Literature Review

Distention Media in Hysteroscopy for Diagnostic and Operative Procedure

Media Distensi untuk Histeroskopi Diagnostik dan Operatif

Wachyu Hadisaputra, Farani Harida Putri, Ramadhina

Department of Obstetrics and Gynecology
Medical Faculty of Indonesia University/
Dr. Cipto Mangunkusumo Hospital
Jakarta

Abstract

Objective: Hysteroscopy is the "gold-standard" procedure used to describe the morphology of uterine cavity and the presence of intrauterine lesions and it is a minimally invasive intervention that can be used to diagnose and treat many intrauterine and endocervical problems. Hysteroscopy requires uterine distention for the effective visualization of the uterine cavity and the clearing of blood and tissue debris. Options for uterine distention include insufflation with carbon dioxide (CO_2) gas, and instillation with electrolytic and nonelectrolytic liquid distention media. In this review, we would like to review known available distending media and its characteristics for diagnostic and operative hysteroscopy.

Method: Literature review.

Conclusion: Carbon dioxide and normal saline are the most preferable distention media for diagnostic hysteroscopy. There is no significant difference between these medium in terms of visualization quality, but most practitioners prefer to use normal saline because of it's availability and acceptability, quick performance, fewer additional procedures, more satisfaction rate, and good visualization. Low viscosity fluids are the most preferable media for operative hysteroscopy. Low viscous-electrolytic fluids, mostly normal saline is recommended in operative cases using mechanical, laser or bipolar energy that requires no electricity. Nonelectrolytic low-viscosity fluids are most preferable for extensive operative procedures using electrosurgery. Mannitol are chosen over glycine or sorbitol when using monopolar electrosurgery.

[Indones J Obstet Gynecol 2010; 34-3: 150-4]

Keywords: hysteroscopy, distention media, diagnostic procedure, operative procedure

Abstrak

***Tujuan**: Histeroskopi merupakan metode standar baku untuk mengetahui morfologi kavum uteri serta kelainan yang ada di dalamnya. Metode ini merupakan tindakan dengan invasi minimal yang dapat digunakan baik untuk diagnosis maupun tatalaksana kelainan intrauterin dan endoservik. Histeroskopi membutuhkan media distensi untuk mendapatkan gambaran rongga uterus yang baik serta untuk menghilangkan darah dan debris. Berbagai macam media distensi yang ada antara lain gas* CO_2*, cairan nonelektrolitik dan cairan elektrolitik. Tulisan ini ditujukan untuk menelaah berbagai media distensi yang tersedia serta karakteristik-nya masing-masing untuk digunakan pada histeroskopi diagnostik dan operatif.*

***Metode**: Tinjauan pustaka.*

***Kesimpulan**: Karbon dioksida (*CO_2*) dan cairan NaCL 0,9% (salin) merupakan media distensi yang paling banyak disukai untuk histeroskopi diagnostik. Tidak ditemukan perbedaan yang bermakna pada kualitas gambar yang dihasilkan kedua media distensi tersebut, namun kebanyakan ahli lebih menyukai menggunakan cairan salin karena mudah didapat, waktu yang digunakan lebih cepat, prosedur lebih mudah, lebih nyaman dan gambaran yang baik. Cairan berviskositas rendah lebih disukai untuk media distensi pada histeroskopi operatif. Cairan salin direkomendasikan untuk tindakan operatif menggunakan metode mekanik, laser atau energi bipolar. Cairan non-elektrolitik dengan viskositas rendah merupakan pilihan pada prosedur operatif menggunakan energi listrik mono-polar, dan manitol lebih di pilih dibandingkan glisin atau sorbitol untuk keperluan tersebut.*

[Maj Obstet Ginekol Indones 2010; 34-3: 150-4]

***Kata kunci**: histeroskopi, media distensi, prosedur diagnostik, prosedur operatif*

Correspondence: Farani Harida Putri. Japos Graha Lestari B2/28 Ciledug Tangerang 15152, Telp.: 0811 966 370, Email: hp_farans@yahoo.com

INTRODUCTION

Hysteroscopy is commonly used to get the view of the uterine cavity and to know the lesion of the intrauterine in, it also could be used as a "gold-standard" method to look inside the uterine cavity through transcervical approach.[1] It is known that this method was more cost-effective and safe compare to hysterectomy. It is also less invasive and has lower morbidity, shorter recovery times, lower cost and fewer long-term side effects compare to hysterectomy, for some cases.[2]

The term "minimally invasive intervention" are really suitable for hysteroscopy, because by using a small fiberoptic endoscope passed through the cervix, a distended uterine can be examined. Surgical instruments can be introduced through the scope to cut or coagulate tissue. And for that reason hysteroscopy can be used to diagnose and treat many intrauterine and endocervical problems. Because of its safety and efficacy, hysteroscopy procedure are now a standard procedure in gynecology practice.[2,3]

To get the effective visualization of the uterine cavity, the distended uterus are required. There are some choices for distention media in hysteroscopy such as carbon dioxide (CO_2) gas, and many electrolyte or non electrolyte containing liquids. In this review, we would like to review some known available distending media and its characteristics for diagnostic and operative hysteroscopy.[4]

Classification of Uterine Distending Media

The important role of distention media is to expand and enhance magnification in the visualization of uterine cavity. Adequate pressure that correlates to the thickness and tone of uterine muscles, and refractive index of each media is needed.[3,4]

Patient's condition and type of procedure determines the choice of distention media. Basically, distention is achieved by means of insufflation with carbon dioxide (CO_2) gas or by instillation of an electrolytic or non-electrolytic fluid. Fluids can be used for both diagnostic and operative procedures.[1,3-10]

Based on the American Association of Gynecologic Laparoscopist (AAGL) consensus in 2000, electrolytic fluid is recommended to be used in diagnostic cases and operative cases using mechanical, laser or bipolar energy. It is not recommended for use in procedures with monopolar electrosurgical devices because of its capability to conduct electricity.[5]

Non-electrolytic solutions eliminate electrical conductivity issues, but increases risk due to osmolality difference to body fluids. Different physiological effects are developed within use of different solutions. Several studies emphasis on hyponatremia, and even cease the use of water as distention fluid in the end of the eighties due to water intoxication and hemolysis.[3]

Table 1. Types of distention media.[3]

Classification
Gaseous
CO_2
Liquid-non electrolytic
Hyskon
Glycine
Sorbitol
Mannitol
Liquid-electrolytic
Normal saline
Ringer lactate

Table 2. Characteristics of an "ideal" medium.[3]

Isotonic
Clear visibility
Ease of instrument cleaning
Minimal impact on body fluids volumes
Ease of hysteroscopic delivery
Non-hemolytic
Non-conductive

Gaseous Media

Carbon dioxide (CO_2)

Carbon dioxide (CO_2) is the gaseous media that can be used as a distended media for hysteroscopy. It has refractory index as same as the air (1.0), so that it can provide a superb view inside the uterine cavity at low magnification. It also has some advantages that make the CO_2 really useful in office-based diagnostic hysteroscopy. Those advantages are, it can easily flows through narrow channels in small-diameter scopes, rapidly absorbed, and by respiration can be easily clean out from body.[3-9]

However CO_2 also has some limitations, it is not easily mix with the blood. If this condition happens, there will be a bubbles form in this interaction, and causes the uterine cavity hardly visible.[3,4] The second limitation is, CO_2 can not clear blood from the scope.[3-9] Those limitations make CO_2 really useful in diagnostic hysteroscopy but limited in operative hysteroscopy procedure.[3,4]

In order to perform the best diagnostic hysteroscopy procedure with CO_2 as the distending media, the mucosal contact of the cervix must be avoided by using a tight fit of endoscope. By doing that procedure, the bleeding can be avoided. CO_2 can be a good choice when small diagnostic sheaths (3mm) are used, though the clearance around the telescope is limited.[3,4]

In order to perform the hysteroscopy, it is important to control intrauterine pressure. By using CO_2 as a distending media through hysteroscopic insufflators, the flow and minimal-maximal limit of the pressure can be controlled. A flow rate to 40 - 60 ml/min at a maximum pressure of 100 mmHg is generally accepted as safe. It has been recommended that an initial flow rate of 30 ml/min is the best to dilate and view the cervix followed by an increase to 40 to 50 ml/min flow to view the uterine cavity. Cardiac arrhythmias, embolism, and arrest are some potential side effects if the pressure and rate are higher than 50 ml/min flow. Deaths have been reported when CO_2 has been infused without proper flow and pressure regulator. The hysteroscopic insufflator should be calibrated regularly (every 6 - 12 months) for accuracy of pressure and flow readings.[2]

Until now, CO_2 is still the first-rate medium for diagnostic hysteroscopy procedure. CO_2 can be used in a simple operative hysteroscopy procedure such as intrauterine device (IUD) removal, polypectomy, or directed endometrial sampling.[4]

Fluid

Many literature study mentioned the superiority of fluid media, whether of high or low viscosity, gas media in their use in uterine distention, because of its ability to distend uterine cavity symmetrically and to clear the visual field from blood, mucus, bubbles, and tissue fragments. A pressure of 75 mmHg is sufficient to accomplish uterine distention.[2-4,7]

Patients undergoing uterine distention by fluid media face risks of adverse events ranging from fluid escaping the uterus through efflux systems, leakage to the cervix and tuba, or intravasation, with the last happening mostly with a fluid pressure of over 100 mmHg. These hypotonic fluids must not be absorbed excessively. Hence for patient safety, the delivery of the fluid media, as well as the recording of its inflow and outflow volume are mandatory and have been designed in various methods.[1-3,5]

Normal saline (sodium chloride 0.9% solution), lactated ringer solution

Normal sodium chloride solution and lactated ringer solution are common solutions used for distending media. Isotonic, conductive, low-viscosity are the characteristics for those solutions. Therefore their utility are prominent in diagnostic hysteroscopy but limited in operative purpose.[1-4] These solutions are also readily available in hospital day care centre.

Refractive index for saline is 1.37, slightly different from CO_2, but little difference may be appreciated clinically.[4] The capability for mixing with the blood makes normal saline useful in an operative sheath with multiple ports or continues flow. The blood and saline mixture may be suctioned until a clear field is obtained.[3,4,7]

Normal saline is a preferred medium for hysteroscopy using Nd:YAG laser, but its utility is less when performing electrosurgery with standard instrumentation of operative hysteroscopy Surgical procedures using mechanical, laser, monopolar, and bipolar energy are safe using this medium.[2] Many gynecologists who perform laser ablation or bipolar ablation of the endometrium prefer saline because of its safety.[3-5,7]

There are also some limitations in using these solutions as a distended media. The low viscosity liquids can flow through the tubal ostia, carrying cellular debris, bacteria, and other flotsam into the oviducts and out into peritoneal cavity. They tend to leak retrograde from the uterus through the cervix into the vagina.[3,4] Hyponatremia can be one of the consequence of intravasation of fluid overload.[3-5,7]

Use of 5% mannitol, 3% sorbitol, and 1.5% glycine

These fluids can be used in diagnostic and operative hysteroscopy procedures because of their hypotonic, nonconductive and low-viscous nature. They enhance imaging in cases of bleeding, but raises risks of intravascular absorption, especially when used more than two liters. Volume overload and hyponatremia usually follows in cases of absorption, requiring watchful monitoring during the use of these fluids. Stopping the procedure and administering diuretics induce manitol intravasation to extracellular compartment. Work up for hyperglycemia risk is done in cases of sorbitol intravasation, because their intravasation will result in metabolism to fructose and glucose. Glycine will be metabolized to ammonia, so it has to be monitored vigilantly in patients with impaired hepatic function.[2-4,7]

Dextrose 5% in water or water

Dextrose 5% in water (D5W) is an non-conductive distending media and also low viscosity solutions. It can be mix with the blood, and may be used in high-flow situations theoretically (D5W) has greater limitations than normal saline or Lactated Ringer's. It can cause dilutional hyponatremia though it is an electrolytic non-conductive.[2-4]

Water has optical properties that provide excellent visualization. This medium is severely limited in its operative indications because of its ability to cause intracellular hemolysis and subsequent potential for renal damage. It is the reason why water is not the best choice for hysteroscopy.[3]

1,5% Glycine

It is low in viscosity and based in mixture of 1.5% amino acid. Risk for intracellular hemolysis is small, but risk for volume overload and concurrent hyponatremia is considerable. Glycine is metabolized first to urea and then to ammonia so it is used with prominent concern in patients with impaired liver function for risk of ammonia intoxication. Acute transient visual disturbance and coagulation defects is also linked in the use of this fluid.[3,4]

Dextran 70

Dextran 70 (Hyskon) is a nonelectrolytic, nonconductive, contains glucose into high molecular weight polymer and the only high-viscosity medium available.[3,4]

There are some advantages that offered by Hyskon. The clarity makes Hyskon is one of the the best media to use for performing operative hysteroscopy, since debris can be aspirated and, if required, the cavity can be flushed with fresh material.[3] It can be the easiest material that the beginner can learn panoramic hysteroscopy, since it consistently and promptly dilates the cervix canal and uterine cavity. The thickness of Hyskon diminishes the likehood of massive retrograde leakage characteristic of other liquid media. It can dilate the cervix by dipping the dilators in the material before engaging them in the external os because of its excellent lubricant characteristic.[4] This solution provide an excellent medium for performing operative hysteroscopy and also been used as a postsurgical adjuvant in attempt to decrease adhesions.[3,4]

However this solution is poorly mixed with blood and it is found difficult to evacuate the solutions because the viscosity of the solutions cause it difficult to deliver through the relatively small inflow channels of the hysteroscope.[3,4]

We need to control the volume amount to avoid fluid overload. With each 100 ml of Dextran 70 absorbed, the intravascular volume increases by 800 ml.[7,8]

Historically, Hyskon had proven to be an exceedingly safe medium. Allergic reactions and anaphylaxis, fluid overload, pulmonary edema, disseminated intravascular coagulopathy, anuria and destruction of instruments are adverse effects of this medium.[3,4]

Comparison of Hysteroscopic Distention Media

In general, there are no differences in image quality in the use of CO_2 and normal saline, both offers high quality images (Nagele et.al. 1996, Paschopoulos et.al. 2004). Several literatures describe no difference in patient characteristics, indication for procedure and visual findings.[1,5,7-10]

Many studies compare the use of normal saline and carbon dioxide as a common distention media for daily diagnostic hysteroscopy procedures. Both differ in procedure technique, administration mode and patient's tolerance to media.[1,5]

Soderstorm et.al. (1992) recommends CO_2 for diagnostic hysteroscopy. Whereas, Goldfarb et. al. (1996) mentioned vision impairment due to inadequate distention and disturbance of mucus, bubbles and blood in the use of CO_2 in a procedure to determine submucous myomas' mass percentage. Nagele et. al. (1996) also reported higher occurrence of bubbles in the use of CO_2. Therefore, diagnosis of myomas are more accurate when normal saline was used.[1] In other aspect, CO_2 offers low risk of side effects, less pelvic discomfort, and because there is no magnification (CO_2 refractive index is the same as air = 1), it obtains wider visual field than normal saline; whereas discomfort has been reported with normal saline use, especially in premenopausal nullipara.[1,5,7-10]

On the contrary, less problems arise with normal saline use, because distention is more rapid, less risk of vagal reaction, rapid reabsorption from peritoneal cavity in case of transtubal leakage, easy insufflation by using pressure bag, with low viscosity and miscibility in the blood. There is magnification of visual field with normal saline (refractive index = 1.37 bigger than air = 1). Operator satisfaction rate and patient acceptability is bigger in the use of normal saline to CO_2 because the use of normal saline is associated with quicker, fewer additional procedure (e.g. cervical canal dilation, cervical anaesthesia), and feasibility for some minor procedures. In short, normal saline are more convenient in technical aspect, thus more preferable than CO_2 in diagnostic procedure.[1,5,7-10]

Table 3. Comparison of hysterocopic media.[4]

Equipment Type/subtype	Operative	Office use	Miscibility with blood	Complex	Safety
Gaseous					
CO_2	+	+++	+	+	+
Liquid non electrolytic*					
Hyskon	+++	+++	+++	+	+
Glycine	+++	+	+	+++	+
Sorbitol	+++	+	+	+++	+
Mannitol	+++	+	+	+++	+
Liquid electrolytic**					
Normal saline	+++	+	+	+++	+++
Ringer lactate	+++	+	+	+++	+++

Note: Lasers may be used with any medium.
**Monopolar electro surgery*
***Bipolar electro surgery*
+++ highly advantageous; ++ average; + unsatisfactory

Operative hysteroscopy

Operative "therapeutic" hysteroscopy has similar technique with diagnostic hysteroscopy, but it needs bigger endoscope (7 - 8 mm) in outer diameter and can result in cervical dilatation. It requires distended uterine cavity, depending on the procedure, the most suitable media is selected.[11]

Targeted biopsy, removal of endometrial polyps, removal of submucous leiomyomas, division of uterine septa, removal of 'lost' intrauterine devices and other foreign bodies, lysis of intrauterine adhesions, endometrial ablation by laser or electrosurgery, tubal cannulation, chorionic villus sampling, tubal occlusion by electrocoagulation, cryocoagulation, chemical and mechanical are the kind of procedure that can be done by operative hysteroscopy.[11]

Role of low viscosity fluids as media distention in operative hysteroscopy

The role of low viscosity fluid in operative procedures is similar with diagnostic procedures: they distend the uterine cavity and provide clear visualization as they lavage the blood clots and debris that may form during the operation. There are two types of low viscosity fluid: electrolyte-containing and non-electrolytic fluids.[11]

The most common electrolyte-containing fluids used in operative hysteroscopy procedure are normal saline (0.9% NaCl), dextrose 5% in 50% saline (0.45% NaCl) and Ringer's lactate solution. They are crystalloids that sustain osmotic gradient balance between extravascular and intravascular compartments in the body. All are equally effective as a distending media and provides good visualization.[6,11]

In 2000, American Association of Gynecologic Laparoscopists (AAGL) recommends the use of these electrolytic fluids in operative procedures requiring no electricity, such as mechanical, laser or bipolar energy. Their electrical conductivity prevents use with monopolar electrosurgical devices. Procedures are relatively safer because electrolytes prevent hyponatremia if intravasation occurs. Nevertheless, sodium concentrations in these fluids can expand plasma volume, causing an isotonic fluid overload that leads to the risk of pulmonary edema and congestive heart failure. Consequently, strict monitoring upon fluid deficit in each procedure should not be excluded. The amount of fluid instilled and recovered should be monitored and measured cautiously to predict risk of complications that can arise because of intravasation.[6,11,14]

Electrolytic fluids are good conductors but may disperse electrical output erratically. Therefore, for safety reason, non-electrolytic fluids are used during electrosurgery with either the hysteroscope or resectoscope. These fluids are dextrose 5% in water, glycine 1.5%, sorbitol 3%, combination of sorbitol 2.8% and mannitol 0.5% and mannitol 5% solution. Water was included in this list until the late 80's when it was discontinued due to water intoxication and hemolysis. There are no major differences regarding practicality and visualization among all these fluids, regardless of the osmolality variations.[6]

Hyponatremia is the main risk when non-electrolytic solutions absorption occurs. Intravasation of hypotonic fluid will result in accumulation of free water that will move from intravascular to extracellular and intracellular compartments. Cerebral edema and increased intracranial pressure may develop and if untreated will lead to pressure necrosis of the brain by the skull, cerebral and the fatal brain stem hernia-tion. Permanent brain damage, coma, or death may result. (Glasser, 2005). Mannitol 5%, an osmotic diuretic, decreases this risk; nonetheless, in the acute state, sodium may be lost and therefore, careful monitoring of these patients is required.[6,11,14]

Several procedure or devices used in operative hysteroscopy requires certain distention media. Endometrial ablation using laser, formerly with yttrium aluminum garnet (Nd:YAG) laser and later using an argon laser formerly uses normal saline with 5% dextrose and later without dextrose.[12] Extensive operative procedures, in particular submucous myomectomy, uses glycine or sorbitol. Mannitol instead of gylcine or sorbitol is chosen when using monopolar electrosurgery (AAGL 2000).[6]

CONCLUSIONS

Hysteroscopy is a minimal-invasive intervention that has a diagnostic and therapeutic value in many intrauterine problems. One key for successful hysteroscopic procedure is a wise selection of medium for uterine distention, either with a gas (CO_2) or liquid medium. Regardless of technique, indication or distention media selection, watchful monitoring of media inflow and outflow is mandatory.

Carbon dioxide and normal saline is the most popular distention media for diagnostic hysteroscopy. There is no significant difference between both, but normal saline seems to be superior because it is easily available, more acceptable, and results in quicker procedure time, fewer additional procedures, and more satisfaction rate.

Distention media selection for operative hysteroscopy depends highly on procedure and types of device. Low viscosity solution, in particular normal saline, is recommended in operative cases using mechanical, laser or bipolar energy that requires no electricity. Non-electrolytic solutions like glycine and sorbitol are chosen for extensive operative procedures using electrosurgery device, whereas mannitol is chosen for monopolar electrosurgery.

REFERENCES

1. Litta P, Bonora M, Pozzan C, Merlin F, Sacco G, Fracas M. Carbon dioxide versus normal saline in out patient Hysteroscopy. Hum Rep 2003; 18 (11): 2446-9
2. Petrozza JC, Attaman JA. Hysteroscopy. eMedicine.com. Retrieved from http://emedicine.medscape.com/article/267021-overview (Updated 2010, Jan 7)
3. Bieber EJ. Distention Media. In: Bieber EJ, Loeffer FD, editors. Hysteroscopy, Resectoscopy and Endometrial Ablation. New York. Informa Health care 2003; 55-66
4. Baggish MS. Distending media for hysteroscopy. In: Baggish MS, Valle RF, Guedi H. Editors. Hysteroscopy: visual perspectives of uterine anatomy, physiology and pathology. Third ed. New York: Lippincott Williams & Wilkins. 2007; 200-10
5. Nagele F, Wieser F, Deery A, Hart R, Magos A. Endometrial cell dissemination at diagnostic hysteroscopy: A perspective randomized cross-over comparison of normal saline and carbon dioxide uterine distension. Hum Rep. 1999; 18 (11): 2739-42
6. Swanson DY, Wilma B, Witt D. Fluid Selection and management in hysteroscopy. Retrieved from http://www.cor-excel.com/rw/fluid.selection.hysteroscopy.title.htm at 2010, Feb. 13th
7. Paschopoulos M, Kaponis A, Makrydimas G, Zikopoulos K, Alamanos Y, Donovan PO. Selecting distending medium for out-patient hysteroscopy. Does it really matter? Hum Rep 2004; 19 (11): 2619-25
8. Shankar M, Davidson A, Taub N, Habiba M. Randomised comparison of distension media for outpatient hysteroscopy. BJOG 2004; 111: 57-62
9. Brussco GF, Arena S, Angelini A. Use of carbon dioxide versus normal saline for diagnostic hysteroscopy. Fertil Steril 2003; 79 (4): 993-7
10. Revel A, Shushan A. Investigation of infertile couple-hysteroscopy with endometrial biopsy is the gold standard investigation for abnormal uterine bleeding. Hum Rep 2002; 7 (8): 1947-9
11. Valle RF. Manual of clinical hysteroscopy. UK: Parthenon Publishing Group. 1998: 54-77
12. Arici A, Seli E editors. Non-invasive management of gynecologic disorders. India: Informa UK Ltd. 2008
13. Pinion SB, Parkin DE, Abramovich DR, Naji A, Alexander DA, Russell IT. Randomised trial of hysterectomy, endometrial laser ablation, and transcervical endometrial resection for dysfunctional uterine bleeding. BMJ 1994; 309: 979-83
14. Bradley LD. Cutting the risk of hysteroscopic complications. J Fam Pract 2004; 16: 1
15. Sodersrom RM. Distending the uterus: what medium is best? Clin Obstet Gynecol 1992; 35 (2): 225-8