

The Application Effect of Hysterosalpingography in Infertility

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Abstract: *Objective:* To analyze the application effect of hysterosalpingography in infertility and provide a reference for the clinical diagnosis of infertility. *Methods:* A total of 80 infertile patients admitted to Guangdong Women and Children's Hospital from March 2023 to March 2024 were selected as the research objects. They were randomly divided into two groups: the control group and the observation group, with 40 patients in each group, and 80 fallopian tubes were observed in each group. The control group underwent traditional gynecological examinations, while the observation group underwent X-ray hysterosalpingography ^[1]. Four indicators, namely diagnostic accuracy, specificity, sensitivity, and excellent/good rate of image quality, were compared between the two groups to evaluate the diagnostic effect on the fallopian tubes. *Results:* The values of the above four indicators in the observation group were 95.00%, 93.33%, 95.38%, and 97.50% respectively, while those in the control group were 76.25%, 73.33%, 70.77%, and 80.00% respectively. There were statistically significant differences in the four indicators between the two groups ($P < 0.05$). The incidence of adverse reactions in the observation group was 5.00%, and that in the control group was 25.00%, showing a significant difference with statistical significance ($\chi^2 = 6.275$, $P < 0.05$). *Conclusion:* Modified hysterosalpingography for infertile patients can significantly improve the diagnostic effect of infertility and reduce the incidence of adverse reactions, which has high clinical promotion value.

Keywords: Hysterosalpingography; Infertility; Fallopian tube patency; Image quality; Diagnosis; Adverse reactions

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1. Introduction

There are various examination techniques for infertility, with commonly used clinical methods including laparoscopic chromopertubation, X-ray fallopian tube examination, and hysterosalpingography (HSG). The increasing demand for female fertility diagnosis and treatment, continuous updates in imaging equipment and materials, and improvements in HSG techniques have led to new progress in the application of traditional X-ray in HSG. Additionally, the use of CT, MRI, and ultrasound (US) in HSG has gradually gained clinical recognition and acceptance. With changes in living environments and habits, the incidence of infertility is increasing, mainly manifested as fallopian tube obstruction or patency with difficulty. Different examination techniques for this

condition have distinct characteristics ^[2]. Among them, laparoscopic chromopertubation is the most accurate technique for infertility examination, but it is not widely used clinically due to its high cost, long duration, and potential for examination-related trauma. X-ray fallopian tube examination, with minimal damage, is one of the most commonly used methods, featuring relatively low rates of misdiagnosis and missed diagnosis. In this paper, 80 infertile patients admitted to the hospital were selected as the research subjects. The application effects of traditional gynecological examination and X-ray HSG were compared, with the analysis as follows.

2. Materials and methods

2.1. General information

A total of 80 infertile patients admitted to our hospital from March 2023 to March 2024 were selected as the research objects, with a total of 160 fallopian tubes. The research objects were randomly divided into two groups: the control group and the observation group, with 40 patients and 80 fallopian tubes in each group. The age of the control group ranged from 22 to 44 years old, with an average of (28.18 ± 3.89) years old, including 17 cases of primary infertility patients, with a total of 34 fallopian tubes. The age of the observation group ranged from 21 to 42 years old, with an average of (28.58 ± 3.12) years old, including 13 cases of primary infertility patients, with a total of 26 fallopian tubes. There was no statistically significant difference in the average age and the number of primary infertility patients between the two groups ($P > 0.05$), so the two groups were comparable.

2.2. Inclusion and exclusion criteria

2.2.1. Inclusion criteria

- (1) Diagnosed as infertility by clinical diagnosis
- (2) Suspected of fallopian tube obstruction or patency.
- (3) Patients signed the informed consent form.
- (4) Hysterosalpingography was performed 3–7 days after menstruation.

2.2.2. Exclusion criteria

- (1) Patients with other pathogenic factors of infertility, including but not limited to vaginal diseases, genital inflammation, and hydrosalpinx.
- (2) Patients with underlying diseases.

2.3. Methods

2.3.1. Laparoscopic dye test

Laparoscopic salpingostomy was performed, with methylene blue solution used to observe the overflow of the dye from the fimbrial end of the fallopian tube.

2.3.2. Gynecological examination

Patients in the gynecological examination group underwent routine gynecological examinations for infertility diagnosis. Specifically, patients reported their pregnancy preparation experiences and truthfully described their physical symptoms upon inquiry by the examining doctor. A preliminary diagnosis was then made through vaginal palpation and observation of external morphology. Additionally, patients were guided to the ultrasound

examination room for transvaginal ultrasound to further identify infertility and assess fallopian tube patency based on ultrasound images. Patients then received targeted treatment as prescribed by the doctor.

2.3.3. Hysterosalpingography (HSG)

Patients were instructed to prepare for the examination: no sexual intercourse 3 days before the examination, and emptying of the bladder and bowels before the procedure. Atropine, an antispasmodic (Xinxiang Changle Pharmaceutical Co., Ltd.; National Drug Approval No. H41020202), was administered intramuscularly. Before the angiography, all instruments were prepared and disinfected, including perineal hole towels, kidney basins, cervical clamps, vaginal speculums, as well as gloves, syringes, and disposable hydrotubation catheters. Thirty minutes before the operation, 50 mg of flurbiprofen axetil injection was administered intravenously. The patient was placed in the lithotomy position. The vagina and vulva were disinfected using conventional methods, and sterile towels were laid. The operator wore gloves according to standard, used a speculum to expose the vagina and cervix, disinfected the fornix and cervix with iodophor, fixed the anterior lip of the cervix with a uterine clamp, and probed the depth of the uterine cavity^[3]. A water-filled catheter was inserted into the uterine cavity through the cervix, and 1–2 mL of gas was injected into the balloon. The catheter was slightly adjusted to ensure tight adherence to the internal cervical os, preventing leakage during drug injection. A syringe was filled with contrast medium, connected to the injection lumen, and fixed to a high-pressure injection pump.

Under X-ray fluoroscopy, 20 mL of iohexol injection (GE Pharmaceutical Co., Ltd., batch number YBH00982017, specification: 50 mL:17.5 g) was slowly injected into the uterine cavity to observe the morphology of the uterus and fallopian tubes. The first image was taken when both the fallopian tubes and uterine cavity were fully filled with contrast medium. If significant resistance to injection or non-visualization occurred, the injection was stopped to avoid fallopian tube rupture or mucosal tearing due to obstruction. If no abnormalities were found, the injection continued, and a second image was taken after complete injection. A third image was taken at the same site 15–20 minutes later. The diffusion of the contrast medium was analyzed to determine the location of fallopian tube obstruction and assess patency based on its distribution in the pelvic cavity^[4]. The diagnostic criteria for tubal patency were the presence of extensive, flocculent contrast medium visualization in the pelvis. Sparse contrast diffusion in the pelvis suggested tubal suboptimal patency, with further observation for residual contrast in the fallopian tubes and signs of hydrosalpinx. The presence of localized, well-defined contrast medium at the fimbrial end indicated suspected hydrosalpinx or adhesions. Absence of pelvic contrast diffusion indicated bilateral tubal occlusion.

2.4. Observation indicators

- (1) Comparison of fallopian tube patency between the two groups of patients: Count the number of cases with patent and blocked fallopian tubes in each group respectively.
- (2) Comparative analysis of diagnostic effects between the two groups: Laparoscopic chromopertubation was used as the gold standard to analyze the diagnostic accuracy, specificity, and sensitivity of the two groups of patients.
- (3) Comparative analysis of image quality between the two groups: The image quality was divided into three grades: excellent, good, and poor; Excellent: The hysterosalpingography is good with clear visualization, having high diagnostic value; Good: The visualization is clear, with some blurred details, but it does not affect disease diagnosis; Poor: The image has low contrast and blurred visualization, failing to show the condition of the uterus and fallopian tubes, thus affecting disease diagnosis.

- (4) Comparison of the incidence of adverse reactions between the two groups: Compare three indicators, namely allergic reactions, lymphatic venous reflux, and moderate/severe abdominal pain.

2.5. Statistical processing

Statistical analysis was performed using SPSS 23.0 software. Measurement data were expressed as mean \pm standard deviation ($\bar{x} \pm s$) and analyzed by t-test. Count data were presented as number (percentage) [n (%)] and examined using the chi-square (χ^2) test. A P -value < 0.05 was considered statistically significant.

3. Results

3.1. Comparison of detection results of tubal patency and tubal obstruction between the two groups

The results of laparoscopic chromopertubation test showed that 15 fallopian tubes were patent and 65 were obstructed; the examination results of the observation group showed that 17 fallopian tubes were patent and 63 were obstructed; in the control group, 26 fallopian tubes were patent and 54 were obstructed, as shown in **Table 1**.

Table 1. Comparison of detection results of tubal patency and tubal obstruction between the observation group and the control group

Group	Category	Laparoscopic dye perfusion test		Total
		Unobstructed	Obstructed	
Observation	Unobstructed	62	1	63
	Obstructed	3	14	17
Control	Unobstructed	46	8	54
	Obstructed	19	7	26

3.2. Comparison of diagnostic effects between the two groups

Among the three indicators of diagnostic accuracy, sensitivity and specificity, the observation group was significantly higher than the control group, and the differences were statistically significant ($P < 0.05$), as shown in **Table 2**.

Table 2. Comparison of diagnostic effects between the observation group and the control group [n(%)]

Group	Number of Cases	Accuracy	Sensitivity	Specificity
Observation group	80	95.00 (76/65)	95.38 (62/65)	100.00 (15/15)
Control group	80	76.25 (61/80)	70.77 (46/65)	73.33 (11/15)
χ^2 Value		11.425	14.007	4.615
P Value		< 0.01	< 0.01	0.032

3.3. Comparison of the excellent and good rate of image quality between the two groups

In terms of the excellent and good rate of image quality, the observation group was significantly better than the control group, and the difference was statistically significant ($P < 0.05$), as shown in **Table 3**.

Table 3. Comparison of excellent and good rates of image quality between the observation group and the control group [n(%)]

Group	Number of cases	Excellent	Good	Poor	Excellent and good rate
Observation group	80	70	8	2	78 (97.50)
Control group	80	40	24	16	64 (80.00)
χ^2 value					6.135
<i>P</i> value					0.013

3.4. Comparison of the incidence of adverse reactions between the two groups

The incidence of adverse reactions in the observation group was significantly lower than that in the control group, and the difference was statistically significant ($P < 0.05$), as shown in **Table 4**.

Table 4. Comparison of the incidence of adverse reactions between the observation group and the control group [n(%)]

Group	Number of cases	Allergic reaction	Lymphatic venous reflux	Moderate to severe/severe abdominal pain	Incidence rate
Observation group	80	2	0	2	4 (5.00)
Control group	80	8	4	8	20 (25.00)
χ^2 value					6.275
<i>P</i> value					0.012

4. Discussion

In recent years, the incidence rate of female infertility has shown a significant increasing trend. As the most important influencing factor of female infertility, tubal factors account for 25% to 40% of the causes of infertility. Tubal factors are mostly caused by fallopian tube obstruction, which leads to resistance in the process of sperm transportation and fertilized egg transportation. In clinical practice, diagnosis is usually made based on whether the fallopian tubes are patent, and then appropriate treatment methods are selected to improve infertility. After excluding lesions, treatment should be given according to the actual performance of the patient to eliminate the obstruction site of the uterine fallopian tube. Uterosalphingography with iodine solution under X-ray guidance is a commonly used clinical examination method, which is easy to operate and has high sensitivity.

In this paper, iodine contrast agent is injected into the uterine fallopian tubes, and through X-ray examination, the development of the fallopian tubes is observed from the X-ray images. Based on the examination results, it is determined whether the fallopian tubes are patent, and the location of the blockage is accurately identified. Then, the iodine contrast agent is pushed in again to play an auxiliary therapeutic role.

Compared with gynecological examinations, X-HSG has obvious advantages: First, it has high safety and causes little harm to patients. Even if there are uncomfortable symptoms such as nausea and vomiting, they can disappear on their own in a short time. Second, it has high accuracy. Through this method, the location of fallopian tube obstruction can be quickly identified, and auxiliary treatment can be performed on the fallopian tubes, thus providing doctors with reliable diagnostic basis and consolidating the clinical effect. Third, the operation is simple. In the process of clinical diagnosis and treatment, reagents such as iodine water can be directly injected into the uterine cavity to

support the fallopian tubes, provide a smooth channel for the combination of sperm and egg, and thus improve the pregnancy rate of patients. At the same time, patients generally do not feel pain and can complete the diagnosis quickly without anesthesia ^[5,6]. By means of intuitive observation, it can objectively understand the morphological characteristics of the uterus and fallopian tubes, and has become a commonly used method for treating fallopian tube obstruction in clinical practice. Fourth, it has a wider application field. It can not only be used to check the shape of the uterine cavity, but also to examine the shape and adhesion of the fallopian tube cavity, as well as the contraction of the internal cervical orifice and the internal conditions of the uterus in patients with multiple miscarriages.

It is of great significance for the diagnosis and treatment of tubal infertility to accurately evaluate the patency and functional status of fallopian tubes. According to different approaches, it can be divided into transabdominal, translaparoscopic, transvaginal-cervical and transreproductive approaches. Due to its high cost, expensive expenses, difficult operation and easy damage to the fallopian tube mucosa, it is rarely used in clinical practice. In recent years, hysteroscopy has been widely used in clinical practice. It enters the abdominal cavity through laparoscopic puncture holes and enters the fallopian tube through the fimbrial end of the fallopian tube to observe the condition of the fimbrial end of the fallopian tube and the ampullary mucosa. Because it has certain invasiveness and limitations, it cannot be used as a routine examination method ^[7,8].

At present, there is no imaging method that can evaluate all structural and structural factors related to infertility, including lesions in the uterus and fallopian tubes. Fallopian tube angiography remains the preferred method for diagnosing tubal infertility. Hysterosalpingography (HSG) is the first-choice examination method for evaluating fallopian tube lesions. It has certain clinical application value in understanding the condition of fallopian tube lesions, assessing the patency of fallopian tubes, and determining the location of fallopian tube obstruction ^[9].

The use of contrast agents allows dynamic observation of the entire process of contrast enhancement in the uterine cavity and fallopian tubes. Meanwhile, multi-angle, multi-planar, and multi-perspective operations can be performed, which can avoid interference from parauterine muscle reflux. However, with the advancement of equipment and various new technologies, new vitality has been injected into the examination technology, ultimately benefiting patients and gaining clinical recognition and acceptance.

The conventional injection method using a fallopian tube angiography hydrotubation device is affected by the experience and technical level of the operator. If the contrast agent is pushed too slowly, with too little pressure or too small an injection volume, it will affect the imaging, thereby reducing the accuracy of disease diagnosis. Conversely, if the injection speed is too fast, the pressure setting is too high, or the injection volume is too large, side effects may occur, potentially causing abdominal pain in the patient. Additionally, rapid and excessive injection of the contrast agent can lead to overlapping when it reaches the fallopian tubes and pelvic cavity, hindering medical staff's observation of the imaging. This paper proposes an improved contrast agent injection method using an injection device, which maintains stable air pressure and flow rate during the injection of the contrast medium. This reduces the influence of manual operation and effectively prevents the occurrence of side effects. The method can significantly reduce exposure conditions, achieving a balance between radiation dose and image quality, and obtaining the best imaging effect with a reasonable radiation dose. The technology adopts a disposable vaginal speculum, which can be removed during angiography ^[10].

Administration of flurbiprofen axetil injection 30 minutes before the operation can prevent fallopian tube spasm, avoid false positive results, relieve cervical traction, and prevent vagal reactions in patients. Under normal circumstances, re-examination for patients 5–7 days after menstruation can yield better results, with a significant reduction in venous reflux. In cases of complete fallopian tube obstruction, irregular uterine cavity, or uterine malformation, it is necessary to ensure appropriate injection pressure and speed. During the angiography process,

dynamic observation should be conducted; if any abnormalities are detected, the injection should be stopped immediately, and corresponding treatment measures should be taken. In summary, X-ray hysterosalpingography can improve image quality, enhance examination accuracy, and reduce side effects in infertility examinations. It is a safe and effective method worthy of clinical promotion.

5. Conclusion

Modified hysterosalpingography demonstrates significant efficacy in improving the diagnostic accuracy of infertility while effectively reducing the incidence of adverse reactions. These advantages highlight its high clinical value and support its widespread promotion in infertility assessment and management.

Disclosure statement

The author declares no conflict of interest.

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