serious side effects of fluid overload. Treatment for serious side effects can include intravenous diuretics and continued monitoring of electrolyte levels until the patient is safely recovered.

Treatment for Fluid Overload, Nonelectrolytic Fluids: When intravasation occurs with isotonic solution combinations such as, 5% mannitol or mannitol/sorbitol mixtures, no specific treatment may be necessary as these fluids have a diuretic effect and the body may rid itself of the excess fluid, rebalancing the sodium levels through diuresis. The nurse should assess and consider the patient's physical condition, age and serum sodium levels; fluid restriction and observation may be all that is required as the patient diuresis.

Sorbitol and Glycine 1.5% can cause fluid overload as well as hyponatremia. The nurse should observe for signs and symptoms of adverse neurological and cardiovascular effects such as muscle twitching, seizures, hypotension, and tachycardia, which can lead to pulmonary and cerebral edema, cardiovascular collapse, and death (see Table 2).

Table 2 – Stages of Hyponatremia

Stage	Sodium Level	Symptoms
Mild	130 to 135 mEq/L	Changes in mental status; apprehension, disorientation, irritability, twitching, nausea, vomiting, tachypnea.
Moderate	125 to 130 mEq/L	Signs of impending pulmonary edema; moist skin and mucous membranes, pitting edema, polyuria, dilute urine, pulmonary rales.
Severe	120 to 125 mEq/L	Vital sign changes including hypotension and bradycardia, anemia, jaundice, cyanosis, further changes in mental status.
Hyponatremic Encephalopathy	<120 mEq/L	Congestive heart failure, lethargy, confusion, muscular twitching, focal weakness, convulsions.
Patients with mild hyponatremia can deteriorate rapidly, including seizures followed by respiratory arrest in a matter of minutes. Therefore, prompt treatment for hyponatremia is essential.		

To correct hyponatremia, it may be necessary to administer hypertonic saline to stabilize serum sodium levels while avoiding the potential for overcorrection. Overcorrection of serum sodium to more than 135 mEq/L may result in adverse cerebral effects, necessitating the administration of diuretics.

Treatment for a patient with a serum sodium level less than 120 mEq/L, due to absorption of hypotonic fluid, can include the following:

- Patient to be monitored in a critical care unit; and
- IV infusion of 3% sodium chloride or a dose sufficient to raise the serum sodium level by approximately 1 mEq/L per hour up to the level of 130 mEq/L.

Although most women recover, seizures, permanent brain damage and death have been reported.[27]

FLUID MONITORING

Fluid Calculation During Infusion

It is essential to accurately monitor and control the flow of distention fluid to avoid complications of intravasation. The nurse plays a crucial role in calculating fluid deficit (the amount of distention fluid instilled minus the amount recovered) during the procedure. The ultimate objective of monitoring fluid absorption during hysteroscopic surgery is to identify fluid overload and decrease serum sodium concentration *before* they have an adverse effect on the brain and cardiovascular system.

Significant fluid intravasation can occur in a very short period of time, causing very rapid changes in serum sodium levels and resulting in severe dilutional hyponatremia and encephalopathy. Accurate measurement of intrauterine fluid absorption enables surgical team members to correct problems early, thus decreasing morbidity and mortality.[28]

Fluid calculations can be done using a manual method or using a machine that both instills and calculates fluid deficit. When manual calculation is the only method available to monitor infusion, it is strongly recommended that one person be assigned to monitor and frequently report the calculations to the surgical team and another person assigned to patient care during the procedure. Despite careful diligence, manual calculations of fluid volumes may result in inaccurate estimates. There is often overfilling in the fluid bags, leading to inaccurate fluid deficit calculations. Manual calculation can result in as much as a 10% margin of error, which may translate into an error of 600 to 1500 mL of unrecognized fluid deficit leading to fluid overload.[29] Automated hysteroscopy fluid management systems which are capable of calculating fluid deficit may help to eliminate the miscalculations.

Installation Methods

Methods of instilling distention fluid include: continuous-flow gravity, continuous flow infusion pump, and pressure-controlled or pressure-sensitive fluid pumps.

In continuous-flow gravity systems, pressure is controlled by the height of the fluid source above the uterus and is measured from the height of the highest portion of the continuous column of fluid (fluid bag) to the left of the uterus – approximately one foot equals 25 mm Hg pressure.[30] If the bag is 3 feet above the patient's uterus, this results in 75 mm Hg of pressure. The nurse needs to monitor and calculate the IUP manually in this situation. Gravity based systems are very simple to assemble and operate, but require vigilant patient monitoring and frequent manual intake/output calculations, which can be imprecise and diverts the nurse's attention from patient care. Usually, the fluid deficit is calculated by counting the number of empty fluid bags and then subtracting the out-flow volume in the canister to determine fluid deficit. This method allows for a substantial margin of error.

Continuous-flow fluid infusion pumps provide a constant flow of distention fluid at the in-flow pressure determined by the operator, delivering the same flow rate to the uterus regardless of the out-flow conditions. Continuous flow pumps do not usually monitor or calculate IUP. Like the gravity systems, it requires vigilant patient monitoring and frequent calculations. Significant fluid absorption and complications can occur with these types of systems because the team is unaware of the actual pressure being used during a prolonged or invasive procedure.

Pressure-controlled infusion pumps can be preset to maintain a desired intrauterine pressure by varying the in-flow pressure. By monitoring the patient's MAP and adjusting the IUP setting on the pump, the nurse is able to maintain the IUP below the MAP, thus reducing the likelihood of intravasation. These automated pressure-sensitive pumps can reduce the flow rate when the preset pressure is reached, making this the preferred design.[31]

These pumps can weigh the fluid volume before infusion, which allows them to account for the 3-10% overfill often found in fluid bags.[32] Weight of fluid before installation and then after accounts for the deficit, which provides a more accurate measurement of the fluid retained by the patient (fluid deficit).

Infusion pumps can allow the nurse to change the fluid bags and canisters without interrupting the irrigation flow, which is desirable when performing an operative hysteroscopy using either a resectoscope or mechanical morcellator. Some automated infusion pumps also have a pressure transducer within the in-flow tubing that helps to regulates intrauterine pressure.

Studies have revealed that 86% *less* distention fluid was absorbed by patients who had a pressure-controlled infusion pump delivering the distention fluid and maintaining the IUP versus the patients who had the distention fluid infused through a continuous-flow fluid infusion pump set at random in-flow rates. Further studies comparing these two types of infusion pumps and using the patient's MAP as the upper limit for the IUP setting for the pressure-controlled pump; illustrate the absorption variable between the two pressure types. The women in the continuous-flow pump group absorbed an average of 1; 317 mL of distention fluid, while the women in the pressure-controlled pump group had no measurable absorption of the distention fluid.[33] However, the AAGL considers fluid pumps as a convenience and should not be considered a guarantee for safety.[34]

As with all mechanical monitors, the best outcome is always driven by the operative team's diligence in reading and interpreting the monitor's readings and patient's condition with appropriate adjustments to the patient's care to avoid complications.

Fluid Collection

The fluid collection system for either manual or mechanical installation consists of a plastic drape that incorporates a drainage pouch. The drape is slipped under the buttocks, which then funnels out-flow into the drainage pouch. Tubings are connected to the bottom of the drainage pouch and the out-flow port of the hysteroscope then to one or more calibrated collection containers. Automated systems usually contain a scale to determine fluid weight and automatically calculates fluid deficit. An alarm alerts the surgical team when the fluid deficit reaches a predetermined limit. It is important to use the drapes as they were intended; improper placement during draping may prevent all of the fluid from being captured in the collection containers. If fluid is not captured, it cannot be weighed and calculated by the collection system, which then leads to estimation and opportunity for error.

NURSING IMPLICATIONS

The nurse should perform a thorough pre-operative assessment, including the patient's condition, age, cardiac status, and serum sodium levels to establish the patient's baseline parameters. The pre-operative assessment should also include any medications (prescription or over-the-counter) as well as any comorbidities that may predispose the patient to hyponatremia or fluid overload, which includes: adrenal insufficiency, brain tumors or neuropathies, liver dysfunction, congestive heart failure, renal disease, lung cancers or lung conditions or coagulopathies.[35] This assessment will be helpful for the surgical team to monitor for hyponatremia or fluid overload.

Protocols vary by institution, however, based upon research, the nurse should assess fluid amounts (in-flow, out-flow and deficit) a minimum of 5-15 minutes during the procedure (may be more frequent, as per institution policy) and report the findings to the surgical team. These measurements may be prominently written on a white board in the OR so trending can be easily identified by the team members. It may be advisable for the anesthesiologist to obtain a serum sodium level at deficits greater than 500 mL or when the procedure time reaches 30 minutes. Surgical time, intrauterine pressure, the invasive nature of the procedure itself, amount of fluid infused, actual fluid deficit and the patient's condition all play an important role in developing some of the serious complications previously discussed.

Facilities should develop policies for patient monitoring during hysteroscopy and invite input from the gynecology staff, anesthesiology and nursing staff after carefully researching recommendations found in the literature. These policies should include parameters for the frequency of deficit measurements (intake and output measurements), absorption limits, surgical time limits, procedure staffing levels and a communication plan for the team to follow during the procedure. A formal fluid deficit record (intake/output) can be created for hysteroscopy surgery and be a part of the patient's medical record.[36] Additionally, patient care plans can include plans for untoward events and should be periodically reviewed by the perioperative team who care for patients during hysteroscopy procedures.

SUMMARY

The nurse has an important role in preventing serious complications from operative hysteroscopy, including the use of the correct fluid distention media and the monitoring of fluid absorption. The hospital may consider using mechanical means to measure and monitor fluid deficit, which can be more efficient and effective to calculate fluid deficit. Patient complications may be prevented by using proper precautions and maintaining effective communication between members of the surgical team during the procedure. Diligence in frequent patient and fluid monitoring as well as surgical time, effective staff training on procedures and equipment, and proper equipment utilization are the most effective methods to prevent intraoperative complications and to ensure positive patient outcomes.

GLOSSARY

Cation	An ion with a positive electrical charge.
Electrolyte	An ionized salt (such as sodium, potassium and chlorine) in blood, tissue fluids and cells that conducts electricity and provides the means by which electrochemical impulses are transmitted in nerve and muscle fibers.
Electrolytic Solutions	A fluid that can conduct electricity; recommended by AAGL for use in diagnostic cases and in operative cases in which mechanical, laser or bipolar energy is used. Electrolytic solutions cannot be used in conjunction with monopolar electrosurgical devices.
Embolism	Sudden obstruction of a blood vessel by debris such as an air bubble, particulate matter, blood clots, or cholesterol-containing plaques.
Endometrial Ablation	Removal of the mucous membrane that lines the uterus and 2-3 cm of the underlying smooth muscle layer.
Fluid Deficit	The difference between the volume of distention fluid instilled into the uterine cavity and the volume of fluid removed through the out-flow channel of the hysteroscope, plus fluid collected from the drapes or inadvertently lost in drapes and surrounding area of the operative table. The deficit closely represents the amount of fluid that may have been absorbed into the patient's vasculature.
Hemolysis	The swelling and rupture of red blood cells when they become excessively permeable to sodium and fill with water.
Hypertonic Solution	A solution with a higher salt concentration than in normal cells of the body and blood.

Hypocalcemia	Abnormally low blood calcium level.
Hypokalemia	An abnormally low blood potassium level.
Hyponatremia	An abnormally low concentration of sodium ions, serum sodium is less than 135 mEq/L.
Hypotonic Solution	A solution with a lower salt concentration than in normal cells of the body and blood.
Hysterectomy	Surgical removal of the uterus.
Hysteroscopy	Visual examination of the uterine cavity with a small endoscope passed through the cervix.
Intrauterine Pressure	The amount of pressure exerted against the walls of the uterine cavity. The IUP is influenced by the distention fluid installation pressure, which may be dictated by the infusion pump pressure setting or by gravity flow.
Intravasation	The absorption of the uterine distention fluid through the uterine vasculature.
Isotonic Solution	A solution that has the same salt concentration as the normal cells of the body and blood.
Mean Arterial Pressure (MAP)	The average force applied to arterial walls through the cardiac cycle. It is a function of cardiac output, systemic vascular resistance, and central venous pressure. MAP can be determined by using the formula: Mean arterial pressure = diastolic blood pressure + 1/3 pulse pressure. (Pulse pressure = systolic – diastolic blood pressure.) The usual range is 70-110.
Myomectomy	Excision of submucous fibroids from the uterus.
Osmosis	The passage of water from a region of high water concentration through a semi-permeable membrane to a region of low water concentration. Osmosis is a passive transport method (ie, one that does not require the expenditure of energy).

Partial Pressure
The pressure that one component of a mixture of gases would have if it alone occupied the volume.

Polypectomy
Excision of polyps from the uterus.

Sodium Pump
Also known as Sodium-Potassium pump. The active transport system (one requiring the expenditure of energy) that maintains the equilibrium of sodium and potassium ions in body cells by moving these two ions in opposite directions across the plasma membrane. Body cells contain relatively high concentrations of potassium ions but low concentrations of sodium ions. Sodium pumps maintain these concentrations by pumping three sodium ions out of the cell for every two potassium ions pumped in.

Transection of Uterine Septa
Gynecological procedure to correct the condition in which the vaginal opening of the uterus is divided into two parts by a membranous wall.

Uterine Biopsy
Procedure to obtain a tissue sample from the uterine wall for microscopic examination, usually to establish a diagnosis.

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