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PICTORIAL REVIEW

Hysterosalpingographic features of cervical abnormalities: acquired structural anomalies

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ABSTRACT

Cervical abnormalities may be congenital or acquired. Congenital cervical structural anomalies are relatively uncommon, whereas acquired cervical abnormalities are commonly seen in gynaecology clinics. Acquired abnormalities of the cervix can cause cervical factor infertility and recurrent spontaneous abortion. Various imaging tools have been used for evaluation of the uterine cavity and fallopian tubes. Hysterosalpingography (HSG) is a quick and minimally invasive tool for evaluation of infertility that facilitates visualization of the inner surfaces of the uterine cavity and fallopian tubes, as well as the cervical canal and isthmus. The lesions of the uterine cervix show various imaging manifestations on HSG such as narrowing, dilatation, filling defects, irregularities and diverticular projections. This pictorial review describes and illustrates the hysterosalpingographic appearances of normal variants and acquired structural abnormalities of the cervix. Accurate diagnosis of such cases is considered essential for optimal treatment. The pathological findings and radiopathological correlation will be briefly discussed.

Cervical abnormalities may be congenital or acquired and account for approximately 10% of cases of female infertility.¹ Congenital structural anomalies of the cervix are relatively uncommon, whereas acquired cervical abnormalities are commonly seen in the gynaecologic office setting. Acquired abnormalities secondary to cervical surgery and obstetrical trauma may contribute to cervical factor infertility. Hysterosalpingography (HSG) is a radiographic procedure to evaluate the uterine cavity and fallopian tubes after introduction of a radio-opaque agent through the cervical canal. Although HSG has been used over the years for several gynaecological indications, investigation of infertility is the most common reason for its use today. This method provides useful information regarding the inner surfaces of the uterine cavity and fallopian tubes, as well as the cervical canal and isthmus. HSG is considered to have 81.2% sensitivity and 80.4% specificity in comparison with hysteroscopy in the detection of intrauterine abnormalities.²

We retrospectively reviewed 38,574 hysterosalpingograms performed over a 29-year period (January 1985–December 2013) by one author (GS). The hysterosalpingograms were performed for several indications, including infertility, abnormal uterine bleeding and symptoms related to uterine fibroids.

This pictorial review describes and illustrates the hysterosalpingographic appearances of normal variation and acquired structural abnormalities of the cervix. The cases with structural lesions, such as cervical myomas (CMs), polyps, cancer, tuberculosis and chronic cervicitis, were confirmed by cytological and/or microbiological results.

EMBRYOLOGY OF THE FEMALE GENITAL TRACT

The female genital tract develops from a pair of Müllerian ducts (MDs) by Week 6 of development. These structures undergo a complex series of events including MD elongation, fusion, canalization and septal resorption that form the fallopian tube, uterus, cervix and upper two-thirds of the vagina. The lower vagina has a different origin and originates from urogenital sinus. At Week 12, the uterus represents its typical triangular shape. By Week 20, the vaginal outgrowth is completely canalized and the process of development is completed. The development of both MDs and urinary tract occurs from a common ridge of mesoderm; hence, anomalies of kidney and ureter are commonly observed in females with Müllerian anomalies.^{3,4}

Figure 1. Normal features of the uterine cervix on hysterosalpingography in different patients. (a) Well-defined internal cervical os (gradual funnel-shaped; arrow) with a relatively smooth contour of the cervical canal (arrow). (b) Ball-shaped cervix (arrow). (c) Pear-shaped cervix (arrow). (d) Cylindrical cervix (arrow).

ANATOMY OF THE CERVIX AND ISTHMUS

The normal radiographic appearance of the cervical canal is usually spindle shaped and narrower at the external and internal os and wider in the midportion (Figure 1a). The shape of the cervical canal varies from patient to patient (ball shaped, pear, pyramid, olive and cylindrical; Figure 1b–d).

The uterine isthmus is the transitional region between the cervix and uterine body and corresponds to the level of the internal os, which is seen as an area of narrowing in approximately one-half of hysterosalpingograms. The uterine isthmus measures approximately 1.5 cm in length and 0.5 cm in width.⁵

Figure 2. Radiographic variation of the uterine isthmus in different patients. (a) Well-defined narrow isthmus (thread-like shape; arrow). (b) Constrictive band (arrow). (c) Dilated isthmus (arrow).

Figure 3. Fine, numerous and aggregated (feathery-like) plicae palmatae in a nullipara.

On HSG, the region of the internal cervical os was shown to have different configurations, such as a well-defined narrow internal os (thread-like shape), a constrictive band and a dilated cervical internal os (Figure 2a–c).

The diameter of the internal os is variable and may vary in the same patient during different phases of the menstrual cycle.

Figure 4. Large air bubble. Introduction of an air bubble into the uterine cavity produced a large filling defect in the cervical canal and lower segment of the uterus (arrow). The air bubble was removed by the additional injection of contrast into the uterine cavity.

Figure 5. Mucus plugging in the cervical canal of a 35-year-old female who presented with a linear-shaped filling defect without a rounded contour (arrow). Subsequent image showed disappearing of this mobile filling defect.

Based on normal HSGs, the diameter of the internal os ranges from 1 to 10 mm.⁵

It is uncertain whether or not a wider os may result in cervical incompetence and second trimester pregnancy loss.⁵

The mucosa of the endocervix forms a finely serrated margin (the plicae palmatae). Normal cervical glands may exhibit

Figure 6. An intramural myoma in a 25-year-old female. Marked elongation and distortion of the cervical canal is seen (arrow).

Figure 7. Cervical polyp. An oval-shaped filling defect in the cervical canal (arrow), which is distinguished from an air bubble by the fixed position after injection of additional medium. The diagnosis was confirmed by biopsy. Note the filling defect observed at isthmic portion was owing to rapid evacuation of contrast medium. It is not pathologically significant (open arrow).

various appearances according to the individual patient and the phase of the menstrual cycle. Dense plicae palmatae (>2- to 3-mm thick) are widely separated and few in number, and small plicae (which usually exist in nulliparas) are closer together and numerous (Figure 3).

The injection of air bubbles and cervical mucus through the cervical canal produces artefacts that may be mistaken for polyps and myomas (Figure 4). An air bubble usually appears as a mobile, round filling defect and can be removed by the additional injection of contrast, whereas cervical mucus appears as a linear, amorphous mass with no clear margin (Figure 5).

ACQUIRED STRUCTURAL ABNORMALITIES

Acquired cervical lesions, which may or may not be associated with abnormal cytology, are frequently observed in the gynaecologic office setting. The cervical lesions demonstrate various imaging manifestations in addition to the normal, such as narrowing, dilatation, filling defects, irregularities and diverticular projections. Narrowing, dilatation and irregularities can be a normal variant or owing to a pathological condition.

Narrowing of the cervix is usually caused by surgical intervention, neoplasms, radiotherapy and diethylstilbestrol exposure. Significant stenosis of the external cervical os may prevent the introduction of the HSG cannula.

Dilation noted during HSG may be owing to a normal or incompetent os. Synechiae, neoplasms and scarring can produce filling defects. Mobile filling defects owing to the introduction of

air bubbles or displacement of cervical mucus are occasionally seen. Mesonephric remnants and ectopic ureter also produce linear filling defects. Perforation, adenomyosis and neoplasms of the cervix can cause irregularities of the cervical canal. Out-pouching and diverticular projections of contrast may be secondary to cervical diverticula, pseudodiverticula, perforations, caesarean scars and neoplastic lesions.

CERVICAL NEOPLASM

Cervical leiomyomata

Leiomyomata are the most common tumour of the female genital tract, occurring in 20–50% of females of late reproductive age.⁶ CMs have been reported in <5% of patients with uterine myomas⁶ because of the lower complement of myometrial cells. CMs may be single or multiple and are divided into two types according to the location (intracervical and extracervical). Hysterosalpingographic findings are variable and single or multiple filling defects, distention, elongation, distortion, displacement and irregularity of the cervix may be noted (Figure 6).

Cervical polyps

Cervical polyps are small, red, finger-shaped growths that arise from the surface of the endocervical canal. They are the most common benign lesion of the cervix.⁷ Cervical polyps are usually single and pedunculated.⁷ On hystero-grams, they present as single or multiple round or oval filling defects (Figure 7).

Because they are non-cancerous, cervical polyps should be removed in symptomatic females or females who have abnormal cervical cytological findings.⁷ Cervical polyps can be differentiated from air bubbles, cervical mucosa, synechiae, adenomyosis and normal functional variants based on the oval shape and more rounded and regular appearance.

Figure 8. Cervical cancer. Elongated cervical canal with an irregular contour and a heterogeneous filling defect owing to cervical cancer are seen in a 47-year-old female with a history of abnormal uterine bleeding (arrow). The diagnosis was confirmed by biopsy.

Figure 9. Caesarean section scar in different patients. (a) Hysterosalpingography shows the unilateral wedge-shaped outpouching at the level of the internal os (uterine incision site; arrow). Note the subseptate uterus (open arrow) and marked shortening of both fallopian tubes owing to a tubal ligation (short arrows). (b) Bilateral caesarean scar (arrows).

Cervical cancer

Cervical cancer is the most frequent malignancy of the female genital tract. Cervical cancer is caused by persistent infection with a common sexually transmitted virus (human papillomavirus).⁸ The risk factors for cervical cancer include cigarette smoking, sexual history, HIV infection, genetics and multiple births.⁹

Cervical cancer produces a wide spectrum of radiographic appearances, such as outpouching of the cervical wall in endophytic lesions and polypoid or papillary filling defects in

exophytic tumours (Figure 8). In more advanced cervical cancers with stenosis of the cervical canal, it is not possible to perform a HSG. Early lesions and advanced tumours with wall infiltration may yield normal hysterosalpingographic images.

POST-OPERATIVE HYSTEOSALPINGOGRAPHIC FINDINGS

Caesarean section scars

Several changes related to the caesarean incision site may be seen owing to wall weakness and fibrosis. These changes

Figure 10. Cervical diverticulum in a 32-year-old female with a history of a fibroid resection. Hysterosalpingography following myomectomy showed a diverticular-like structure at the resection site (arrow). Note the marked filling defect in the lower segment owing to synechiae formation (open arrow).

Figure 11. Cervical fistula; a fistula connecting the urinary bladder to the cervix in a 29-year-old female (long arrow). This patient had a previous caesarean section. Note the arcuate configuration of the uterine fundus (short arrow) and lack of cervicoisthmic canal shadow owing to rapid evacuation of contrast medium (open arrow).

Figure 12. Genital tuberculosis in a 23-year-old infertile female. A ragged irregular cervical contour, small diverticular out-pouching and mild intracanal adhesion is seen following the tuberculosis infection (long arrow). Additionally, typical features of tuberculosis in the uterine cavity and fallopian tubes are present. Note the irregularity and deformity of the uterine contour owing to multiple filling defects, bilateral tubal obstruction (short arrows) and intravasation of contrast medium into the venous and lymphatic channels secondary to bilateral tubal occlusion (open arrows).

can be demonstrated during ultrasonography, HSG and hysteroscopy.

Currently, hysteroscopy is considered the most suitable method to evaluate caesarean section scars, and HSG is no longer routinely performed for this indication. On HSG, a lower caesarean scar can be represented as a well-defined focal diverticular projection in wedge or linear shape (Figure 9a–b). The scar may be single or multiple and unilateral or bilateral.¹⁰

Post-myomectomy diverticula

A small diverticular-like projection of contrast, usually <1 cm in diameter, may occasionally be found at the site of resection following a submucosal myomectomy (Figure 10). Because this finding is not associated with uterine distortion within the uterine cavity, a post-myomectomy diverticulum usually has no clinical significance,¹¹ although it can sometimes be responsible for persistent post-menstrual spotting.

Cervical fistulas

Fistulas in the female reproductive tract are usually caused following complications of surgery, trauma, infections, inflammatory bowel disease and malignancies of the gynaecologic tract or other pelvic organs.¹²

In developing countries, the most common cause of cervical fistulas is obstetric, whereas in developed countries a complication of pelvic surgery, commonly hysterectomy, accounts for most cases.¹²

On HSGs, the dye enters the fistula and visualizes the fistulized organ (bladder or rectum), which is better shown in the lateral position (Figure 11). Cervical fistulas cause many health and social problems for the patient, and in many cases surgical management is needed owing to unremitting vaginal leakage of urine.

CERVICAL INFECTIONS

Cervical tuberculosis

Cervical tuberculosis is usually secondary to endometrial tuberculosis or may be metastatic from distant foci *via* the circulation or lymphatics.¹³ Sometimes, primary involvement may occur through intercourse.

A wide range of appearances may be noted during HSG, such as ragged irregular contours and diverticular outpouchings resulting in ulcerations of the mucosa, synechiae, adhesions, distortion and endocervical serrations¹⁴ (Figure 12).

Chronic cervicitis

Chronic cervicitis is common among females. Pathogens causing this infection are the same as the resident microbial flora of the vagina. During HSG, the cervical canal is dilated and elongated and the plicae palmatae are thickened, prominent and disparate with a feathery appearance in patients with chronic cervicitis (Figure 13).

CONCLUSION

HSG is considered an essential tool in the standard evaluation of infertility. HSG has a high sensitivity and specificity for screening of acquired structural abnormalities of the uterus and cervix. An accurate interpretation of the hysterosalpingogram is important in offering optimal treatment and can prevent unnecessary and aggressive surgical procedures.

Figure 13. Dilatation and elongation of the cervical canal with thickened and prominent plicae palmatae secondary to chronic cervicitis in a 31-year-old female (arrows).

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