Torsion of the fallopian tube: a cause of acute pelvic pain in adolescents and younger girls

Poster No.: C-2315
Congress: ECR 2017
Type: Educational Exhibit
Authors: B. Del Rio, C. Duran Feliubadaló, I. Romero Novo, C. Garcia, C. Martin, M. D. Esteba-Bech-de-Careda; 1Terrassa/ES, 2Sabadell/ES
Keywords: Paediatric, Genital / Reproductive system female, Ultrasound, MR, Diagnostic procedure, Ischaemia / Infarction, Acute
DOI: 10.1594/ecr2017/C-2315

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Learning objectives

- To identify the most common type of patient and context in cases of fallopian tube torsion.
- To learn the pathophysiology of the lesion and its differential diagnoses.
- To become familiar with the most common findings in fallopian tube torsion and the possible differential diagnoses in cases of acute pelvic pain.
Background

Fallopian tube torsion is uncommon (incidence: 1 in 1.5 million). However, it is a serious condition that usually presents without alarming symptoms or signs and with nonspecific radiological findings in which delayed diagnosis can lead to the loss of the adnexa.

It is important to remember that the fallopian tube is practically invisible on imaging unless it is dilated, and the only way to examine it is by hysterosalpingography. For this reason, the fallopian tube is not systematically evaluated in different studies and can easily be overlooked. This is why the first step in diagnosing torsion is to know about this condition and to take it into consideration.

When should fallopian tube torsion be suspected?

Clinical presentation

We should suspect fallopian tube torsion in the same cases where we would suspect ovarian torsion. Patients usually have acute colicky abdominal or pelvic pain that may extend to the groin. Other symptoms that can occur in association with tube torsion include nausea or vomiting. Markers of inflammation (ESR, CRP…) are not usually abnormal in the initial phases, and patients usually do not have fever.

The patient

Fallopian tube torsion rarely occurs before menarche; in fact, one of the factors related to its development is engorgement of the zone in the premenstrual phase of the cycle. The most common trigger is an ovarian, paraovarian, or paratubal mass that favors the mobility of pelvic structures. In the absence of a pelvic mass, torsion has been associated with ovulation induction medications and with pregnancy, both of which are situations that increase the size and engorgement of the ovaries.

In pediatric patients, the incidence peaks between 10 and 12 years of age, coinciding with menarche. The greater laxity of the mesenteries in newborns and infants favor adnexal mobility. Thus, situations in which the volume and weight of the adnexa increase favor torsion by weakening the ligaments and mesenteries that hold them in place. Torsion is more common on the right side, possibly because the colon occupies the left pelvic space, reducing the possibility of movement.

How does adnexal torsion occur?
Anatomy

The internal female genitalia are attached to the abdominal cavity by a series of ligaments and peritoneal reflections that also support their vascular bundles. The uterus, tubes, and ovaries are held in place by a coronal peritoneal fold that is called the broad ligament of the uterus. The superiormost portion, which surrounds the fallopian tubes, is called the mesosalpinx, and the portion that surrounds the ovarian ligament is called the mesovarium. The ovary is also attached to the abdominal wall by the suspensory ligament of the ovary; one of its bundles supports the infundibulum of the uterine tube, so it is also called the infundibulopelvic ligament. A more distal ligament with the same coronal disposition, the cardinal ligament, subjects the neck of the uterus.

The vessels that supply and drain the uterus and the adnexa run alongside these ligaments. The ovarian artery arises from the descending aorta, courses along the suspensory ligament of the ovary, and continues along the ovarian ligament, giving rise to terminal tubal branches. When it reaches the uterus, it anastomoses with the uterine artery, which arises from the internal iliac artery and reaches the inferior portion of the uterus through the cardinal ligament. For the most part, venous return is parallel to the arteries, with the exception of the left ovarian vein, which drains into the left renal vein instead of into the vena cava. Fig. 3 on page 8

The fallopian tube is a tubular structure (10 cm-12 cm long) originating in the uterine horn and open to the abdominal cavity. It can be divided into four portions: the intrauterine portion is the shortest and is immersed in the thickness of the muscular wall of the uterus. Next comes the isthmic portion, the longest and narrowest portion, which connects the ampulla and infundibulum to the uterus. The ampullary portion is the dilated part where fertilization takes place; its abdominal tip joins the fimbrial portion, where fingerlike projections called fimbriae embrace the ovary, grasping the eggs that are released and transporting them toward the rest of the tube. The widest part of the tube is the ampulla, which is 10 mm in maximum diameter.

Pathophysiology
Fig. 4: Diagram illustrating isolated fallopian tube torsion. The tube twists around the axis of infundibulopelvic ligament. Torsion begins as an occlusion of venous drainage, which causes engorgement and wall thickening. If this situation persists, it leads to arterial thrombosis and hemorrhagic infarction. Clinical presentation: Nonspecific acute pelvic pain. Patient: Woman or girl with an adnexal mass. Pregnant woman or woman undergoing ovulation induction treatment. Girl aged 10 to 12 years, premenarche.

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The point where torsion originates coincides with the occlusion or difficulty in venous and lymphatic drainage, which can be caused by extrinsic compression or by incomplete torsion. The ectatic tube becomes engorged and increases in size and weight, which facilitates further twisting, often around the axis of the infundibulopelvic ligament. When adnexal torsion also occurs (ovary and tube), it is the ovarian ligament that twists with the tubal isthmus as the axis. If the torsion persists, the edema and capillary pressure increase in a process that leads to arterial thrombosis and hemorrhagic infarction. Without treatment, the adnexa can become necrotic, become infected, and cause peritonitis.

Management
The **treatment** is invariably **surgical**. In the past, this always meant **adnexectomy** because of the risk of venous thrombi. However, it has been demonstrated that early diagnosis can enable the tube to be **untwisted**, with good outcome (i.e., viability of the tube and even fertility). **Whether one approach or the other is used depends on whether there is arterial thrombosis and hemorrhagic infarction**, and the final decision is usually up to the surgeon. Nevertheless, the **radiologist can help in the decision-making process by indicating in the report whether there is still arterial flow in the ovary** and in cases in which **CT and/or MRI** are done, specifying **whether hematosalpinx is seen**. During the intervention, the surgeon should review the contralateral tube to search for possible trigger points, such as cysts or hydatid cysts of Morgagni. There is no proof that binding the contralateral tube is useful.
Fig. 1: Diagram illustrating the disposition of the pelvic organs, support ligaments and arterial vascularization. 1: Deep inguinal ring, entrance to the inguinal canal. 2: Round ligament of uterus. 3: Ligament of ovary. 4: Suspensory ligament of the ovary with the ovarian vessels. 5: Uterine artery, branch of the internal iliac artery. 6: Uterosacral ligament. 7: Mesosalpinx. 8: Broad ligament.

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Fig. 2: Diagram illustrating the support and vascularization of uterus, ovary and fallopian tube. 1: Ovarian vessels running alongside the suspensory ligament of the ovary. 2: Ovarian vessels in the mesovarium and ligament of ovary. 3: Terminal tubal vascularization. 4: Uterine vessels running alongside the cardinal ligament. 5: Cardinal ligament of uterus. 6: Round ligament of uterus. 7: Broad ligament of uterus.

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**Fig. 3:** Diagram showing the origin of the main arteries and veins. The uterine arteries arise from the infrarenal aorta, follow a parallel course, and reach the adnexa through the infundibulopelvic and ovarian ligaments. The uterine arteries are branches of the internal iliac artery. Except for the left ovarian vein, which drains into the left renal vein, the ovarian and uterine veins follow a parallel course and drain into the inferior vena cava.

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**Fig. 5:** Diagram illustrating combined ovarian and fallopian tube torsion. The ovary and tube twist around the axis of the tubal isthmus; the ovarian ligament and the suspensory ligament of the ovary become twisted, leading to occlusion of the adnexal veins that run alongside them.

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Findings and procedure details

How can fallopian tube torsion be seen?

Diagnostic imaging

_Ultrasonography is the "gold standard"_ in the evaluation of acute pelvic pain in these patients. If doubt persists, CT or MRI can be done. In cases with high clinical suspicion, exploratory laparoscopy can be done, even in the absence of imaging signs.

Ultrasonographic signs

_Fig. 6:_ 12-year-old girl with acute pelvic pain in the right inferior fossa. A: Axial pelvic ultrasound shows a twisted anechoic tubular structure with thickened walls between the uterus and the right ovary. B: Sagittal ultrasound to study the lesion seen in A shows an anechoic tubular structure with thickened walls and a tapered end located behind the uterus.

**References:** UDIAT-CD. Hospital Universitari Parc Taulí (Sabadell, Spain)

In cases of isolated fallopian tube torsion, a **tortuous fusiform anechoic tubular structure**, with or without debris inside, **between the uterus and the ovary** can be seen. Evaluating the pelvis with slices in different planes will help obtain the typical image of a dilated tube. Secondary signs usually include free fluid in the ipsilateral hemipelvis and involvement of the surrounding pelvic fat. Tube torsion is often associated with an adnexal mass or cyst that can make it difficult to identify the structures.
Fig. 7: 15-year-old girl with a two-day history of acute pelvic pain in the right inferior fossa. Pelvic ultrasound shows a septated cystic lesion with an adjacent structure that is difficult to identify. T2-weighted MR images show a cystic lesion (a) next to an enlarged fallopian tube with thickened walls (thin arrows), a normal-appearing ovary (thick arrow), and free fluid in the pelvis. These findings are compatible with fallopian tube torsion secondary to an adnexal cyst.

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Doppler imaging is not always helpful; when venous return is obstructed, Doppler shows patent arteries in the initial phases, implying that arterial thrombosis has not occurred and the tube is still viable. Occasionally, a decrease in venous flow can be
appreciated in Doppler imaging. The "twirl sign" caused by the tubal vessels when there is torsion has been described; however, we have never seen it.

CT findings

Fig. 8: Portal phase contrast-enhanced pelvic CT in the axial projection shows a cystic lesion with thickened walls and fluid (16UH) inside (star) located between the uterus and the right ovary. The shape of the ovaries is normal (arrows). There is a small amount of free fluid in the pelvis.

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Pelvic CT with intravenous contrast and images acquired in the portal phase shows a soft-tissue-density tubular structure more than 15 mm thick with hypodense thickened walls and fluid inside. Intraluminal attenuation greater than 50 HU suggests hematosalpinx.

Secondary signs include ipsilateral displacement of the uterus, trabeculation of surrounding fat, free fluid in the lesser pelvis, thickening of the broad ligament, or focal ileus.

Multiplanar reconstructions can be very useful for identifying the tubular shape and the "beak sign" of the twisted ends.
MRI findings

**Fig. 9:** 15-year-old girl with acute pelvic pain in the right inferior fossa. Axial and sagittal fat-saturated T2-weighted MR images show a tortuous dilated fallopian tube with fluid inside (arrow), as well as an ovary that is not significantly enlarged and free abdominal fluid. Isolated torsion of the fallopian tube was diagnosed.

**References:** UDIAT-CD. Hospital Universitari Parc Tauli (Sabadell, Spain)
Although MRI is not usually done in the acute context, it can be helpful in cases where doubt persists after ultrasonography.

MRI's greater spatial resolution helps us differentiate between the normal ovary and the **dilated tube with thickened walls.** Occasionally, the "beak sign", which corresponds to the tapered tips of the twisted tube, can be seen. Thickening of the fallopian tube wall is easily appreciated in **T2-weighted sequences**, and **T1-weighted and fat-suppression T1-weighted sequences** should be acquired to assess hematosalpinx.

**Exploratory laparoscopy**
Fig. 10: Video of a therapeutic laparoscopy in a patient with isolated left fallopian tube torsion. After an attempt to unwind the structure, salpingectomy was done.

References: UDIAT-CD. Hospital Universitari Parc Taulí (Sabadell, Spain)

In cases with strong clinical suspicion of fallopian tube torsion in the absence of relevant radiologic signs, it will be necessary to do exploratory laparoscopy to rule out torsion or untwist the tubes if necessary.

What other entities should we suspect? Differential diagnosis

Ovarian torsion

Ovarian torsion is much more common than fallopian tube torsion and is the main differential diagnosis. In fact, tube torsion is usually diagnosed when we are trying to rule out ovarian torsion.

Ovarian torsion and fallopian tube torsion share the same anatomy and pathophysiology, and they often occur together. Both structures have double vascularization from
the ovarian and uterine arteries, which run along the same ligaments, such as the suspensory ligament of the ovary (also known as infundibulopelvic ligament) and the ovarian ligament.

The two structures also share the same epidemiology and triggering factors, the most frequent of which are adnexal cysts and masses, especially those greater than 5 cm. In pediatric patients, the incidence peaks between 10 and 12 years of age with menarche and the laxity of the mesenteries favors torsion of both. After menarche, ovulation induction medications, premenstrual states, and pregnancy, as well as all situations in which the volume and weight of the adnexa increase, can lead to torsion.

Fig. 11: Schematic diagram of ovarian torsion. Pathophysiology: Occlusion of venous return causes engorgement and enlargement of the ovary (>4 cc premenarche; >10 cc postmenarche) and parenchymal edema, displacing the follicles toward the periphery, seen here as the "pearl collar sign". If this situation persists, it results in arterial thrombosis and hemorrhagic infarction. Clinical presentation: Nonspecific pelvic pain. Patient: Woman or girl with an adnexal mass. Pregnant woman or woman undergoing ovulation induction treatment. Girl aged 10 to 12 years, premenarche.

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When the ovarian pedicle becomes twisted, its venous and lymphatic drainage becomes occluded, and the adnexa become engorged, enlarged, and edematous. The follicles are displaced toward the periphery by edema and venous congestion. The edematous ovary is compressed by its capsule, causing the capillary pressure to rise. The process continues with arterial thrombosis, ischemia, and infarction.

Fig. 12: 12-year-old girl with a 24-hour history of pelvic pain. Pelvic ultrasound shows a significantly enlarged right ovary (thin arrow) with increased echogenicity compared to the left ovary (thick arrow). The right ovary has multiple small peripheral cysts, seen as the "pearl collar sign". No Doppler signal was observed. Ovarian torsion was diagnosed.

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Ultrasonography is the first-choice technique. The main finding is an increase in the size of the ovary to >4cc in prepubertal patients and >10 cc in postpubertal patients. The ovary is usually displaced toward the midline and above the fundus of uterus. In association with this increase in size, we can also find the "pearl necklace sign", which corresponds to the ovarian follicles displaced peripherally. Occasionally, a cyst or mass is seen together with the ovary; these might correspond to the lesion that has triggered the torsion. A tubular structure seen simultaneously corresponds to the twisted tube. Often free abdominal fluid will be present. Doppler ultrasonography is not very useful for the diagnosis because the obstruction only involves venous and lymphatic drainage and the arterial supply to the adnexa is unaffected. Nevertheless, it is useful for prognosis because arterial flow is a sign that the ovary is viable. Although CT and MRI are not usually used, they can help clear up doubt. The findings are nonspecific: an enlarged ovary displaced toward the midline, the uterus displaced toward the affected side, and free pelvic fluid. Occasionally, these findings are accompanied by a tubular cystic structure with thickened walls, which corresponds to the twisted tube.

Fig. 13: 12-year-old girl with a 24-hour history of pelvic pain. Portal phase contrast-enhanced pelvic CT shows a very enlarged right ovary (thin arrow) with abundant free fluid in the pelvis without other relevant findings. The left ovary (thick arrow) appears normal.

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Appendicitis
In this case, in addition to pain and nausea, patients can have diarrhea and fever. Ultrasonography shows a noncompressible tubular structure with a blind distal end extending from a cecum measuring more than 6 mm, with involvement of the surrounding fat. Occasionally, free abdominal fluid or periappendicular fluid collections are seen.
**Fig. 14:** 13-year-old girl with a 24-hour history of pain centered on the right iliac fossa, fever, and leukocytosis. Pelvic ultrasound shows a blind-ended tubular structure in the right iliac fossa attached to the cecum, compatible with the vermiform appendix. It is enlarged (> 6 mm) and there is marked involvement of the surrounding fat.

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**Hemorrhagic cyst**

Ovarian cysts are the most common adnexal lesions in pediatric patients. An anechoic focus in the ovary is considered a follicle if it measures less than 3 cm. When a dominant follicle does not involute correctly, it can enlarge and become a functional cyst. Rupture of or bleeding from the cyst causes nonspecific pelvic pain. Ultrasonography shows a **hyperechogenic image in the painful ovary.**
Fig. 15: 12-year-old girl with a 6-hour history of pain in the right iliac fossa and no other symptoms. Pelvic ultrasound shows a hyperechogenic oval structure with well-defined margins that has irregular anechoic areas inside it; no follicles are visible. The lesion is located in the right ovary. The left ovary appears normal. A hemorrhagic cyst was diagnosed in the right ovary.

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Hemoperitoneum secondary to the rupture of a follicular cyst

When the dominant follicles themselves break, coinciding with ovulation, they can cause slight bleeding and hemoperitoneum that results in pelvic pain. In these cases the keys to the diagnosis are the coincidence with ovulation, the slight increase in the echogenicity of the ovary, and a minimal amount of free abdominal fluid. In any case, this is a diagnosis of exclusion.

Fig. 16: 15-year-old girl with pain in the right iliac fossa. Pelvic ultrasound shows (A) a moderate amount of free fluid in the pelvis; (B) a normal-sized right ovary with slightly increased echogenicity and multiple follicles. Given the point in the menstrual cycle and the nonspecific ovarian findings, the first diagnostic possibility was the rupture of a follicular cyst. To clear up clinical uncertainty regarding the patient's pain, she underwent laparoscopy, which confirmed normal ovaries and moderate hemoperitoneum.

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Hydrosalpinx
This pathology is extremely rare in pediatric patients. It can have many causes, including endometriosis or pelvic inflammatory disease, and it can be acute or chronic. It consists of the accumulation of secretions in the fallopian tube due to occlusion of its ampullary tip or of both tips. The imaging findings are dilation and enlargement of the tube with fine walls. The longitudinal folds that are present in the normal fallopian tubes enlarge and become more visible, with the dilated tube giving the "cogwheel sign".

In cases with an elongated and dilated fallopian tube, we need to pay attention to the walls of the tube to differentiate between hydrosalpinx and fallopian tube torsion. In acute hydrosalpinx the walls are thin, whereas in fallopian tube torsion they are thickened.
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Conclusion

Fallopian tube torsion is an uncommon cause of acute pelvic pain with nonspecific imaging findings. Nevertheless, radiologists need to be familiar with this entity and include it in the differential diagnosis for acute pelvic pain in adolescents and younger girls because it represents a surgical emergency.
Personal information

Belén del Río. Consorci Sanitari de Terrassa (Terrassa, Barcelona)

E-mail: belendlrio@gmail.com
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