

Colour-coded Duplex Sonography for the Assessment of Fallopian Tube Patency

G N Allahbadia,* MD, DNB (New Delhi)

Abstract

Tubal patency was studied in 53 infertile women by means of colour-coded duplex sonography (CCDS) with transcervical injection of normal saline. In 47 women the patency was studied using a 2.5 MHz transabdominal transducer while in the last six cases, a 5.0 MHz vaginal probe was used. The results were compared with a conventional hysterosalpingogram (HSG) and laparoscopic chromopertubation. When the results of CCDS were compared with those of HSG and laparoscopy, there was a 92.5% agreement, that is, there was patency or occlusion of the Fallopian tubes. In addition, CCDS demonstrated all the soft tissues and their mobility. The colour signals generated by the air bubbles make it possible to demonstrate tubal patency on both sides separately. Vaginal CCDS offers a much better resolution with the advantage of lesser volume of normal saline being utilised. Tubal patency can be demonstrated in the presence of anatomical complications and requires only a small quantity of normal saline. This new tubal patency test is offered, not as a substitute for HSG, laparoscopy, hysteroscopy or salpingoscopy, but as a screening technique in the armamentarium of infertility investigations.

Keywords: Colour Doppler, Infertility, Investigation, Screening, Tubal factor

Introduction

The incidence of tubal sterility is on the rise because of an increasing prevalence of salpingitis, ectopic pregnancies and surgical interventions on the pelvic organs.¹ The main tools in the diagnosis of tubal disorders so far have been hysterosalpingography (HSG) and chromolaparoscopy. Each of these methods carries a risk of complications. Chromolaparoscopy requires anaesthesia and the surgical intervention carries a 1-2% risk of complications, such as infections or injury of the intestine or blood vessels.² Radiographic HSG involves radiation exposure and is also contraindicated in patients with idiosyncrasies to X-ray contrast agents.³ Also, inherent risks of ionising radiation on the oocyte which may result in congenital malformations if conception were to take place in the investigation cycle cannot be excluded.

Ultrasound scan does not require general anaesthesia or carry the risks outlined above. The technique has received wide acceptance by both technologists and physicians alike and has established itself as a definitive diagnostic test in many clinical situations. Previously, attempts have been made with the institution of sterile dextran, hyskon and antibiotic solutions under ultrasound scan guidance and tubal patency was deduced indirectly from the finding of increasing fluid in the pouch of Douglas.⁴⁻⁶ The results have been unsatisfactory. The aim of this prospective study using

colour-coded duplex sonography (CCDS) and normal saline was to demonstrate the diagnostic efficacy of colour-coded duplex sonography in assessing Fallopian tube patency as compared to hysterosalpingography and laparoscopic chromopertubation.

Materials and Methods

Fifty-three infertile women (average age 24.6 years; range 18-33 years) were recruited into this prospective, open clinical trial after obtaining their informed consent. These included 42 cases of primary infertility and 11 cases of secondary infertility. A detailed history was taken and the nature and duration of infertility were noted. After performing the other routine investigations for infertility, the patency of Fallopian tubes was checked, using colour-coded sonography in the preovulatory phase of the menstrual cycle. Forty-seven patients were examined by means of a transabdominal approach with a 2.5 MHz transducer (Vingmed Dasonics, Norway). The last six cases were assessed using a 5.0 MHz vaginal transducer. Hysterosalpingography was carried out the next day using Conray 280, a watersoluble dye. Diagnostic laparoscopy was performed under general anaesthesia in the secretory phase soon after the HSG. The colour-coded sonography, the HSG and the laparoscopic examinations were performed by three independent persons who did not know the corresponding findings of the other procedures. A

* Lecturer in Obstetrics & Gynaecology

Lokmanya Tilak Municipal Medical College & General Hospital

Address for Reprints: Dr Gautam Allahbadia, 262, My-Nest, Wadala, Bombay-400 031, India.

comparison of accuracy with the three methods of evaluating tubal patency was next done after analysing the collected data.

PROCEDURE

Colour-coded duplex sonography (CCDS) with a 2.5 MHz abdominal transducer was used to evaluate Fallopian tube patency on a Vingmed Diasonics 700 colour Doppler ultrasonography machine which has realtime/2D sector and linear imaging modes along with M mode. The image documentation was performed with a multiformat camera and video-cassette recorder. Atropine 0.6 mg was injected intramuscularly and a pelvic examination was done. After the vagina was disinfected with an antiseptic solution, a speculum examination was then performed and a Leech-Wilkinson canula screwed on to the cervical canal. A routine pelvic sonographic examination was then performed. The uterus was used as a landmark for depiction of other adnexal structures. Once the colour signals were obtained, an anatomic Doppler window could be selected to get a selective spectral waveform from a chosen vessel. The Doppler window was then narrowed down to an area between the left ovary and the uterus. 10-40 ml of sterile normal saline was injected through the canula. For the last six cases, a no. 8F Foleys catheter was inserted to just beyond the internal os with the usual aseptic precautions. The Foleys bulb was then inflated with 2.5 ml of normal saline thus stabilising the Foleys catheter within the uterine cavity (Fig. 1). Ten ml of normal saline was then injected through the Foleys catheter. Direction of flow into and out of the Fallopian tubes was observed with colour-coded duplex sonography. At the end of the procedure, the Foleys bulb was deflated and the catheter removed.

A patent Fallopian tube was diagnosed when colour-flow signals were recorded during perturbation of normal saline for at least ten seconds. When no fluid was seen



Fig. 1. The beginning of the free peritoneal spill as recorded by transabdominal CCDS.

to enter the peritoneal cavity, tubal occlusion was diagnosed. The same procedure was repeated on the right side. Each tube could be assessed separately and the free spill from each tube was depicted with a characteristic colour bruit showing phasic indeterminate colour assignment (Figs. 2 & 3).

The patients were allowed to rest for about half an hour and then sent home on a seven-day course of ampicillin and metronidazole. The entire procedure can be recorded on a videocassette and preserved by the patient as permanent documentation of her tubal status.



Fig. 2. Phasic colour indeterminance signifying free peritoneal spill.



Fig. 3. Semiaxial view of the Foleys bulb lying within the uterine cavity using transvaginal CCDS.

Results

Table I summarises the accuracy with three different tubal patency tests. When the results of CCDS were compared with those of HSG and laparoscopy, there was a 92.5% agreement, that is, there was patency or occlusion of the Fallopian tubes. The HSG and laparoscopy findings were in 100% agreement for bilateral tubal patency. Two cases which showed left and right-sided tubal occlusion respectively with CCDS showed bilateral patency subsequently on both HSG and chromopertubation. Laparoscopy confirmed all

TABLE I: ACCURACY OF TUBAL PATENCY COMPARING THREE DIFFERENT INVESTIGATIVE MODALITIES

Method	Total cases	Bilateral patency	Bilateral block	Left block	Right block
CCDS	47	40	1	3	3
CCDS (V)	6	2	4	-	-
HSG	53	44	1	5	3
LAP	53	44	3	3	3

CCDS: colour-coded duplex sonography (transabdominal)

CCDS (V): colour-coded duplex sonography (transvaginal)

HSG: hysterosalpingogram

LAP: chromolaparoscopy

findings with the other two techniques and in addition picked up peritubal adhesions in two cases and endometriosis in one case showing free spill with all three methods. An important finding from our preliminary study using vaginal CCDS revealed a much better resolution and image of the free spill with only 10 ml of normal saline sufficing for testing the patency on both sides as compared to the 20-40 ml required for transabdominal CCDS. Further, in case of a bilateral block, the reflux of normal saline was picked up very clearly in the stem of the Foleys catheter. An area of criticism would be that the site of blockage in the Fallopian tube could not be clearly defined even on vaginal CCDS.

There was no febrile morbidity reported in our series. All the patients complained of transient mild suprapubic pain at the time of injection of saline. Transient severe pain was reported during pertubation of saline in one patient in whom bilateral tubal block was diagnosed. The injection pressure was released with immediate relief of pain.

Discussion

Patency of the tubes was the earliest, and until recent decades, the only aspect of the tubal function that was studied and evaluated. The beginning of this century was marked by the development of diagnostic procedures for tubal patency and pathology with the introduction of HSG, tubal chromopertubation and laparoscopy. Radiological studies complement endoscopic investigations as each provides information, albeit with a varying degree of accuracy, on one or more segments of the oviduct, and each can also be used to confirm the findings of the other. Sonography as a tool for checking the patency of Fallopian tubes was an expected development in the giant strides of progress the field of gynaecology was taking.^{7,9}

The advent of duplex Doppler techniques in the late 1970s opened up a new field of sonographic investigation, namely, the direct recording of peripheral, abdominal and cardiac blood flow, albeit limited to a relatively small sample volume. Normal and abnormal blood-

flow characteristics were defined by duplex Doppler techniques setting the stage for clinical acceptance of a new generation of sonographic imaging devices, namely, colour Doppler units capable of displaying regional physiologic and pathophysiologic arterial and venous flow in the familiar anatomic format of a gray scale sonographic image.¹⁰

Colour-coded duplex Doppler can be used in an office setting, which makes it more convenient for both the patient and physician. Difficulty in making a diagnosis of tubal occlusion arises in patients with dilated hydrosalpinges because flow through the dilated Fallopian tube may simulate spillage on the Doppler ultrasonography screen.¹¹ The limitation of this modality compared with conventional standard studies (HSG, laparoscopy) seems to be the impaired diagnostic value if no tubal flow can be demonstrated.¹² In addition, tubal architecture is not demonstrated with CCDS as it is with HSG. However, a recent study has shown that this information is not useful in preoperative salpingoplasty procedures.¹³ Although the mucosal folds can be outlined by HSG, the correlation between radiological studies and endoscopy in the assessment of tubal mucosa is poor. Investigators¹⁴ have used scanning electron microscopy on microbiopsy specimens to demonstrate that, in infertile patients with apparently normal tubes on HSG and laparoscopy, there were lesions of the mucosa, such as flattening of the folds, loss of cilia and alteration of cilia pattern. They considered these lesions to be a major cause of infertility and of failure of tubal reconstructive surgery.

Radionuclide hysterosalpingography has been recently described to evaluate the functional capability of the tubal mucosa.¹⁵ Further work is required, but the initial impression is that radionuclide hysterosalpingography (RN-HSG) could be used in combination with other tests of tubal morphology to detect a possible cause of unexplained infertility when the tubes are patent and apparently normal.

Keeping all the above-mentioned recent advances in mind, the author proposes that colour-coded duplex sonography for evaluating Fallopian tube patency be used as a basic screening test followed by either RN-HSG or salpingoscopy if there is bilateral free spill. If the colour bruit showing phasic colour indeterminance is not seen on one or both sides, then the entire gamut of investigations should be done for the tubal factor. Although this was a small study, colour-coded duplex sonography is proposed as a new screening diagnostic procedure that demonstrates normal findings and tubal patency with high reliability.

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