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Role of ultrasound and Doppler in pelvic emergencies

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Abstract
Pelvic emergencies are common in females. Common causes include pelvic inflammatory diseases, cystitis, Mittleshmerz bleed, hemorrhagic cyst, endometriosis, ruptured ectopic pregnancy, ruptured ovarian cyst and ovarian torsion.
Aim: The purpose of the study is to document female patients presenting to emergency room with acute pelvic pain and to study their aetiology.
Materials and methods: 30 patients were included in this study. All patients were examined by a senior faculty and referred for ultrasound and Doppler. Based on the clinical findings and Ultrasound and Doppler findings, patients were treated. Patients with intra-uterine pregnancy are excluded in this study.
Conclusion: Acute pelvic pain is a common presenting symptom to emergency room. All patients must undergo ultrasound and Doppler to decide whether patient should undergo operative versus non-operative treatment.

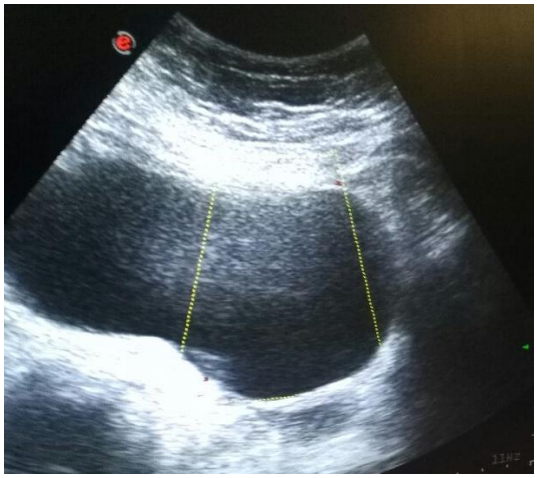
Keywords: Pelvic Emergencies, Ultrasound, Doppler, ovarian cyst torsion, Fimbrial cyst, ectopic pregnancy. Hemorrhagic cysts

Introduction
Ultrasound is the first line imaging modality for pelvic emergencies. Ultrasound is portable and readily available. There is no ionising radiation as in CT which makes ultrasound a versatile tool in the pelvic emergencies of adolescent female and pregnant ladies.

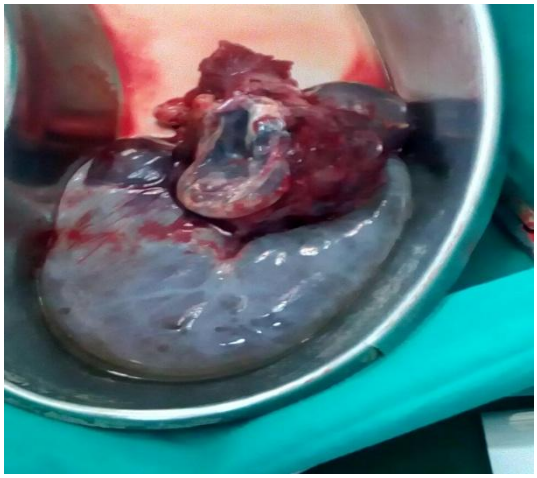
Background
There are many causes of pelvic pain in the female. Associated symptoms include nausea, vomiting, white discharge per vaginum and fever. There are many causes in the pregnant ladies, especially in the first trimester. We plan to evaluate common and uncommon causes excluding complications associated with intra-uterine pregnancy. Ultrasound and Doppler are used as primary imaging modality. Ultrasound features were elaborately studied and findings well known. This article includes common ultrasound findings in pelvic emergencies and emphasise on Doppler findings. Few Doppler signs also demonstrated.

Materials and Methods
This is a retrospective study of cases from Apollo medical college chittoor from May 2017 to February 2018. Patient was first seen in the clinician's office and referred for ultrasound and Doppler study. A detailed ultrasound and Doppler study was done in the radiology department. Patients were treated according to the symptomatolgy. Most common diagnosis is Pelvic inflammatory disease Ectopic pregnancy and ovarian torsion were least in number and they were treated by surgery Total number of cases included in this study is 30 Case distribution is as follows:
Pelvic inflammatory disease–12, Cystitis–3, Ectopic pregnancy–4, Ovarian torsion–2 Endometriotic cysts–2, Hemorrhagic cysts–5, Mittelschmerz bleed–2
Pelvic inflammatory disease is the most common in our study. A careful structured approach is required to rule out severe conditions like ectopic pregnancy and ovarian torsion. Ultrasound and Doppler can confirm most of the cases. Few cases may require CT or MRI pelvis in addition to ultrasound and Doppler.

This a 30 year old lay with torsion ovary
Ultrasound picture shows cyst within the right ovary with no vascularity (picture 1). Patient was taken for emergency explorative laparotomy. Intra operatively it was confirmed as torsion of right ovary. Post operative specimen picture showing gangrenous right ovary (picture 2)



Picture 1



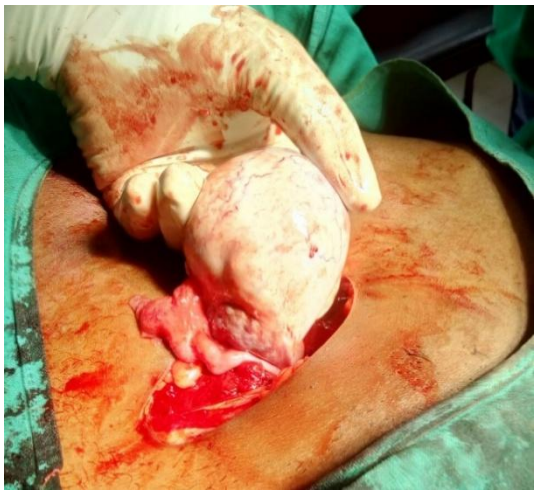
Picture 2

A young lady presenting with acute pelvic pain
Ultrasound showed hemorrhagic cyst. Ultrasound showed hemorrhagic cyst. Doppler showed vascularity in the periphery of the ovary (picture 3 and 4)

Picture 3

Picture 4

As the patient was not responding to conservative treatment, patient was taken for surgery. Hemorrhagic cyst was confirmed.
Post operative specimen picture (picture 5)



Picture 5

Middle aged lady came to emergency room with pelvic pain. Urine pregnancy test was positive. Ultrasound image shows tubal ring sign in the right adnexa (picture 6). Uterine cavity shows minimal free fluid (picture 7). There is also free fluid with no internal echoes in the pouch of Douglas (picture 8).

Picture 6

Picture 7

Picture 8

Intra-operative findings confirmed right tubal ectopic pregnancy. Following are intra operative (picture 9) and post operative pictures (picture 10) of the right tubal ectopic pregnancy.

Picture 8

Picture 8

Discussion

Given the many possible causes of pelvic pain, a structured approach to image interpretation is necessary to narrow the differential diagnosis. First, the distinction between pregnant and non-pregnant patients, as determined by beta human chorionic gonadotropin (β-hCG) levels in correlation with menstrual history, is crucial. This clinical information is important to understand the physiologic changes that may be expected and allows accurate image interpretation [1].

Pelvic inflammatory disease

Common symptoms include lower abdominal pain and white discharge per vaginum. Usually, they were menstruating female who has had multiple sexual partners and does not use barrier contraception and complains of pelvic pain and or lower abdominal pain with vaginal discharge. Signs include tenderness in the lower abdomen, vaginal discharge, cervical motion tenderness and bilateral adnexal tenderness. Sonographic signs of salpingo-ophoritis include enlarged ovaries, hyperaemia, swelling and tortuosity of the fallopian tubes, free fluid in the cul-de sac, purulent exudate (originating from the tubal lumen and serosal surfaces of the tubes) [2]. Uterine findings include mild-to-moderate uterine enlargement, increased endometrial thickness (>12 mm) and altered echogenicity of the endometrium. Color Doppler demonstrates increased angiogenesis. If untreated, patients may develop a tubo-ovarian abscess. A complex adnexal mass with thick septations and echogenic cysts is suggestive of a tubo-ovarian abscess

Ectopic pregnancy

Ectopic pregnancy accounts for~2% of all pregnancies and is the most common cause of pregnancy-related mortality in the first trimester with a 9%–14% mortality rate. (3) Any women of reproductive age presenting with acute pelvic pain with positive urine or serum pregnancy (1) test should be evaluated for ectopic pregnancy. The most common location for an ectopic pregnancy is fallopian tube. Common findings include an adnexal mass which is separate from the ovary and the tubal ring sign. Other types of ectopic pregnancy include interstitial, cornual, ovarian, cervical, scar, intra-abdominal and heterotopic pregnancy. Interstitial pregnancy occurs when the gestational sac implants in the myometrial segment of the fallopian tube. Cornual

pregnancy refers to the implantation of a blastocyst within the cornua of a bicornuate or septate uterus. An ovarian pregnancy occurs when an ovum is fertilized and is retained within the ovary. Cervical pregnancy results from an implantation within the endocervical canal. In a scar pregnancy, implantation takes place within the scar of a prior caesarean section. In an intraabdominal pregnancy, implantation occurs within the intraperitoneal cavity. Heterotopic pregnancy occurs when an intrauterine and an extrauterine pregnancy occur simultaneously [4]

Table 1: Risk Factors of Ectopic Pregnancy [4]

Prior ectopic pregnancy
History of pelvic inflammatory disease
History of gynecologic surgery
Infertility
Use of intrauterine device
History of placenta previa
Use of in vitro fertilization
Congenital uterine anomalies
History of smoking
Endometriosis
Exposure to diethylstilbestrol

Tubal ring sign and ring of fire sign helps in confirming the diagnosis of ectopic pregnancy. Tubal ring sign refers to an adnexal mass which contains gestational sac and yolk sac and is surrounded by thick echogenic ring. Ring of fire sign refers to peripheral hypervascularity surrounding the extrauterine gestational sac.

Hemorrhagic cyst

A hemorrhagic ovarian cyst is a cyst that is filled with blood, which usually occurs when a blood vessel breaks into the cyst. Pain from a hemorrhagic cyst is probably due to stretching of the ovarian capsule, as opposed to pain from ovarian cyst rupture which is due to peritoneal irritation. Patients present with unilateral lower abdominal and or pelvic pain associated with nausea, vomiting and/or vaginal bleeding and suprapubic pain. Ultrasound findings include cyst with echoes in recently formed cyst to reticular formation in an established hemorrhagic cyst [5]

Ovarian torsion

The most common imaging finding in ovarian torsion is unilateral ovarian enlargement (>4cm in longest dimension) which can be present even before infarction has occurred. [6]
Typically, the ovary is displaced to the midline and superior to the fundus. Ovarian stroma may appear heterogeneous and echogenic due to edema and hemorrhage Ultrasound may demonstrate multiple uniform cysts in the periphery of the enlarged ovary, the “string of pearls” sign. Doppler ultrasound findings have classically been described as a lack of arterial flow. However, Doppler evaluation alone for torsion has been shown to be unreliable with variability in the presence or absence of arterial and venous flow in surgically proven cases of torsion
Common grey- scale findings include unilateral enlarged ovary (>4 cm), String of pearls sign, coexistent mass within the twisted ovary, free pelvic fluid and twisted vascular pedicle
Usually the torsed ovary is located in the midline and superior to the fundus of the uterus.

The most common tumor predisposed for ovarian torsion is the benign mature cystic teratoma [7]. Doppler signs include absence of both arterial and venous flow to the affected ovary or absence of venous flow with persistent high-resistance arterial flow. These are highly specific signs of adnexal torsion and may help clinch the diagnosis. However, the presence of normal color flow and spectral waveforms does not exclude the possibility of torsion. In one study, Doppler flow was found to be normal in 60% of surgically confirmed cases of ovarian torsion [8]. The reason for persistent vascular flow despite torsion is not altogether known and likely multifactorial. The dual blood supply to the ovary via both the ovarian artery and the ovarian branch of the uterine artery is thought to be one source of continued blood flow in a torsed ovary. Another hypothesis is that venous thrombosis and infarction produce symptoms before the arterial supply to the ovary is compromised.

Whirlpool Sign [9]

This sign is demonstrated on Doppler. Torsed vascular pedicle appears like whirlpool sign on Doppler. This sign is also useful in torsion of the testis.
Torsion may also be incomplete or even intermittent, with transient restoration of blood flow in between episodes of torsion. Therefore, in the appropriate clinical setting, a unilaterally enlarged ovary should raise the possibility of ovarian torsion, even with the presence of Doppler flow. For these reasons, it is important to make a careful comparison to the contralateral ovary for both the gray-scale appearance and Doppler findings in order to make the diagnosis, especially in subtle cases. Ovarian torsion is uncommon after pelvic inflammatory disease, endometriosis or malignant neoplasms. This may be due to the presence of adhesions, rendering the ovaries relatively immobile. Right ovary is more likely to twist because the space occupied by the sigmoid colon on the left side protects the left ovary.

Endometriosis

Endometriosis is characterized by ectopic endometrial tissue, primarily within the ovaries and pelvic peritoneum. Most of the endometriosis occurs within the ovaries. The pathogenesis of endometriosis is a controversial subject with multiple proposed theories and has yet to be fully elucidated. The most widely accepted theory involves ectopic implantation of endometrial tissue by retrograde menstruation. Other theories include hematologic or lymphatic dissemination. Ectopic endometrial tissue is hormone sensitive and can cause cyclic bleeding, pain, and in-fertility. Although most of the pain is chronic, endometriomas can cause acute on chronic pain, which also can occur in association with secondary infection or rupture [10].

Summary

Ultrasound is the first imaging modality in cases presenting with acute pelvic pain. Typical imaging features allow a confident diagnosis and treatment. Doppler study further adds value to the diagnosis. Ring of fire sign is seen in cases of ectopic pregnancy. Swirl sign is seen in cases of ovarian torsion.

Conclusion

We conclude that all patients presenting with acute pelvic pain should undergo ultrasound including Doppler for

making a correct diagnosis and for the best management of patients

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