

## Multidetector computed tomography virtual hysterosalpingography in the investigation of the uterus and fallopian tubes

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### Abstract

**Objective:** To compare the efficacy of multidetector CT virtual hysterosalpingography (MDCT-VH) with conventional X-ray hysterosalpingography (HSG) in the evaluation of patients with diagnosis of infertility.

**Methods:** Sixty patients with diagnosis of infertility scheduled to perform a HSG, were evaluated with 16-row ( $n = 50$ ) and 64-row ( $n = 10$ ) MDCT-VH. In 35 patients the examination was performed without a tenaculum. The HSGs were carried out using standard technique. The HSG and MDCT-VH findings were compared. The duration for both examinations and patient discomfort were documented. The sensitivity and specificity of MDCT-VH for the detection of uterine pathology and tubal obstruction were calculated using the exact binomial method. Agreement between the two methods was assessed by the Cohen's kappa method ( $k$ ).

**Results:** The mean duration for MDCT-VH (16 and 64-rows) was  $5 \pm 3$  min, whereas for HSG was  $28 \pm 3$ . The MDCT-VH without a tenaculum was the procedure with less patient discomfort. Sensitivity, specificity and inter-method agreement for the detection of uterine pathology were 100%, 92% and  $k = 0.92$  for 16-row MDCT-VH and 100%, 100% and  $k = 1$  for 64-row MDCT-VH, respectively. Sensitivity and specificity for detection of tubal obstruction were 80% and 80% for 16-row MDCT-VH and 100% and 100% for 64-row MDCT-VH, respectively; inter-method agreement for the visualization of the tubes was  $k = 0.54$  for 16-row MDCT-VH and  $k = 1$  for 64-row MDCT-VH.

**Conclusion:** This study demonstrated the feasibility of evaluating the female reproductive system by MDCT-VH. 64-Row MDCT-VH could be an alternative diagnostic technique in the infertility workup algorithm. A larger study is in progress to validate these encouraging results.

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### 1. Introduction

Since the first description of virtual endoscopy of the colon using computed tomography (CT) by Vining et al. in 1994 [1], improvements in CT equipments and virtual endoscopy post-processing software have been achieved. Nowadays CT colonography has become an alternative diagnostic procedure for the evaluation of the colon lumen [2–5] and other organs

such as the stomach [6], the airways [7], the urinary tract [8] and the vascular system [9] which also benefit from this technique. The development of multi-detector row CT permits volumetric data acquisition with thinner collimation, improving the quality of bi-dimensional and three-dimensional reconstructions and allowing the virtual endoluminal evaluation of smaller structures such as the uterine cavity and the fallopian tubes. The assessment of the female reproductive system using virtual endoscopy techniques is very recent and, to our knowledge, there are few related publications using ultrasound [10,11] and multidetector row CT [12,13].

The objectives of our study were (i) to assess the utility of multidetector CT virtual hysterosalpingography (MDCT-VH) in the evaluation of patients with diagnosis of infertility and (ii) to determine the degree of patient's discomfort in comparison with conventional X-ray hysterosalpingography (HSG).

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## 2. Materials and methods

The study protocol was approved by the local and independent Ethic Committee and all the patients signed an informed consent to be incorporated. Sixty patients (age range 23–44 years, mean age 35 years) with diagnosis of infertility were studied with MDCT-VH and HSG in the follicular phase of the cycle.

The HSG procedures were performed with a Dinan 1000 X-ray unit and digitalization of the images. Each patient was placed on the imaging table in a supine position. After placing a speculum in the vagina, a metal cannula was inserted in the external cervical os and it was stabilized by hooking it to a single-tooth tenaculum applied to the anterior lip of the cervix. Thereafter, a combination of radioscopy and spot radiographs were acquired during the injection of 10 mL of iodine-contrast material (ioxitalamate; Telebrix Hystero, Laboratorios Temis Lostalo, Buenos Aires, Argentina) until the diagnosis was obtained or intraperitoneal spill was documented. The average radioscopy time was  $2 \pm 0.4$  min and four to six spot radiographs were obtained with 80–90 kV and 12–16 mA s. The mean patient effective dose was  $5.08 \pm 0.21$  mSv.

The MDCT-VH was carried out immediately prior ( $n = 30$ ) or subsequent to the HSG. In 50 patients, the studies were performed on a 16-row CT scanner (Brilliance 16; Philips Medical Systems, Cleveland, OH, USA) with the following technical parameters: collimation:  $16 \times 0.75$  mm; slice thickness: 1 mm; slice increment: 0.5 mm; average scan time: 12 s; 120 kV; 200 mAs; rotation time: 0.75 s; mean patient effective dose:  $3.02 \pm 0.15$  mSv. The remaining 10 studies were carried out on a 64-row CT scanner (Brilliance 64; Philips Medical Systems, Cleveland, OH, USA) using:  $64 \times 0.625$  mm; slice thickness: 0.9 mm; slice increment: 0.5 mm; average scan time: 4 s; 120 kV; 200 mAs; rotation time: 0.5 s; mean patient effective dose:  $2.38 \pm 0.11$  mSv. The MDCT-VH technique was based on the HSG technique. The patient was placed on the CT table in a supine position. In a group of patients ( $n = 25$ ) the examination was performed clamping the uterine cervix with a single-tooth tenaculum and in the rest of the patients ( $n = 35$ ) without the tenaculum. A total volume of 10 mL of a iodine contrast dilu-

tion [1 mL of iodine contrast (ioxitalamate; Telebrix Hystero, Laboratorios Temis Lostalo) and 9 mL of saline solution] was injected into the uterine cavity. CT images were acquired once the contrast injection was completed.

Images were transferred to a workstation (Extended Brilliance Workspace; Philips Medical Systems) and reprocessed in four different ways:

- (i) Coronal and sagittal multiplanar reconstructions (MPR) and curved-MPR unfolding the uterus with soft tissue window. Increasing the thickness of the MPR slab, images obtained were similar to those of the HSG.
- (ii) Maximum intensity projections.
- (iii) Three-dimensional volume rendering reconstructions.
- (iv) Virtual endoscopy: endoscopic view of the lumen of the cervix canal, uterine cavity and fallopian tubes.

Findings were compared and classified by both methods in: (1) normal findings, (2) pathological findings, (2a) intrauterine filling defects, diagnosed as polyps or submucosal myomas according to their morphology and uterine cavity configuration; (2b) uterine synechiae; (2c) uterine malformations; (2d) cervix pathology; (2e) fallopian tubes pathology.

The duration and grade of patient discomfort of each procedure were documented. The patients completed a questionnaire about the grade of discomfort during the procedures (G1: no discomfort; G2: slight discomfort; G3: moderate discomfort; G4: severe discomfort).

### 2.1. Statistical analysis

The sensitivity and specificity of MDCT-VH for the detection of uterine pathology and tubal obstruction were calculated using the exact binomial method. Agreement between the two methods was assessed by the Cohen's kappa method.

## 3. Results

No adverse events occurred during the procedures. The mean duration time and standard deviation of HSG and MDCT-VH (16



Fig. 1. Thirty-nine years old woman with endometrial polyp projecting into the endometrial cavity. (A) The hysterosalpingography showed intrauterine filling defect on the left margin of the endometrial cavity. (B) The MDCT-VH coronal multiplanar reconstruction showed similar findings than the HSG. (C) Virtual endoscopic view of the endometrial polyp.

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