

CLINICAL CASE - TEST YOURSELF

Paediatric Radiology

An 8-year-old female with abdominal pain

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PART A

An 8-year-old female patient, with an unremarkable past medical history, presented at the emergency department with acute onset of abdominal pain, without fever, and one episode of vomiting. Pain occurred 8 hours previously, was localised over the

right lower quadrant and was intermittent. Laboratory studies showed elevated white blood cells (17,000/mL). Pelvic Ultrasound scan (US) (**Figs. 1, 2**) and Magnetic Resonance Imaging (MRI) (**Figs. 3-5**) were performed.



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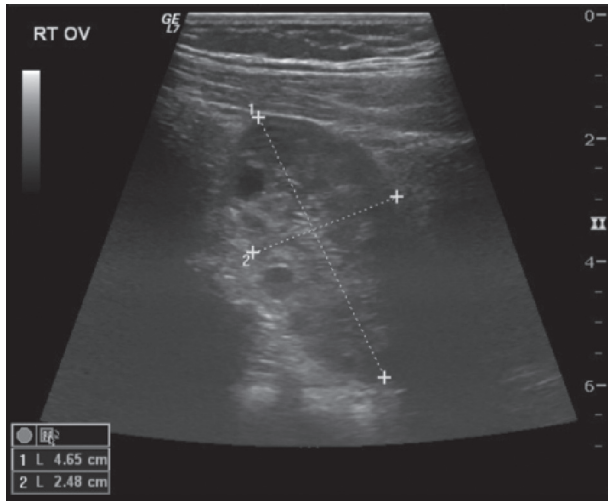


Fig. 1. Pelvic grey scale US.

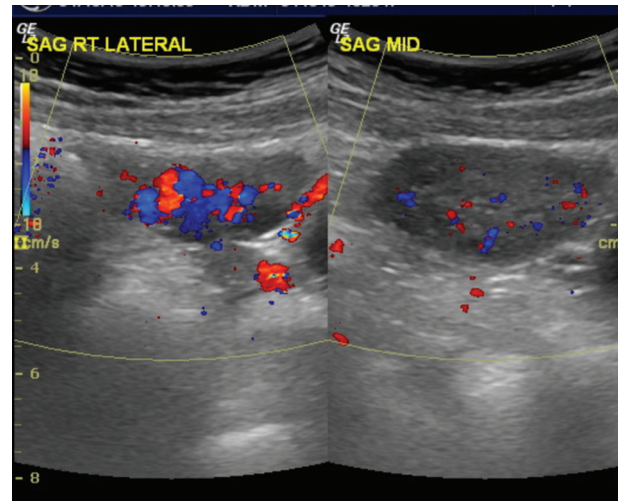


Fig. 2. Pelvic colour Doppler US. Right para-sagittal and mid-sagittal sections.

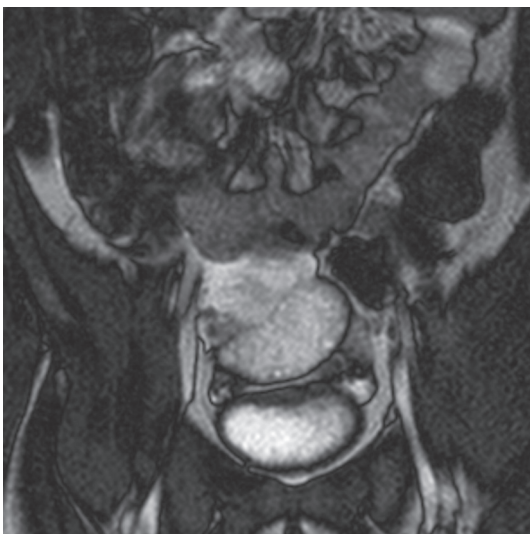


Fig. 3. Pelvic MRI, TRUE Fisp sequence, coronal plane.

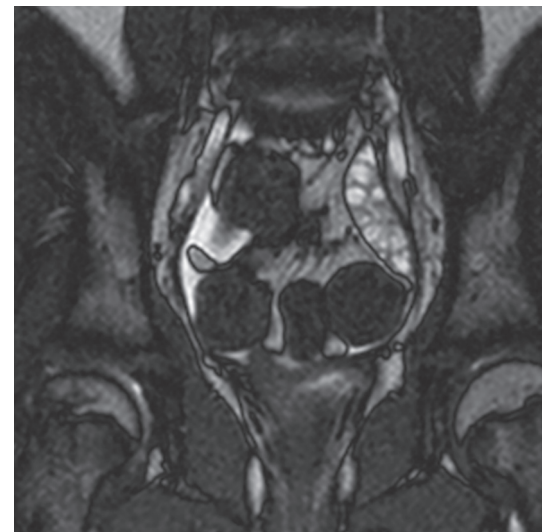


Fig. 4. Pelvic MRI, TRUE Fisp sequence, coronal plane at a more posterior level than in Fig 3.

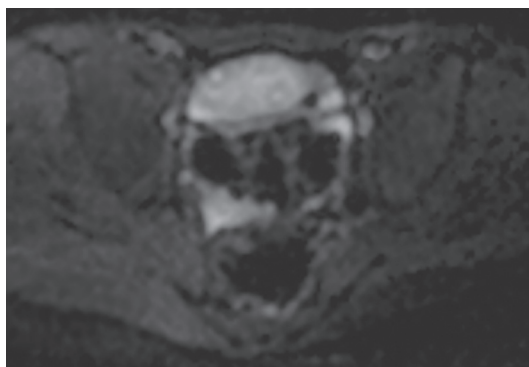


Fig. 5. Pelvic MRI, ADC map, transverse scan.

PART B

Diagnosis: Partial right-sided adnexal torsion, surgically confirmed.

US disclosed an enlarged heterogeneous right ovary measuring 4.7 x 2.5 x 2.4 cm with peripheral follicles, situated at the midline and above the bladder (Fig. 1). The volume of the right ovary was 14.7 ml, which was increased for the patient's age. Colour Doppler US revealed visible blood flow at the right ovary and the "whirlpool", also known as the "whirl" sign of curvilinear vessels laterally to the ovary, which indicated the twisted pedicle (Fig. 2). The left ovary was difficult to evaluate on US due to its smaller size and a gas-filled overlying sigmoid. Based on the above findings and high clinical suspicion, a pelvic MRI was performed in order to further evaluate the viability of the torsed ovary and the morphology of both ovaries. MRI confirmed the presence of an enlarged midline right ovary compared to the normal, elongated, thin left ovary, with hyperintense stroma, peripherally located follicles and some free fluid (Figs 3, 4). Diffusion-weighted imaging (DWI) revealed increased signal on the Apparent Diffusion Coefficient (ADC) map, indicative of no restricted diffusion at the ovary (Fig. 5). A hypointense nodular structure at the lateral side of the right ovary was suggestive of a twisted pedicle. At surgery, a viable oedematous ovary was identified due to right-sided partial adnexal torsion, without any peritoneal reaction.

Ovarian torsion is defined as complete or partial rotation of the ovary around its ligamentous supports, i.e. the infundibulopelvic and the utero-ovarian ligament, which may result in a compromised blood supply [1]. Adnexal torsion refers to twisting of either the ovary, Fallopian tube, or both. The right ovary is more likely to twist because the sigmoid on the left side protects the left ovary [1]. In children, the diagnosis can be particularly challenging [2]. Fifteen percent of all ovarian torsions occur in the paediatric population [3].

The classic clinical presentation of ovarian torsion in children is acute onset of moderate-to-severe pelvic pain, nausea, vomiting, fever as well as peritoneal pain, gastrointestinal or urinary tract symptoms [3, 4]. These symptoms may mimic other conditions including renal stone, appendicitis, ectopic pregnancy, tubo-ovarian abscess and haemorrhagic ovarian cyst. The major risk factor for ovarian torsion is the presence of an ovarian cyst or mass with

a diameter larger than 4 cm, such as benign mature cystic teratoma, haemorrhagic cyst and cystadenoma [2]. Ovarian torsion is uncommon in malignant neoplasms due to the presence of adhesions which render the ovaries relatively immobile [1]. Torsion of a normal adnexa (idiopathic torsion) is more common in children and is due to increased mobility and tortuosity of the adnexa because of elongated ovarian ligaments. This elongation is attributed to the incomplete abdominopelvic descent of the ovaries which is completed by early puberty [3]. Other predisposing factors in adolescence and adulthood include ovulation induction, prior ovarian torsion and polycystic ovarian syndrome [4].

US is the imaging modality of choice for the evaluation of children with lower abdominal pain because it is noninvasive, easily accessible and cost-effective [2]. US findings indicative of non-neonatal ovarian torsion are common in all remaining ages. The most important grey scale US finding of idiopathic torsion is an enlarged ovary with peripherally displaced follicles. In order to determine ovarian enlargement, calculation of the ovarian volume and comparison with the contralateral ovary are advised [3]. An ovarian volume which is at least 3-4 times the volume of the contralateral one is very suggestive of the diagnosis, especially when the ratio is >4.4 [2, 3]. Medialisation of the torsed ovary, as occurred in our patient, and a similar finding of ipsilateral uterine deviation constitute findings of high specificity and a moderate sensitivity for ovarian torsion [2, 4]. Other findings suggestive of torsion include the presence of an ovarian mass, heterogeneity of the ovarian stroma, free pelvic fluid and a visible twisted vascular pedicle [3]. Colour Doppler US findings may demonstrate decreased vascularity of the twisted ovary as well as the whirlpool sign. Absence of blood flow in the twisted pedicle is indicative of necrotic or infarcted ovary. In our patient the ovary contained visible vessels possibly due to incomplete torsion with venous congestion and oedema or due to intermittent detorsion. Furthermore, the presence of blood flow in the ovary does not exclude torsion because of the dual blood supply of the ovary both from the ovarian and the uterine artery [1, 2, 4].

If US findings are non-conclusive (for example if US discloses an equivocal adnexal mass) but there is still a high clinical suspicion for ovarian torsion, MRI is a suitable second-line method, provided that further imaging is readi-

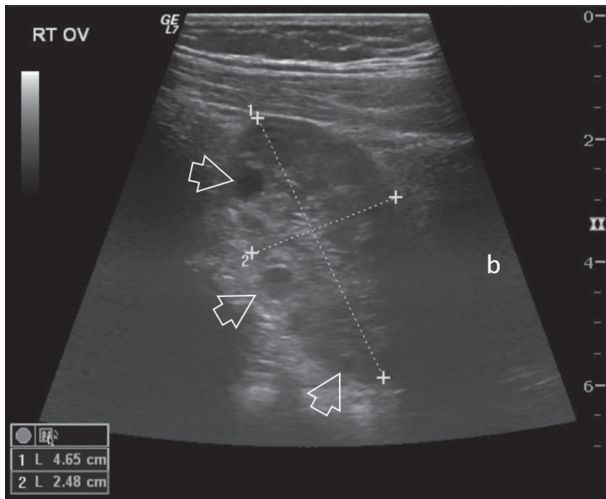


Fig. 1. Pelvic grey scale US shows an enlarged midline right ovary over the bladder (**b**) with peripherally located follicles (arrows).

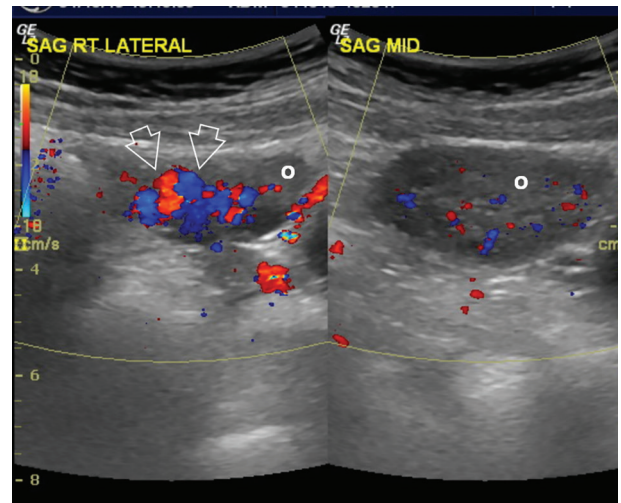


Fig. 2. Pelvic colour Doppler US. Right para-sagittal and mid-sagittal sections. Right para-sagittal section on the left shows the "whirl" sign as a tangle of vessels (arrows), representing the twisted pedicle, situated laterally to the right ovary (o). On the right, a mid-sagittal section demonstrates an enlarged and hyperaemic midline ovary (o).

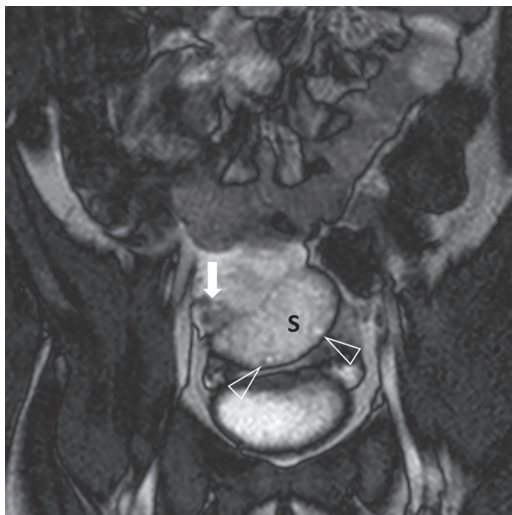


Fig. 3. Pelvic MRI, TRUE Fisp sequence, coronal plane. The enlarged midline, horizontally oriented right ovary is identified. Note hyperintense stroma (s), peripherally located follicles (arrowheads) and suggestion of the twisted pedicle (arrow) to the right of the ovary.



Fig. 4. Pelvic MRI, TRUE Fisp sequence, coronal plane at a more posterior level than in **Fig 3**, shows the normal ovary. The left ovary (arrow) is demonstrated for comparison to the rounded right ovary seen in **Fig. 3**. There is also some free fluid (f).

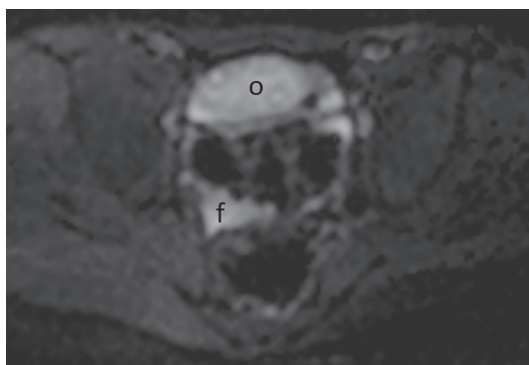


Fig. 5. Pelvic MRI, ADC map, transverse scan. There is increased signal over the torsed right ovary (o) which indicates lack of restriction, oedema and possible viability of the ovary. Note increased signal of the free fluid (f).

ly performed without delay [4]. MRI may demonstrate an enlarged and occasionally midline ovary, with a central afollicular stroma and peripheral follicles. MRI allows the distinction between oedema of the ovary, appearing hyperintense on T2-weighted (W) images, and the adjacent thickened hypointense Fallopian tube [5]. These characteristics are best appreciated on fast spin-echo T2-W MRI without fat saturation. The twisted pedicle may exhibit a variable orientation relative to the standard anatomic planes. We routinely add TRUE Fisp sequences in the paediatric pelvis protocol in female patients due to its ability to identify small cystic structures like ovarian follicles and vascular structures (including the twisted pedicle) in free-breathing children. Furthermore, DWI has become a promising tool for the diagnosis of ovarian torsion since ADC values of the torsed side are statistically significantly lower than those of the non-affected ovary [6]. DWI is used to evaluate the viability of the twisted ovary; very low values on ADC map are indicative of a non-viable ovary [6]. Haematoma is best seen on T1-W sequences with fat saturation, as signal hyperintensity [7].

Neonatal ovarian torsion differs from torsion in the paediatric and adult age groups. In neonatal ovarian torsion, different US patterns have been described and include a cyst with a fluid-debris level, the “double wall” sign, a cyst with a retracting clot, a cyst with multiple mesh-like septa and occasionally calcifications in the cyst wall [3]. These findings of ovarian torsion in foetuses and infants are different from those in older children and may simulate any complex cystic mass encountered in other conditions such as hydrocolpos, duplication cyst and infected urachal remnants. Hydrocolpos is seen as a fluid-filled midline mass between the bladder and the rectum connected to the neonatal uterus, while duplication cysts may be located anywhere along the gastrointestinal tract, most commonly in the ileum, with the characteristic “double wall” sign (hy-

perechoic inner mucosa and hypoechoic outer muscular layer) [8]. Infected urachal remnants may have a complex appearance with internal echoes and are found anteriorly at the midline just above the bladder [3].

Surgical management in ovarian torsion is controversial. Oophoropexy following de-torsion of a normal adnexa is not universally performed and in some centers is preserved for the 5-7% of patients with ovarian torsion who recur [9]. However, many observational studies advocate fixation of the ovaries to the pelvic sidewall or plication of the ovarian ligament which may prevent re-torsion in idiopathic adnexal torsion [10].

Conclusively, ovarian torsion does occur in childhood and requires a high index of suspicion by the referring physician and the radiologist to ensure prompt diagnosis and preservation of fertility. Sudden onset of acute pelvic pain with nausea or vomiting in a female child and adolescent, without appendicitis or renal stone, suggests torsion until proven otherwise. US findings of idiopathic paediatric ovarian torsion may be subtle and the most important include an enlarged ovarian volume (at least threefold) compared to the contralateral ovary, peripherally located follicles, with or without compromised Doppler flow and an adjacent twisted pedicle containing the whirl sign. Secondary torsion due to cysts or masses have identical clinical and imaging manifestations as in adults. Torsion in neonates and foetuses differ because they may present with a complex cyst, mimicking other entities. MRI can be considered on an emergency basis as a second-line, supplementary study in the few cases with controversial US findings or when both ovaries are not visible on US. **R**

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Conflict of interest

The authors declared no conflicts of interest.



KEY WORDS

Abdominal pain; Ovarian torsion; Ultrasound; Magnetic Resonance Imaging; Child

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