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SHORT COMMUNICATION

CT vaginography: a new CT technique for imaging of upper and middle vaginal fistulas

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Objective: Different types of vaginal fistulas is a relatively uncommon condition in the Western world but very frequent in developing countries. In the past, conventional vaginography was the radiological examination of choice for exploring this condition. CT and MRI are now both used for this purpose. Our objective was to test the feasibility and to explore the potential role of a new CT imaging technique implementing vaginal introitus obstruction and opacification of the vagina with iodine contrast agent, to show patency of a fistula.

Methods: We describe the technical protocol of CT-vaginography as performed in Geneva University Hospitals, including vaginal catheterization with a Foley catheter and obstruction of the introitus by inflating the balloon of the catheter. We also report three cases of patients with suspected vaginal fistula who underwent CT-vaginography.

Results: The examinations were technically successful. In one patient, it revealed the presence of fistulous pathways from the vaginal fornix along the bilateral infected surgical prostheses. In a second patient, it showed a fistula between the vagina and the necrotic cavity of a recurrent cervical cancer. In a third patient, it proved the absence of a suspected vaginal fistula.

Conclusion: CT-vaginography is a technically feasible CT protocol that provides anatomical and functional information on clinically suspected vaginal fistulas.

Advances in knowledge: After the abandon of conventional vaginography in the era of transaxial imaging, the current modalities of imaging vaginal fistulas provide excellent anatomical detail but less functional information concerning the permeability of a vaginal fistulous pathway. We propose the use of CT-vaginography, a technical protocol that we describe in detail.

INTRODUCTION

Vaginal fistulas are a heterogeneous group of pathologies, including ureterovaginal, vesicovaginal, rectovaginal fistulas and other types of fistulous pathways between the vagina and other pelvic anatomical structures. Most vaginal fistulas in the developed world result as complications of surgery for benign conditions or as complications of malignant gynaecologic disease and associated radiation or surgical treatment. In the developing countries, vaginal fistulas are much more frequent, and the most common cause is obstetrical complications.¹

Vaginography is a conventional radiological technique that was traditionally used for detection and exploration of vaginal fistulas. This technique included obstruction of vaginal introitus intravaginal instillation of iodine contrast media and conventional radiological images of the pelvis.^{2,3}

METHODS AND MATERIALS

With the evolution of radiological techniques, MRI and CT⁴ have both been increasingly used for the purpose of diagnosis of vaginal fistulas. MRI can provide anatomical information on potentially functional fistulas mainly using heavily T_2 weighted sequences that allow detection of the presence of fluid in the lumen of the fistula. CT techniques are based mainly on intravenous late opacification of the urinary tract and/or retrograde bladder opacification.⁵ Thus, a rectovaginal or other type of fistula cannot be adequately explored. When looking for an enterovaginal fistula, rectal contrast administration can help identify the pathology. The main sign that allows the definite diagnosis of a patent enterovaginal fistulous tract is the presence of contrast agent in the vagina.⁶ However, by means of rectal opacification, the introduced contrast is not under sufficient pressure to guarantee its entry to a potential fistulous trajectory to the vagina.

The proposed CT protocol is based mainly on low-dose CT acquisitions, before and after vaginal opacification with diluted water-soluble iodine contrast agent. The examinations were performed on a 64-row CT scanner GE 750HD CT (General Electric Company, Milwaukee, WI). Interpretation of axial images and multiplanar reconstructions was performed to a dedicated workstation (OsiriX; Pixmeo, Bernex, Switzerland). The detailed protocol is described thoroughly in [Table 1](#).

Using the described CT-vaginography protocol, we examined three patients; the first was a 51-year-old female patient with history of surgical treatment of pelvic organ prolapse with subtotal hysterectomy, cervical amputation and lateral suspension with a mesh,^{7,8} with clinical suspicion of infection of the prosthetic material and associated right iliac fossa subcutaneous collection. For this patient, MRI was not possible as it could not be obtained within a reasonable delay. The second patient was a 54-year-old female with recurrent cervical cancer and clinical suspicion of vaginal fistula, in the context of previous total hysterectomy and radiation therapy. This patient had undergone MRI that failed to show a fistula. The third patient was a 49-year-old female with Type-1 diabetes mellitus and history of renal transplantation in the right iliac fossa, with fluid collection surrounding the transplanted kidney and suspected communication between the collection and the vagina. Owing to renal insufficiency, we preferred not to perform enhanced MRI. For the same reason, the described protocol of CT-vaginography was slightly

changed, omitting the intravenous injection of iodine contrast medium, as the patient had chronic renal insufficiency and the information of a pre-existing fluid collection surrounding the transplanted kidney had previously been obtained by ultrasound. Subsequently, for this patient, the protocol included only two low-dose pelvic acquisitions.

RESULTS

CT-vaginography was performed with technical success without any complication for all three patients. Vaginal opacification was optimal for all patients.

In the first patient, we confirmed the presence of a double fistulous path, extending from the vagina along the prosthetic material on both sides. On the right side, the fistulous pathway was not communicating with any anatomical structure, whereas on the left side, it was communicating with a subcutaneous collection. Both fistulous trajectories were visible on the initial CT without vaginal opacification. However, the CT-vaginography technique provided additional information, with opacification of both fistulous paths with air bubbles and positive contrast, thus confirming their patency ([Figure 1](#)).

The patient was subsequently operated, and the diagnosis of bilateral vaginal fistulas from the vaginal fornix, along the infected right and left prosthesis was confirmed. On the left side, the fistulous tract communicated with a subcutaneous collection.

Table 1. Detailed CT-vaginography protocol, with explication of different steps of the examination and the utility of each step

Description of the CT-vaginography protocol	
Technical protocol in steps	Information obtained
Step 1: unenhanced low-dose abdominal CT	
Collimation: 64×1.25 mm; pitch: 1.375; gantry rotation time: 0.7 s; tube current: 45 mA; tube voltage: 120 kVp reconstructed slice width: 2.5 mm; voltage: 120 kVp; reconstructed slice width, 2.5 mm; matrix: 512×512 ; reconstruction: FBP with 40% ASiR	Detection of pre-existing hyperdense material
Step 2: vaginal catheterization	
Insertion of a 30-cm ³ urinary (Foley) catheter. The balloon of the catheter is inflated with air in the vagina. The maximal insufflation volume needed may vary significantly (10–30 ml). After inflation, the patient is instructed to cross her legs and the balloon is pulled towards the vulva in order get stuck and obtain optimal obstruction	
Step 3: vaginal opacification	
100–200 ml of diluted (1/10, V/V) iodinated non-ionic contrast material (Accupaque™ 350; GE Healthcare, Glattbrugg, Switzerland) are instilled through the catheter. The injection should be stopped soon after resistance is felt	
Step 4: low-dose pelvic CT acquisition (optional)	Demonstration of vaginal filling
Step 5: i.v. contrast administration	
2.5 ml kg^{-1} of iodinated non-ionic contrast material (350 mg ml^{-1}) at a flow rate of 3.5 ml s^{-1} followed by 30 ml of normal saline flush	
Step 6: diagnostic venous-phase CT	
60 s after i.v. contrast injection, with vaginal opacification (collimation: 64×1.25 mm; reconstructed slice width: 2 mm pitch: 1.375; gantry rotation time: 0.7 s; tube current: 45 mA; tube voltage: 120 kVp; reconstructed slice width: 2.5 mm; matrix: 512×512 ; reconstruction: FBP with 40% ASiR)	Demonstration of vaginal fistulas/detection of any concomitant pathology as pelvic abscesses or tumoural lesions

ASiR, adaptive statistical iterative reconstruction; FBP, filtered back projection; i.v., intravenous.

Figure 1. A 51-year-old female patient with previous surgical treatment of pelvic organ prolapse with clinical suspicion of infection of the prosthetic material. (a) An axial plane CT image of the first low-dose acquisition, before administration of intravenous (i.v.) and vaginal contrast. White arrows show a suspected fistulous tract along the trajectory of the prosthetic surgical material on the right lower pelvis. White arrowheads show the non-opacified vaginal fornix. (b, c) Axial plane images of the CT acquisition after vaginal opacification. White arrowheads in (b) show the vaginal fornix filled with contrast. White arrows in (b) show air bubbles and iodine contrast entering the two fistulous tracts along the trajectory of the prosthetic material. White arrowheads and white arrows in (c) show the contrast and air-containing fistulous trajectories on the right and left iliac fossae, respectively. (d) Oblique coronal plane maximum intensity projection reformatted image of the full-dose diagnostic CT acquisition with i.v. contrast injection showing both the right and left fistulous pathways (white arrowheads) departing from the proximal vagina, containing contrast material, thus confirming their patency. (e) Axial plane enhanced full-dose CT image on a higher level, showing a subcutaneous collection of the left iliac fossa (white arrowheads) which was in continuity with the right fistulous tract. (f) Laparoscopic image showing the dissection of the vaginal fornix (arrowheads) and the left (thick short arrows) and right (thin arrows) fistulous tracts.

In the second patient, the CT-vaginography showed a recurrent tumour in contact with the vaginal cul-de-sac. Thanks to vaginal opacification under slight pressure, we proved a direct communication between the vaginal dome and the necrotic cavity of the tumour but no communication with any adjacent organs such as the bladder, ureters or rectum (Figure 2). A CT scan 4 months later showed progressive disease and the same fistula with a more extensive pathway with erosion of the bladder and a direct vesicovaginal communication.

In the third patient, CT-vaginography proved the absence of a communicating fistulous pathway, with integrity of the vaginal wall. 6 months later, the patient was asymptomatic (Figure 3).

The delivered radiation dose ranged between 1.8 and 2 mSv for the initial abdominal low-dose acquisition, between 0.8 and 1.1 mSv for the second pelvic low-dose acquisition and 8.9 and 9.5 mSv for the final diagnostic abdominal CT acquisition.

DISCUSSION

Vaginal fistulas are relatively rare pathologies in the Western world. However, they represent a very frequent condition in developing countries. Their optimal exploration is necessary for treatment planning. It facilitates the decision between conservative and surgical treatment, and if the second option is decided, it helps the surgeon plan the appropriate interventional procedure.

Vaginography is a conventional radiographic technique for the detection of vaginal fistulas, first described in the early 60s.² It consists of a fluoroscopic examination of the pelvis after iodine contrast opacification of the vagina with relative pressure obtained by balloon blockage of the vaginal introitus. This technique provides excellent functional information. The reported sensitivity of vaginography for detection of fistulas is 79–100%.⁹ However, the anatomical delineation of fistulous pathways is restrained in two-dimensional conventional images and suffers from projections of different tissues.

With the development of transaxial imaging, MRI and multi-detector CT⁴ have become the main radiological methods for exploring vaginal fistulas. The current imaging modality of choice is considered to be MRI,^{4,10} including heavily T_2 weighted sequences that provide adequate anatomical detail and can also detect fluid in the lumen of the fistula. However, as the clinical condition is rare in the Western world, only a few studies have addressed the question of its diagnostic performance and these included very small patient series. Sensitivity of MRI is reported to be as high as 91% in a study including 15 patients.¹¹

CT-vaginography as described in this study has the potential to combine the excellent spatial resolution and possibility of multiplanar reconstruction of CT, with the functional information obtained from vaginography. The technique of obstruction of the vaginal introitus and injection of contrast under pressure is detailed by several authors in the second half of the past

Figure 2. A 54-year-old female patient with recurrent cervical cancer and clinical suspicion of vaginal fistula. (a) CT-vaginography in the axial plane confirming the presence of a recurrent tumour (white arrowhead) in contact with the vaginal wall (black arrowhead) and a fistulous pathway between the two (white arrow). (b) A coronal plane reconstruction showing the fistulous tract between the vaginal fornix and the necrotic tumoural cavity (white arrow), but also the absence of communication with neighbouring organs. Black arrowheads show the inflated balloon obstructing the vaginal introitus. (c) The same patient showed rapid progression of the tumour in the following few months and was examined 5 months later with a dedicated CT protocol including retrograde bladder opacification, due to suspicion of vesicovaginal fistula. The figure shows, in the sagittal plane reconstruction, the fistulous pathway (thin white arrow) between the bladder (black arrowhead), the tumoural cavity (thick white arrow) and the vagina (white arrowheads).

century.^{2,9,12–15} Obstruction is obtained by inflation of the balloon of a Foley catheter in the vagina. The catheter is subsequently pulled out by the operator and gets stuck in the vulva, as the patient is instructed to cross her legs after the insertion. According to the above mentioned literature and to our experience, this manoeuvre allows obtaining a relative pressure when

injecting the contrast in the vaginal cavity, enough to detect a “symptomatic” fistula that is already patent.

For suspected urovaginal fistulas, the optimal CT protocol includes retrograde bladder filling and/or late-phase excretory acquisitions.⁵ Using this protocol, functional information regarding the permeability of the fistula can be obtained. However, if the suspected fistulous tract is enterovaginal, or other, then the optimal technique should include vaginal opacification that will allow precise anatomical depiction and control of permeability of the fistula. The information obtained by this technique can help the surgeon program his surgical approach in an optimal way, as the exploration of any potential fistulous pathway will be known in advance.

Moreover, even if the vaginal fistula is not confirmed, based on the diagnostic enhanced CT acquisition, information on any other potential alternative diagnosis can be obtained.

Concerning the safety of the proposed technique, as an evolution of conventional vaginography, it is related to similar risks. To our knowledge, no major complication related with the technique has been mentioned in the literature. Any potential danger due to passage of contrast in the peritoneal cavity can be avoided with the use of water-soluble iodine contrast agents. The vagina being a non-sterile environment, the technique can be performed in non-sterile conditions.

The radiation dose of CT can be minimized by acquisition of only one diagnostic full-dose image series with the effective dose ranging between 5 and 10 mSv, depending on the patient’s body

Figure 3. A 49-year-old female patient with history of renal transplantation in the right iliac fossa with fluid collection surrounding the transplanted kidney and suspected communication between the collection and the vagina. Back arrowheads show the inflated balloon obstructing the vaginal introitus. Injection of iodine contrast under slight pressure allows confirming the integrity of the vaginal wall with the absence of vaginal fistula.

mass index and CT scanner specifications. The unenhanced and any other acquisition potentially needed should be obtained at low-dose settings, with the dose in the order of 1 mSv.

A potential limiting factor of CT vaginography could be the fact that obstruction of vaginal introitus with the balloon under pressure might prevent the contrast from entering a low-placed fistula and thus its visibility; however, this limitation has not been described for conventional vaginography.

Overall, CT vaginography as described above could be an alternative or a complementary technique to MRI for the detection of vaginal fistulas. This can be of special importance in countries where MRI is much less accessible and where vaginal fistulas are

much more frequent. This study shows the feasibility of the technique and describes the technical protocol in detail. Further studies are needed to confirm its diagnostic performance.

In conclusion, the proposed CT-vaginography protocol combines the spatial resolution and multiplanar reformation potential of CT, with the functional information provided by vaginal opacification, allowing detection and providing anatomical delineation of the fistulous tract, for planning surgical or conservative treatment. It can be proposed that for the diagnosis of vaginal fistulas, especially those originating from the proximal two-thirds of the vagina and those that are, clinically, not urovaginal ones, as for these cases, CT with retrograde cystography is preferred.

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