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CONTENTS

Review Article

Fertility preservation in gynecological cancers:A review of general impact of treatment and approaches to deal with
Chavan N et al..... 1

Role of color flow and doppler in gynaecology and infertility: Part I
Malhotra N et al 6

Scientific Review

How to approach rectovaginal endometriosis surgically?
Darwish B et al..... 13

Editorial Message

Welcome to the first issue of Indian Geotechnical Journal in 2019. This year marks a milestone in the history of the journal because it comes with some important enhancements. The first enhancement is that the journal will consist of six issues published per year instead of four. This will enable faster processing rate of the articles and gives us scope to include more articles in a year. To get best benefits out of this improvement, we encourage more practice-based articles, state-of-the-art content and critical review articles. This will help us in scoring high in performance measures and moving up in journal ranking lists. We also changed the cover page of the journal to reflect the changes. We continue to publish excellent articles, and our rejection rates are much higher compared to many top journals in geotechnical engineering. Despite these facts, we have a fairly small number of citations, which is a big hindrance to our goal of receiving an impact factor for the journal. Lack of impact factor impedes the submission of high-performance papers to the journal because individual researchers hesitate to publish in a journal without an impact factor, due to research and grant pressures that demand quantitative performance assessment through these metrics. Though our journal has a long history and it continues to improve with time, we cannot really ignore the importance ascribed to the ranking exercises. It is time for us to look at the journal as truly international and continue to work hard to help the journal in climbing up the ranking ladder. I do not believe in rushing into shortcuts that might work in getting more citations for the articles. Instead, we should find better articles that discuss new ideas and research directions, original articles that can create deep interest in the readership of the journal and content that the researchers do not want to miss. It requires a lot of effort and commitment of the Editor to do this evaluation. Many authors may not understand the fact that the role of Editor comes with a great responsibility than power. The decisions may leave some of the authors unhappy, but this is inevitable to shape up the journal into what we are aspiring for. I thank my associate editors Prof. Deepankar Choudhury, Prof. Rajagopal and Prof. Krishna Reddy, the entire editorial board and reviewers for all their support. My warm welcome to the new members of the Editorial Board of the journal. Together we would work towards making the journal a truly influential publication. Comments, suggestions and special issue proposals are always welcome.

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Review Article Open Access

Fertility preservation in gynecological cancers: A review of general impact of treatment and approaches to deal with

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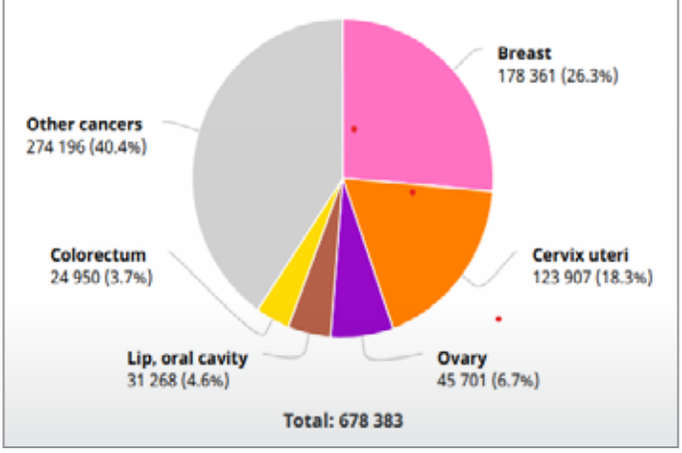
Introduction

Cancer has emerged as an important public health problem in all societies. Data from population-based registries under the National Cancer Registry Program of India indicate that the leading sites of cancer among women are the cervix uteri, breast, and oral cavity. Gynecological cancers adversely affect the reproductive outcome. Oncofertility counselling should be individualized according to the couple, history of medical disorders, patient interest and age as well as type of treatment being the most important.[5]

Figure. 1 Gynecological cancers in females in India 2020, IARC



According to International Agency for Research on Cancer (IARC), & World Health Organisation (WHO), data from India suggests gynecological cancers are one of the most common cancers and hence there is urgent need of fertility preservation techniques.

Chemotherapy affects fertility adversely and the extent of effects depends on the following factors

- Radical chemotherapy affects fertility more than adjuvant chemotherapy.
- Combination chemotherapy is more likely to impact fertility as compared to single drug chemotherapy.
- Larger the dose, larger is the impact.
- Drug-dependent effects. Different agents have a markedly different impact upon fertility with some chemo-therapeutic agents sparing fertility whilst others are extremely toxic in this regard.
- Women receiving chemotherapy under the age of 40 showed has a higher chance of regaining the normal ovarian function while majority of the women who received chemotherapy after 40 years of age were

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rendered postmenopausal following the treatment.

- There is variation in chemosensitivity of different types of ovarian cancers to chemotherapy agents.

Toxic effects of commonly used chemotherapeutic agents

- Adriamycin and cyclophosphamide have a 38% rate of ovarianfailureafter two years of chemotherapy in women over 40 years.[1]
- Cyclophosphamide, Hydroxydaunorubicin (Adriamycin) Oncovin (vincristine) and prednisolone do not cause ovarian failure.
- ABVD (doxorubicin, bleomycin, vincristine, and dacarbazine) is significantly less toxic with respect to fertility than the older regimen MOPP (mechlorethamine, vincristine, procarbazine and prednisolone).[1]
- The effects of bleomycin and doxorubicin on fertility is minimal.[1]
- Vinca alkaloids and antimetabolites have very mild effects on fertility (methotrexate very mild at 6 gm total dose).[1]
- Cyclophosphamide, methotrexate, and 5-fluorouracil (CMF) a classical breast cancer regime leads to amenorrhea in 2 years in 71% of women above the age of 40 years.[1]

Radiotherapy effects on fertility

The effects of radiotherapy on fertility aredose dependent. A dose of 16.5 Gray causes immediate ovarian damage in females under 20 years & 14 Gray in under 30 years.[1] The hormonal as well as the reproductive function is affected.Radiation to the uterus can result in poor implantation due to reduced uterine volume and blood flowwhich canlead to increased second trimester losses, IUGR and preterm births. Vaginal irradiation causes stenosis and drynessfurther decreases fertility due to physical impairments.

Fertility preservation options

- Ovarian suppression
- Ovarian transposition
- Cryopreservation of unfertilized oocyte
- Embryo cryopreservation
- Ovarian tissue cryopreservation
- Conservative medical therapy
- Conservative gynecologic surgery

Ovarian suppression

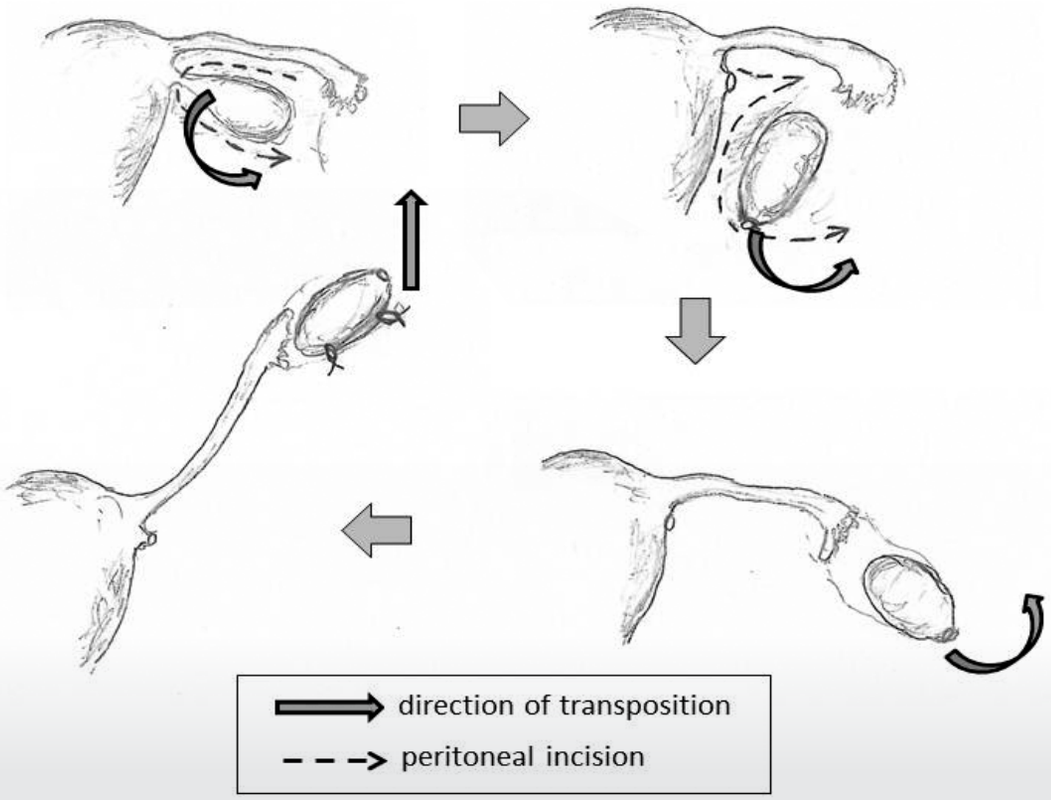
It has been utilized during chemotherapy to suppress ovarian cycling and induce a temporary medical menopause. The action of GnRH analogues is not clearly understood as primordial and primary follicles do not have GnRH receptors and it is possible that GnRH analogues preserve those follicles that have already initiated growth. The Option Trial (Ovarian Protection Trial in Estrogen Non-Responsive Premenopausal Breast Cancer Patients Receiving Adjuvant or Neo-Adjuvant Chemotherapy) for breast cancer looked at hormone suppression using GNRH analogues and progestogens andexamined the impact of this on fertility. It concluded that using goserelin concurrently with chemotherapy isassociated with a high rate of ovarian function preservation.

According to American Society of Clinical Oncology (ASCO) recommendations, there is currently insufficient evidence regarding the effectiveness of gonadotropin-releasing hormone (GnRH) agonists for fertility preservation.

Ovarian transposition (oophorepexy)

The goal issurgically removing the ovaries from the direct field ofradiation. It can be offered when pelvic irradiation is performed as cancer treatment.

Figure. 1 Ovarian transposition



Patient should be counselled that the ovaries are not always protected because of the radiation scatter. It should be performed as close to the time of radiotherapy as possible because of chance of risk of the ovaries.[2] Ovarian transpositions are mostly performedlaparoscopically. Some studies suggest lateral transposition is better than medial transposition. The success rate of this procedure is variable.[2] If these patients need IVF in the future,oocyte retrieval may become technically more challenging.

Cryopreservation of unfertilized oocytes

Cryopreservation of unfertilized oocytes can be used in

- Women without a male partner
- Do not want to use donor sperm
- Denies freezing of embryo on religious grounds.

Oocyte harvesting can be done independent of the day of cycle. Stored eggs can later be thawed and IVF techniques with ICSI can be used. Oocytes have more risk of damage than embryos from cryopreservation techniques secondary to spindle damage from ice crystal formation. It can be prevented by using vitrification techniques.[3] Oocyte cryopreservation is more suitable for the younger patients it can be harvested by transabdominal ultrasound and laparoscopy instead of using transvaginal technique.[3]

Special consideration should be given to patients with estrogen-sensitive breast and gynecologic cancers as these fertility preservation interventions like ovarian stimulation regimens which increases the estrogen levels and/or subsequent pregnancy can increase the chances of recurrences. According to American Society of Clinical Oncology Clinical Practice Guideline Update Aromatase inhibitor–based stimulation protocols

are now well established and may ameliorate this concern.[3] Studies do not indicate increased cancer recurrence risk as a result of aromatase inhibitor–supplemented ovarian stimulation and subsequent pregnancy.[3]

Cryopreservation of embryo

Embryo storage is ideal for an adultwoman in a stable relationship.The success rate with IVF is 30% similar to natural conception without ART. The procedure involvesstimulation of the ovaries with gonadotrophins which leads to raisedestrogen levels, which raises the concernfor tumors such as breast cancers with estrogen receptor positivity. An egg retrieval technique is undertaken after stimulation of follicles. It is done as a day care procedure using transvaginal probe to guide transvaginal egg collection, done under general anesthesia or sedation. The patient's eggs are fertilized with the partner's sperm then the resulting embryos are cryopreserved at either cleavage or blastocyst stage by vitrification.

- Survival rate of thawed embryos upto 90%
- Implantation rate upto 30%
- Cumulative pregnancy rate upto 60%

Disadvantages:

- Need of donor sperms
- Need for IVF
- Supraphysiological level of E2-unacceptable in estrogen sensitive malignancy.

Cryopreservation ovarian tissue

It is mostly used for adults and for children. Best results as seen with ovarian tissue of young females. Ovarian biopsy or whole ovary is removedfor preservation using laparoscopy done under general anesthesia. Tissue obtained is cutinto thin sections and then cryopreserved. Ovarian tissue cryopreservation for the purpose of future transplantation does not require ovarian stimulation and can be performed immediately. In addition, it does not require sexual maturity and hence may be the only method available in children. Finally, this method may also restore global ovarian function. The choice of what tissue type should be preserved depends on the type of cancer, the patient's age, and whether she has a partner.

The importance of counselling for fertility preservation

Patients should be informed on all available fertility preservation options before starting anticancer treatments as women are notwell informed about different options and possibilities. The physician should also counsel regarding reproductive prognosis and risks of fertility treatment. Other factors which affect the patient's decision include financial resource, family support, anxiety, doubts and prejudice should be taken into consideration.[7] An experienced reproductive endocrinologist or urologist should discuss in detail the appropriate Fertility preservation techniques. All adolescents and women of reproductive having gynecological cancers+ should be referred.[4]

None of the options suggested for preserving female fertility despite gonadotoxic chemotherapy methods is ideal and none guarantees future fertility in all survivors; therefore, a combination of methods is recommended for maximizing chances of future fertility.[5]

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Review Article **Open Access**

Role of color flow and doppler in gynaecology and infertility: Part I

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Introduction

Since the advent of ultrasound there has been a exponential rise in its application for non-invasive diagnostic purpose especially for the pelvic region. Yet another development in this field to enhance the diagnostic capabilities of this modality was colour Doppler. Both these modalities have a subjective assessment and are fairly reproducible.

The role of colour Doppler in obstetrics gynaecology and infertility has been ever changing and helped us to diagnose and manage most of the complication even before they manifest.

This prediction capability of colour Doppler along with ultrasound has led to its increase role and use in all these fields helping us to tackle conditions such as pre-eclampsia, IUGR, benign diseases and gynaecological Malignancies, ovarian stimulation, infertility monitories OHSS and many more conditions

Doppler helps in visualizing the blood supply of almost all of the small vessels right from the endometrium, uterus, ovary, myometrium , tubes, adnexa as well as other important blood vessels of the pelvis. The sensitivity as well as the specificity of this modality is fairly high and hence has a wide spread application.

What is colour Doppler?

When ultrasound energy is directed to a moving target it is reflected back with a change in frequency. This phenomenon is what we call as Doppler shift. A waveform is constructed and this waveform is called as "Doppler Velocity waveform". Studying this waveform tells us about the various changes that occur in the pelvic blood vessels which ultimately help us in formulating a diagnosis.

Figure. 1 A typical Doppler waveform, S is systolic and D is diastolic wave.

This velocity of blood flow can be determined using certain equations, if the values of the angle and of the Doppler signal are known. The processing of the Doppler signal includes sequential steps of amplification, demodulation, spectral processing and display.

Variables in Doppler

1. Blood velocity: Doppler frequency increases as the velocity of blood flow increases i.e high velocity blood flow will have a higher frequency depiction on the colour flow.
2. Ultrasound frequency: Doppler frequency is increased with higher ultrasound frequency. As in B-mode, lower ultrasound frequencies have better penetration.Better sensitivity to flow or better penetration , depends on the choice of frequency.
3. The angle of insonation: Angle of insonation is defined as the angle of the ultrasound beam relative to the tissue or organ of interest. The strongest echoes are produced when the angles of incidence approach the angle of reflection.

Calculations in Doppler

In order to quantify the vascular resistance, various indices have been proposed.

1. **PI (Pulsatility Index)** = Peak Systolic Velocity -End Diastolic Velocity (Gosling and King 1975)

   Mean Velocity

2. **RI (Resistance Index)** = Peak Systolic Velocity - End Diastolic Velocity (Bourcelot 1974)

   Peak Systolic Velocity

3. **Systolic / Diastolic Ratio (Stuart et al 1980)**

The higher the value of these indices more the impedance to blood flow and perfusion of the particular area. In order to understand the pathological features of different gynaecological conditions one has to know about the indices of various vessels.

How the color image is formed

Color images are of two type : (i) Asynchronous and (ii) Synchronous imaging. In asynchronous imaging, the gray scale and Doppler information are gathered at different times. In contrast, synchronous imaging information is gathered simultaneously.

Asynchronous color flow imaging

Two images are produced during scanning and are later super impossed. The gray scale comes from a real time image. The Doppler image comes from steering another ultrasound beam at an angle to the array (0-45°). The image is composed in a digital scan converter. Two different frequencies can be used for the two image components; a system could have gray scale at 5 MHz and color at 3MHz.

Synchronous color flow imaging

Simultaneous processing for amplitude, phase and frequency is achieved by the same echo signal. This technology is so different that it is known as angiodynagraphy. The linear array sends a dynamically focussed beam, which is perpendicular to the vessels. This is good for imaging but not for Doppler. To provide the Doppler angle needed to visualize blood flow, a wedge stand off site between the array surface and the skin surface. The image is divided into a set of sample sits, which are same in the field of view. Within this site the system looks at the echo signal amplitude is one path, at the phase and frequency in the other.

The machine now builds the image on a pixel basis, testing first for evidence of motion and its direction. If motion exits at a pixel, it is colored, otherwise it takes on a gray scale proportionate to the echo signal strength. Having set out the image formation

the next step is color-coding the pixels, in which motion was detected.

Types of Doppler

There are basically 2 types of Doppler types that are present on the ultrasound machine.

1. Continuous wave Doppler
2. Pulse wave Doppler

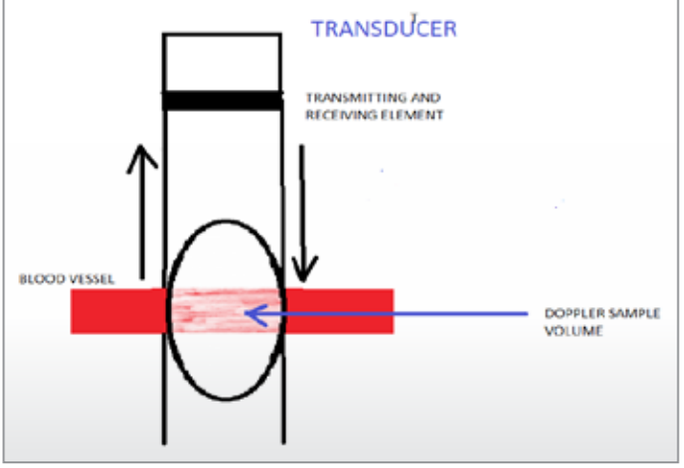
Continuous wave Doppler

As the name suggest this type of Doppler emits continuous wave and recives them simultaneously. The beam of sound flows continuously until it is completely attenuated by the depth of the tissue and it transmits the doppler wave from every blood vessel it encounters in its path. Owing to this property continuous wave Doppler is unable to determine the source as well as the location of the velocities which it passes and hence there is lack of a colour flow image. This type of colour flow is generally more useful in cardiac scans.

Pulsed wave Doppler

Pulsed wave as the name suggest emits and receives sound waves in a pulsatile manner. This small interval in pulsed wave enables it to locate the depth as well as velocity of the vessel (figure 2). Additional advantage of this type of Doppler is that the range gate can be changed according to the diameter of the vessel, hence getting a more accurate flow velocity and interpretation. It allows simultaneous b mode and colour flow images to be seen together. Obstetric or gynaecological ultrasound use pulsed wave Doppler as to continuous flow.

Figure. 2 Pulsed wave Doppler

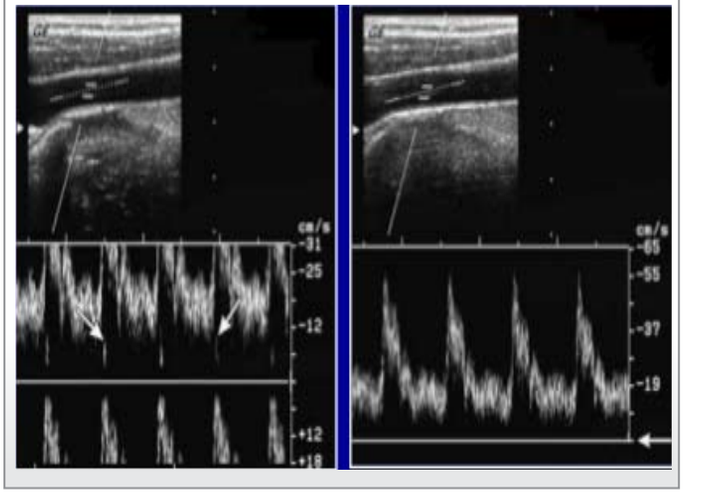


Aliasing

At a given sampling frequency when the pulses are transmitted (Pulse repetition frequency), the maximum Dopplerfrequency (fd) that can be measured without ambiguity is exactly the half of pulse repetition frequency. So if the flow angle and the blood velocity combine to give afd which is more than half of the rules repetition frequency the Doppler signal becomes ambiguous, this is what is called as aliasing.

A simple example is when we see backward rotation of a wheel on a film if the frame rate is low even when the wheel is moving forward.

Figure. 3 Aliasing and correction of aliasing by shifting the baseline (arrows)



Use of Doppler in gynaecology

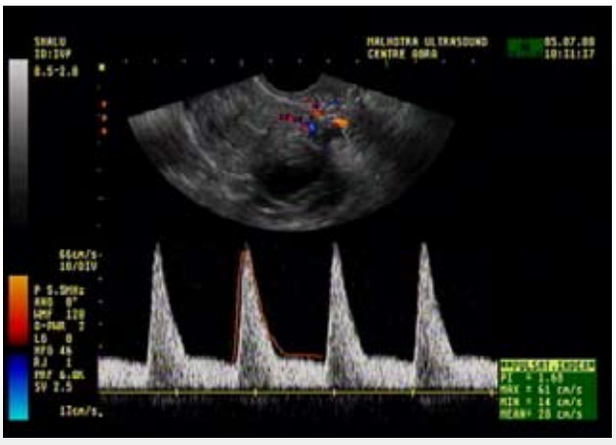
The use of colour Doppler in gynaecology has opened many avenues for diagnosing and preventing various diseases which were previously ambiguous or difficult to diagnose and required invasive diagnostic techniques calculating various indices in all the pelvic vessels gives an idea of the

resistance to blood offered by that vessel. Usually all muscular arteries, due to the musculatior let blood go through to the organ in diastole. This blood is approximately 30% of the systolic push.

Main uterine vessel

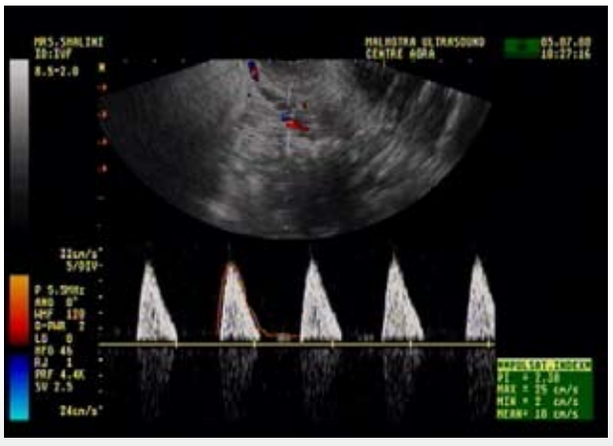
The color Doppler signal from the main uterine vessels may be seen in all patients lateral to the cervix. The small branches of uterine artery can be followed by searching the corpus, ascending along the lateral wall. Waveform analysis shows high velocity and high resistance flow. The RI depends on the age, phase of menstrual cycle and any special condition such as pregnancy or tumor (Figures 4A, 4B)

Figure. 4A In early proliferative phase RI 0.94+ 0.04



(High resistance: Diabtolic flow is very less , less than 10 % of systole) (RI around 0.9)

Figure. 4B Day 18 (secretory phase)RI 0.74+ 0.04



Resistance decreases as menstrual cycle and now the diastole flow is about 30%(RI around 0.7)

Ovarian vessels

It is difficult to visualize the ovarian vessels but an experienced operator using modern colordoppler unit can detect them in most patients in the lateral upper pole of the ovary.

Color flow is usually not prominent, velocity is low and resistance varies according to the menstrual cycle. A low velocity, high impedance pattern is seen during the follicular phase. At ovulation there is maximum increase in the velocity and RI decrease, reaching a dip of 0.44 + 0.09. 4-5 days later slowly increases by 0.04 - 0.05 before menstruation.

Resistance index for ovarian vessels during menstrual cycle Table 1

Table 1. Resistance index (RI) for ovarian vessels during menstrual cycle

Active ovary: RI (corpus luteum)	0.44 ± 0.09	PSV	27 ± 10 cm/sec
Inactive Ovary: RI	0.76 ± 0.22	PSV	8.9 ± 3.8 cm/sec

Iliac flow

The common and external iliac arteries show plug flow, (Triphasic flow) a window under the waveform and a reversed component during diastole. The internal iliac vessel in contrast has a parabolic flow with an even distribution of velocities within the waveform. These can be generally located near the ovary on the caudal side.

Ovarian masses

A recent new classification and terminology for distinguishing ovarian mass is the IOTA (International Ovarian Tumor Association) classification. It follows certain modified terminologies which are as follows

Classification of adnexal masses according to IOTA

- Benign ovarian

Polycystic ovaries, functional cysts, endometriomas, serous cystadenoma, mucinous cystadenoma,

mature teratoma, fibroma (rare, can cause Meig's syndrome: ascites and pleural effusion), thecoma (very rare, can secrete oestrogen and progesterone)

- Benign non-ovarian

Paratubal cyst, hydrosalpinges, tubo-ovarian abscess, peritoneal pseudocysts, appendiceal abscess, diverticular abscess, pelvic kidney

- Primary malignant ovarian

» Epithelial carcinoma

◊ Birderline

◊ Serious cystadenocarcinoma

◊ Mucinous cystadenocarcinoma

◊ Pseudomyxomaperitonei

◊ Clear cell carcinoma

» Germ cell tumor

◊ Malignant teratoma

◊ Dysgerminoma

» Sex cord tumor

◊ Granulosa cell tumor

- Secondary malignant ovarian

IOTA (International Ovarian Tumor Analysis) Terminologies

Table 2. characteristics of masses in IOTA classification

Characteristic	
Locules	Unilocular, unilocular-solid, multilocular, multilocular-solid or solid
Cyst contents	Anechoic, low level, ground glass, haemorrhagic or mixed – Solid material or papillary structures or wall irregularity (presence and size)
Vascularity	PI and RI of the ovarian vessels
Shadows	-
Ascites	-

So colour Doppler helps us in determining the vascularity score and determine if the mass is benign, borderline malignant or malignant.

The pedicle artery sign is characteristic of the endometrial polyp whereas multiple feeding vessels can indicate endometrial hyperplasia, carcinoma or even in submucous fibroid.

Timmerman et al a prospective study found sensitivity of pedicle artery sign as a marker for diagnosis of endometrial polyp to be 76.4%, specificity of 95.3%, PPV of 81.3 % and NPV of 93.8%.[22] Cil et al also found a similar finding with sensitivity of 81.2% , specificity of 88.2 %, PPV of 92.9 % and NPV of 71.4%.[25] Talat et al in a study concluded that pedicle artery sign has 94% sensistivity and 100% specificity. Cogdez et al reported in their study a sensitivity, specificity, PPV and NPV of single feeding vessel in diagnosing polyp to be 80, 100, 100, and 69.2 % respectively.

Adnexal ovarian torsion

Ovarian torsion can occur in females of all ages; however, women in their reproductive years have the highest prevalence, with 17%–20% of cases occurring in pregnant women.[27] This is a difficult diagnosis on either clinical or imaging criteria. The appearances on ultrasound are almost infinitely variable. TVS is one of the best imaging techniques for diagnosing torsion as it is non invasive accessible and cost effective with reproducible and accurate results. A series of study showed that positive predictive value of ultrasound diagnosis of ovarian torsion to be 87.5% and specificity of 93.3 %, hence forming a basic yet effective tool for diagnosing torsion[28]

The ovarian torsion can be broadly divided into 2 types depending on the compromise of the blood vessels and twist on the pedicle

1. Complete
2. Incomplete

Color flow doppler will not distinguish the condition from other pathologies since flow has been

demonstrated both centrally and peripherally in lesion. However it has been suggested that the absence of flow within a twisted ovary identifies one that is beyond salvage by conservative surgery and this may help in the surgical management of this condition.

Doppler findings in ovarian torsion can be as follows

- Minimum or no intravenous flow in the ovarian vessels
- Absence of flow in the arteries (poor prognosis, less commonly seen)
- Diastolic flow is reversed or absent
- Vascularity is normal(does not rule out torsion as ovaries receive dual blood supply)
- Whirlpool sign (twisted ovarian pedicle)[29]
- Probe tenderness over the ovary[30]

Ultrasound has a sensitivity of approaching 100% and specificity of 97% if there is an enlarged ovary with an absence of arterial and venous blood flow.[31]

In an incomplete torsion (<360 degree) there are certain signs which can be seen . the vascular pedicle which is twisted may appear as round hyperechoic with multiple concentric hypoechoic strips called as the TARGET SIGN. This sign instead of circular can also be beak shaped(concentric low echogenic strips), ellipsoid (internal heterogeneousechoes). The WHIRLPOOL SIGN seen as concentric low echoic intrapedicular structure. The presence of whirlpool sign can be either medial or lateral that is between the lateral pelvic wall and ovary or the ovary and the uterus. The hypoechoic rings comprises of fallopian tube, the utero ovarian ligament, broad ligament and branches of ovarian vessels.

Depending on the size of the mass the whirlpool sign can either be medial or lateral . Greater the volume of the ovarian mass higher is the tendency towards lateral whirlpool sign aa due to the large mass the ovary is pulled downwards and the components of whirlpool sign cannot fit between the ovary and the uterus hence the lateralization. In a small mass the components of the whirlpool sign can fit betweenthe mass and the uterus hence the medialization. This finding can further help us in determining the size of the mass.[33] Hence a positive whirlpool or a target sign in a twisted vascular pedicle is the most definitive sign for ovarian torsion.

Conclusions

Today the advent of color flow imaging, doppler and power angio have opened a new diagnostic horizon for understanding physiology and vascular pathology of gynaecology, infertility, utero placental and fetal circulation.

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How to approach rectovaginal endometriosis surgically?

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Abstract

Treating deep infiltrating endometriosis (DIE) in an environment of distorted anatomy can be challenging. Following standardized surgical steps in our routine practice has shown to help speed up the learning experience with well-documented benefits that ensure an optimal surgical outcome. Surgical skills and training are required to untangle this distortion and restore landmarks before treating the deep endometriosis pathology.

Introduction

DIE lesions commonly lead to distorted anatomy with adherent organs which may be the consequence of the disease itself or extensive fibrosis. The key to this condition is to find all your landmarks and restore your anatomy.

Following standardized strategic steps not only help in untangling the pelvis with minimal complications but help build a learning curve and experience. The aim of dissection is to identify and preserve organs to avoid injury, before proceeding towards the diseased rectovaginal site.

This is achieved by the following steps:

1. General overview of the pelvic and abdominal cavity
2. Right ureterolysis
3. Left ureterolysis with sigmoid detachment
4. Optimizing visualization of the operative site by ovarian suspension
5. Dissecting the pararectal fossa
6. Freeing the rectovaginal space
7. Performing specific surgical treatment options for the identified DIE disease of the rectovaginal site

Preoperative evaluation

Preoperative evaluation is obtained through history taking, physical examination, and a bimanual pelvic examination, help in identifying DIE lesions and assessing the severity of disease and quality of life compromise. Magnetic resonance imaging (MRI) is a useful tool in assessing associated DIE of the rectum and vagina. Further assessment, including transvaginal ultrasound in the hands of experienced operators, but also endorectal ultrasound and computed tomography-based virtual colonoscopy is performed to identify the presence of colorectal DIE, the presence of endometriosis nodules along the intestinal tract, and the severity of involvement and lumen stenosis.

General overview

The presence of disease and its extent of disease are identified. The surgeon then orients himself to pelvic structures and the relation of organs to one another.

Identification of the ureters

The ureter in endometriosis may largely deviate from its course. It is therefore prudent to identify and isolate the ureters before embarking into further treatment of any endometriosis lesions.

Right ureterolysis

A superficial direct opening of the peritoneum is done slightly medial to the ureter, as high as the level of the pelvic brim, far away from the pelvis which could be obliterated by adhesions. Adequate peritoneal tissue tension at 90^0 is important to assist with exposure and minimize thermal spread. Ureterolysis is performed all the way down to the ureteric canal.

Left ureterolysis

The white line of Toldt on the left lateral abdominal wall, at the natural sigmoid attachment to the left lateral wall is excised to provide optimal exposure that would help in identifying the left ureter. The peritoneal incision is then continued caudally displacing the infundibulopelvic ligament laterally in order to expose the left ureter.

Optimizing visualization

The ovaries may be suspended to the anterior abdominal wall either with a T-lift system or a straight needle, to help expose the operative area, and free the assistant.

Dissecting the pararectal spaces

The pararectal spaces are dissected bilaterally to help mobilize the rectosigmoid colon, identify the lateral walls of the bowel, and reduce bowel injury.

Freeing the rectovaginal space

During this step the uterus should be anteflexed with the help of the uterine manipulator, and a rectal probe may help dissection during this step. The aim is to free the rectum from the posterior uterine wall until an avascular region is reached. The rectovaginal space is best accessed from a lateral approach.

Tailored treatment of rectovaginal disease

The recommended surgical techniques that could be performed for the treatment of a rectal endometriosis nodule include are rectal shaving, disc excision, and colorectal resection. Rectal shaving of the nodule with guidance of a rectal probe is preferred in older patients especially in situations where the vagina is opened to avoid the risk of a rectovaginal fistula Rectal recurrence is of 8% following rectal shaving, a number that can be prevented with a continuous hormonal pill taken until menopause in cases with no further reproductive desire.[1,2] Rectal shaving can be performed using cold scissors, CO_2 laser, plasma energy, an ultrasound scalpel, or a monopolar hook, under the guidance of a rectal probe. In cases where the bowel lumen is accidently opened, a bowel suture can be taken in one or two layers, or a disc excision performed.

When rectal shaving is not considered an ideal option or when rectal nodules are responsible for severe stenosis of the rectosigmoid colon, disc excision or colorectal resection may be offered in order to improve digestive complaints. Disc excision using an end-to-end anastomosis (EEA) stapler, or by simple resection of the nodule and suturing can be performed in these cases. Disc excision by Rouen Technique by a semicircular stapler is preserved for large low rectal endometriosis nodules to prevent low anterior resection syndrome. When compared to rectal shaving, the risk of rectovaginal fistula may increase but does not exceed 5%.[2] An omental flap between the vaginal and the rectal sutures may be placed to minimize the risk of rectovaginal fistula. A temporary protective colostomy may also be placed in the presence of a low rectal suture directly opposite to a vaginal suture.

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