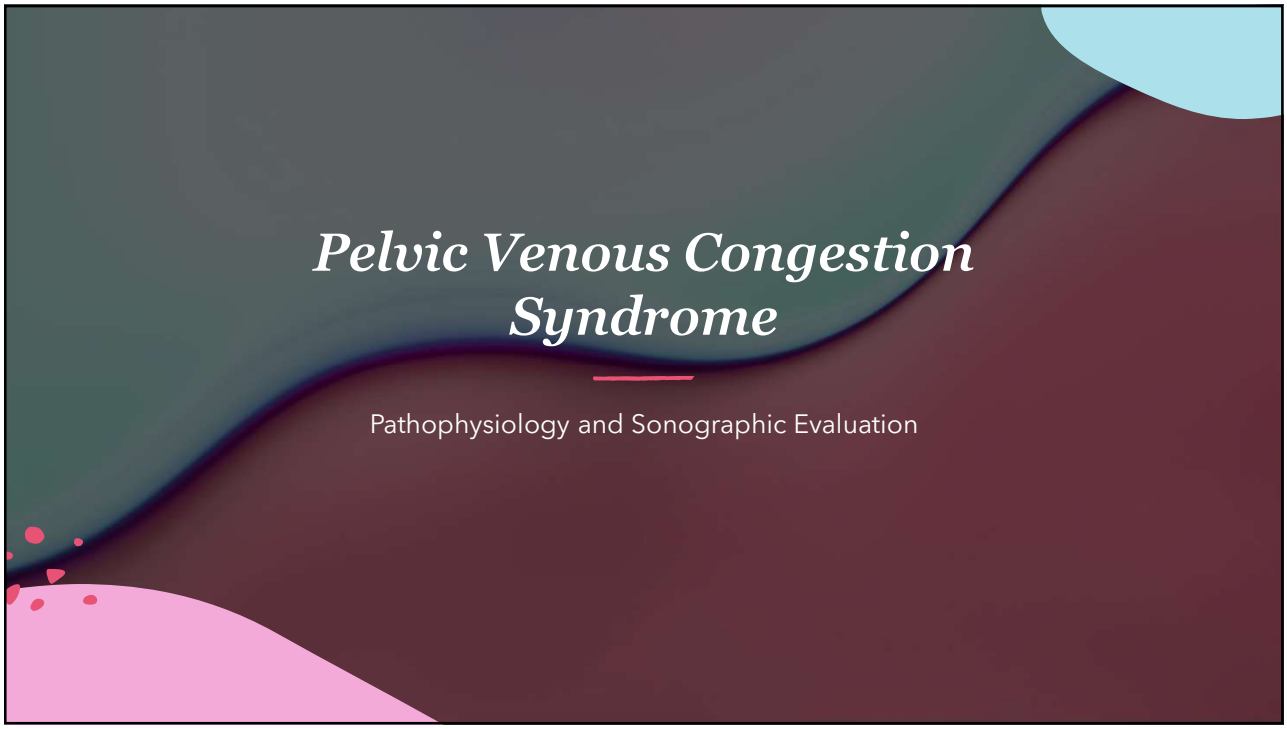


1

Objectives

01

Describe the normal anatomy and physiology of the pelvic venous vasculature.

02

Explain the pathophysiology of pelvic venous congestion syndrome.

03

Classify B-mode, color and spectral Doppler ultrasound images of the pelvic venous vasculature as normal or abnormal.

2

Vascular Anatomy & Physiology of the Female Pelvis

3

Arterial Supply of the Female Pelvis

Ovarian artery > direct branch of abdominal aorta

Uterine artery > direct branch of internal iliac artery

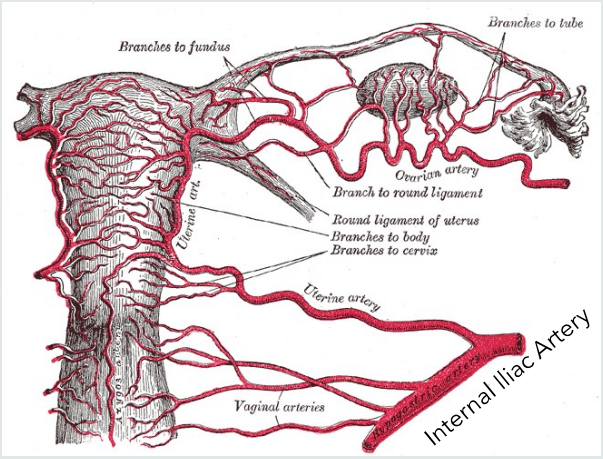


Figure 1: Arterial circulation of the female pelvis (public domain)

4

Arterial Supply of the Female Pelvis

Figure 2: Diagram of the arterial distribution of the uterus, demonstration pathway of uterine artery > peripheral artery > arcuate arteries (A); arcuate artery > radial artery > spiral artery (B).[1]

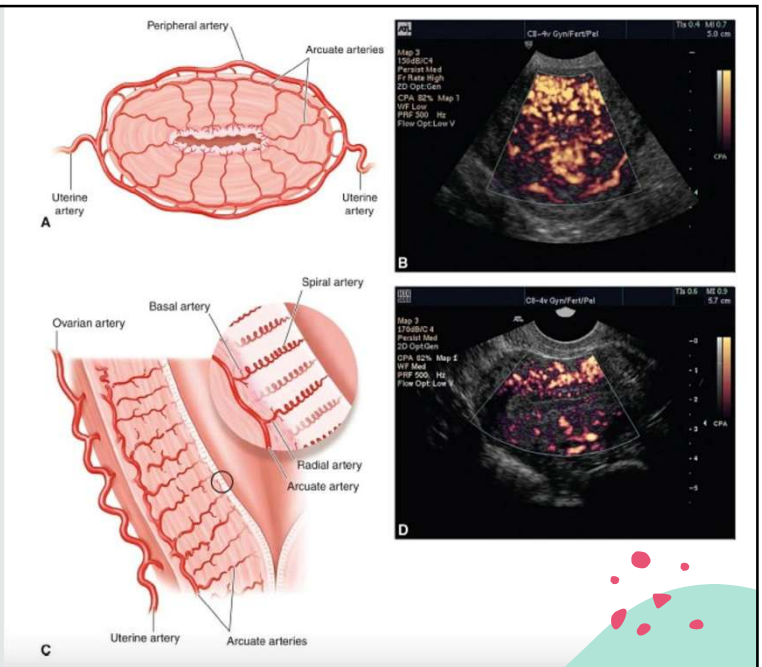


Figure 2: Arterial circulation of the female pelvis[1]

5

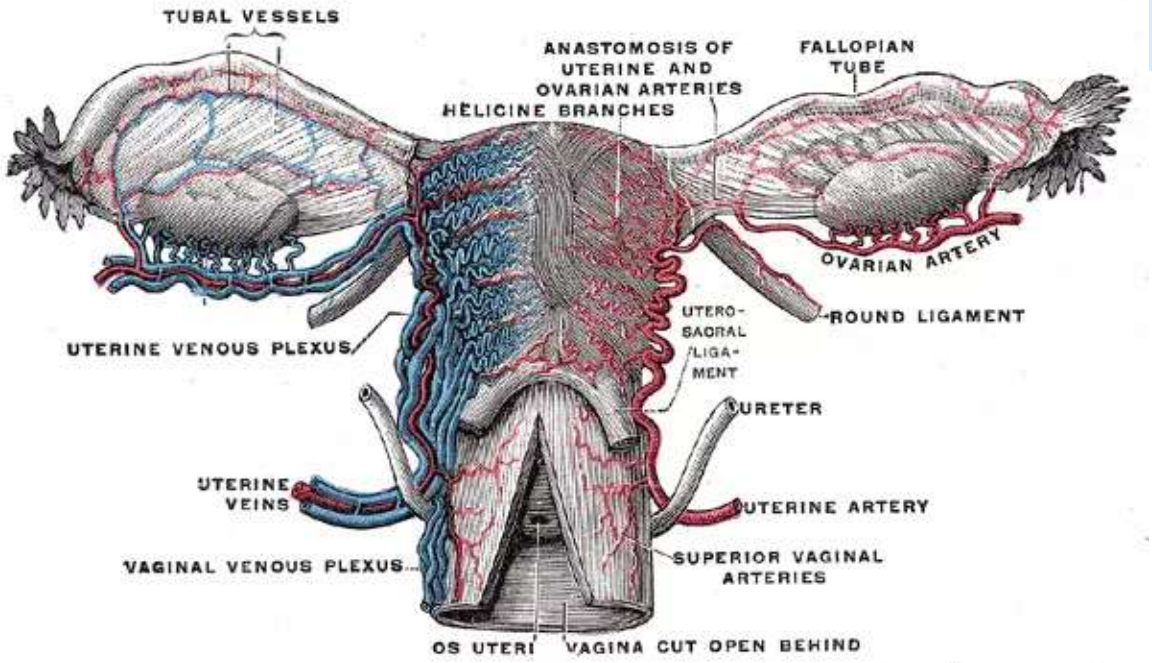


Figure 3: Circulation of the female pelvis (*Gray's Anatomy;* public domain).

6

Vasculature of the Female Pelvis

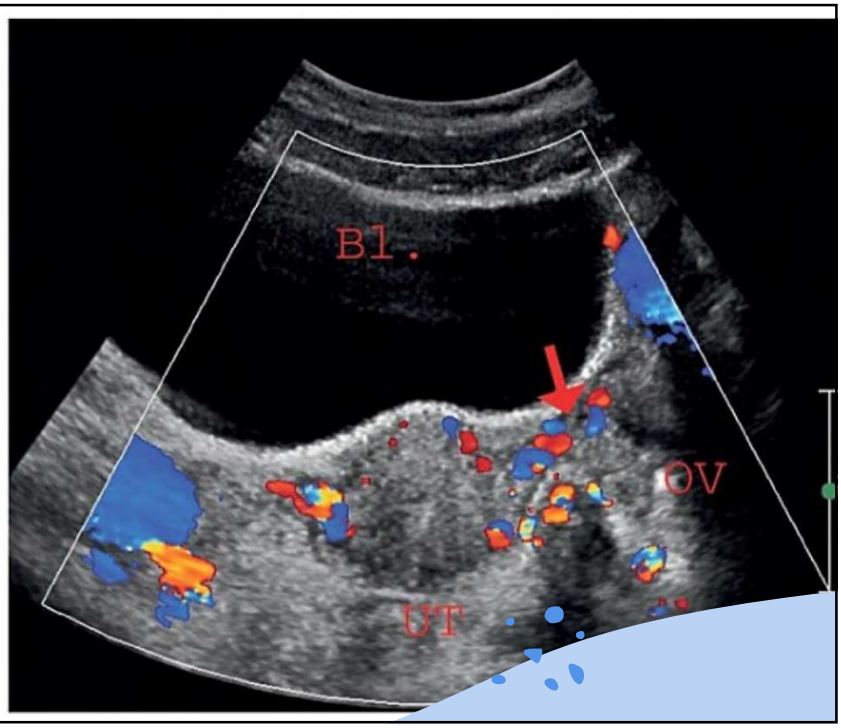


Figure 4: Color Doppler ultrasound image demonstrating communication of uterine and ovarian vasculature.[1]

7

Venous Outflows of the Female Pelvis

IVC, inferior vena cava;
LRV, left renal vein;
LOV, left ovarian vein; ROV, right ovarian vein
LOP, left ovarian plexus; ROP, right ovarian plexus
CIV, Common iliac veins;
IIV, internal iliac veins;
LUP, left uterine plexus; RUP, right uterine plexus.

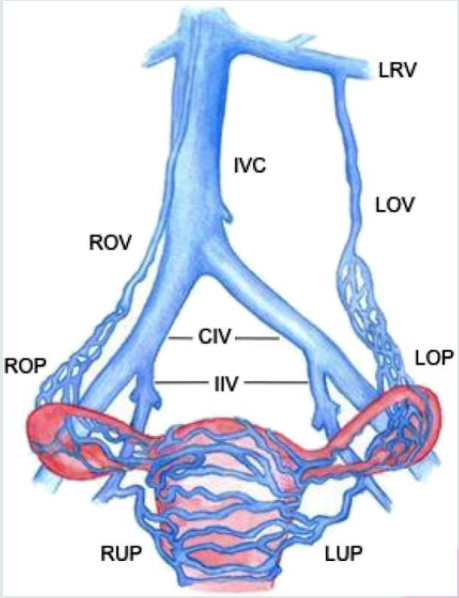
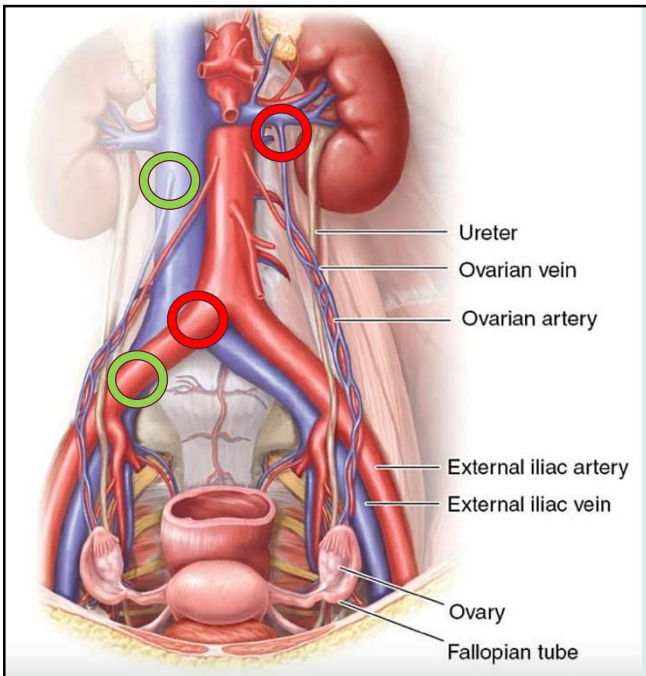


Fig 5. Pelvic venous anatomy.[2]

8



Venous Outflows of the Female Pelvis

Fig 6. Female pelvic vascular anatomy.[1]

9

Venous Outflows of the Female Pelvis: Left Renal Vein

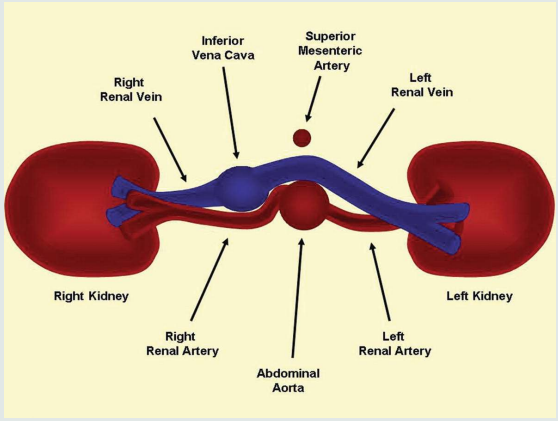


Fig 7. Short axis view of renal vasculature at the level of the left renal vein.[3]

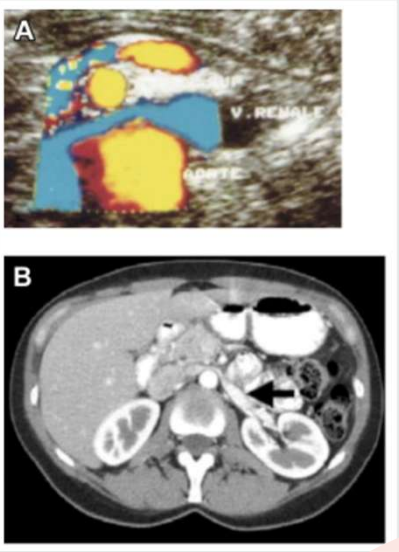
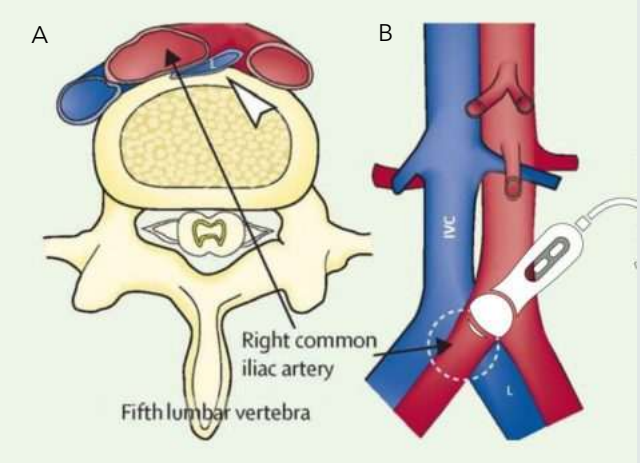


Fig 8. Short axis view of renal vasculature at the level of the left renal vein taken with color Doppler ultrasound (A) and CTA (B).[2]

10

Venous Outflows of the Female Pelvis: Right & Left Common Iliac Veins



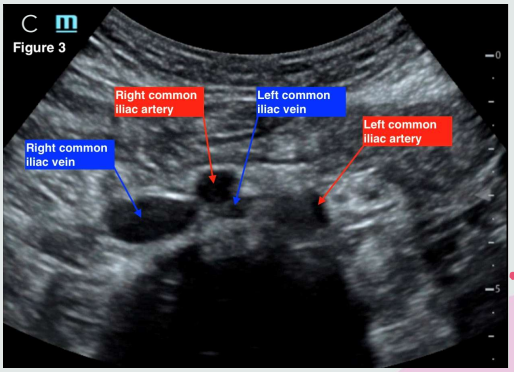


Fig 9. Schema of common iliac artery bifurcations and common iliac venous confluences in short axis sketch (A), frontal view (B), and short axis B-mode ultrasound (C).[4,5]

11

General Hemodynamics

12

Vascular Physiology & Hemodynamics

The purpose of the vascular system is to perfuse and drain tissue with blood, to support cellular metabolism.

The health of all living tissue is dependent on healthy blood flow.

The most direct assessment of healthy blood flow is waveform acquisition and analysis.

13

Ohm's Law

$$Flow = \frac{Pressure\ Gradient}{Resistance}$$

14

Arterial Waveform Basics

Systolic Phase
Measured by Peak Systolic Velocity (PSV)

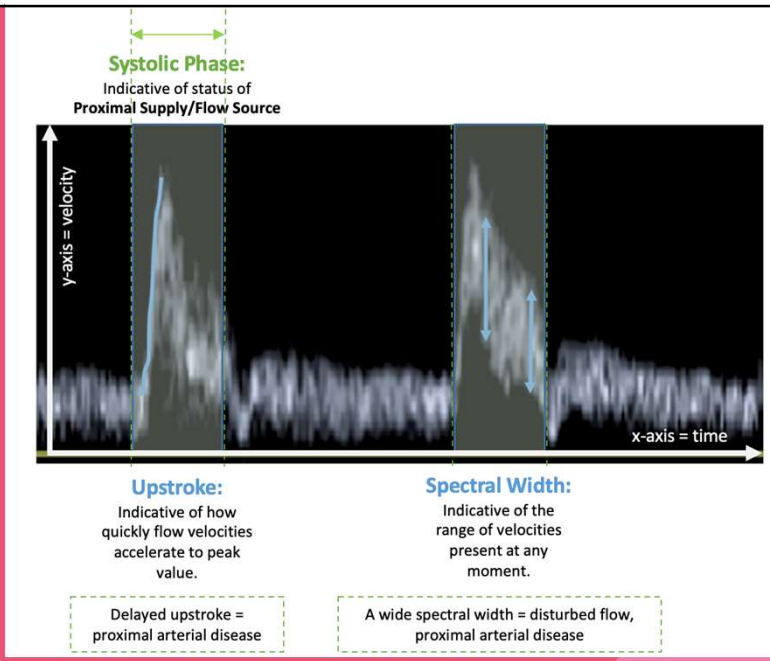


Figure 10: Systolic phase of a spectral Doppler arterial waveform.[6]

15

Arterial Waveform Basics

Diastolic Phase
Measured by End Diastolic Velocity (EDV)

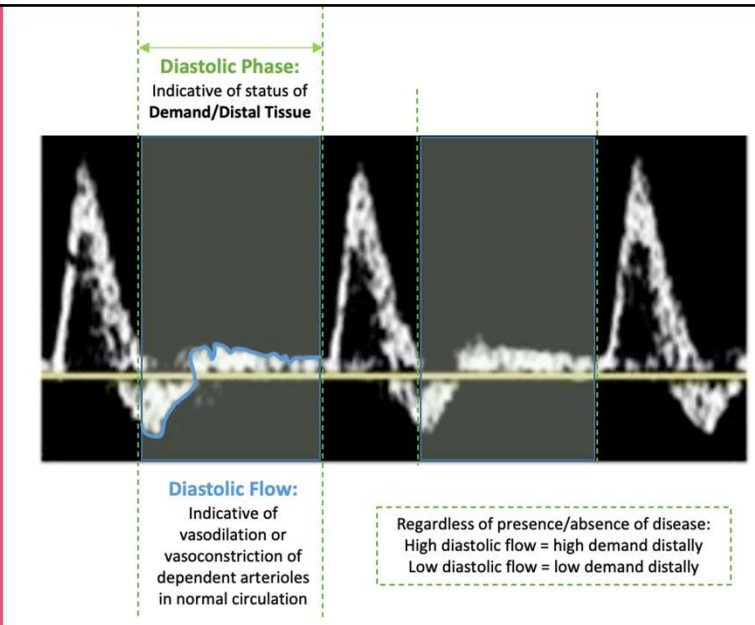


Figure 11: Diastolic phase of a spectral Doppler arterial waveform.[6]

16

Resistivity Index

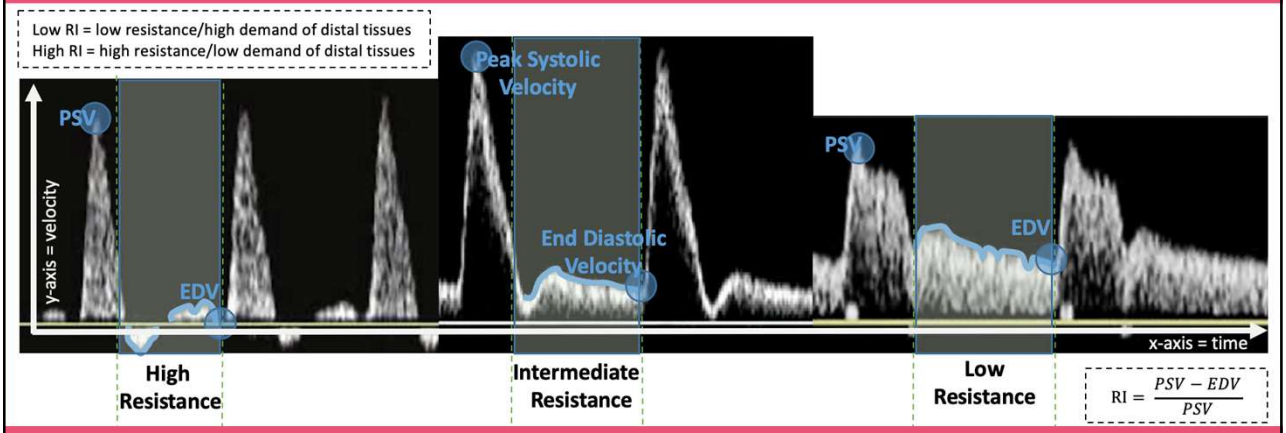


Figure 12: Arterial spectral Doppler waveforms demonstrating varying levels of resistance.[6]

17

Venous Pressure: Arterial Inflow Supplies Venous Outflow

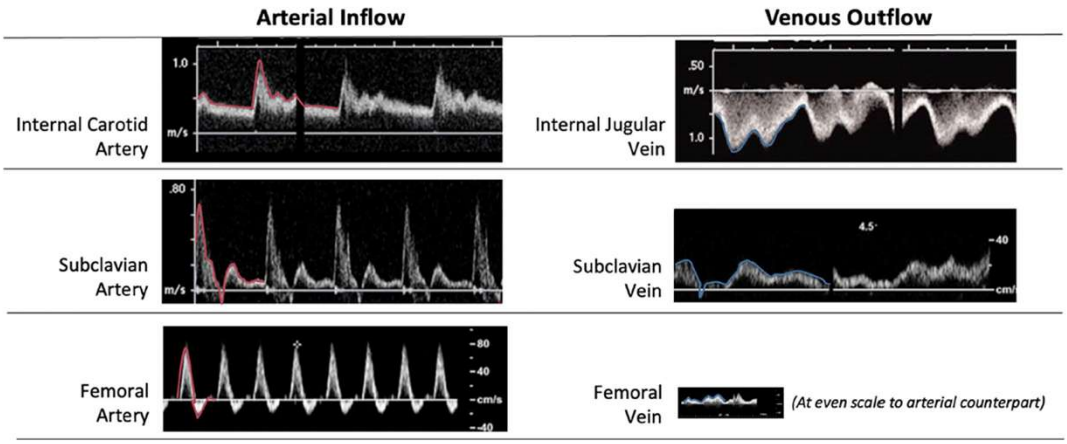


Figure 13: Arterial inflows compared to venous outflows of corresponding vessels[6]

18

Structure of Venous Return

Capillaries connect the arterial inflow with venous outflow of the same vascular bed.

Blood flow in the vein is determined by the inflow in its companion artery.

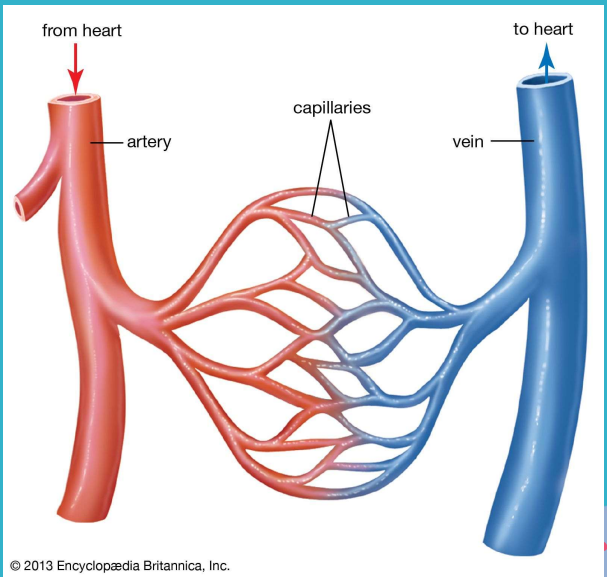


Figure 14: Capillary bed connecting arterial and venous circulation[7]

19

Pressure

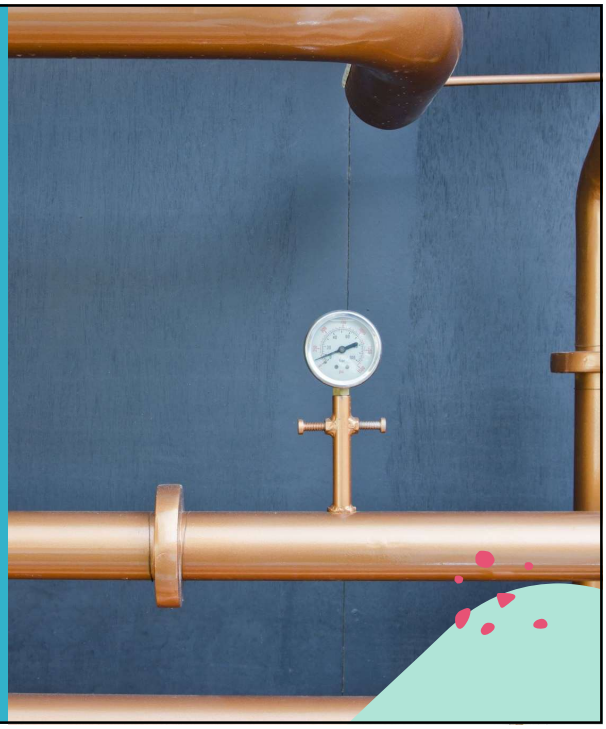
Created at the blood's SOURCE

Arteries = heart

Veins = *confluence of returning blood*

- Respiratory motion
- Cardiac motion
- Hydrostatic pressure

When pressure is gradient is high, flow is high.



20

21

Resistance

Created at the blood's DESTINATION

Arteries = arteriolar bed

Veins = location-dependent

- Breathing motion
- Cardiac motion
- Hydrostatic pressure

When resistance is high, flow is low.

22

Pelvic Hemodynamics

23

Blood volume in the pelvis varies.

Change in the status of the female reproductive tract creates fluctuating demand for arterial blood.

24

Flow volume of the ovarian artery changes with the menstrual cycle.

25

Ovarian Arterial Doppler:

- **Source of pressure:** heart
- **Force of resistance:** ovarian vascular bed

WAVEFORM MORPHOLOGY

- Sharp upstroke
- **Medium to high diastolic flow**
- **Low RI**

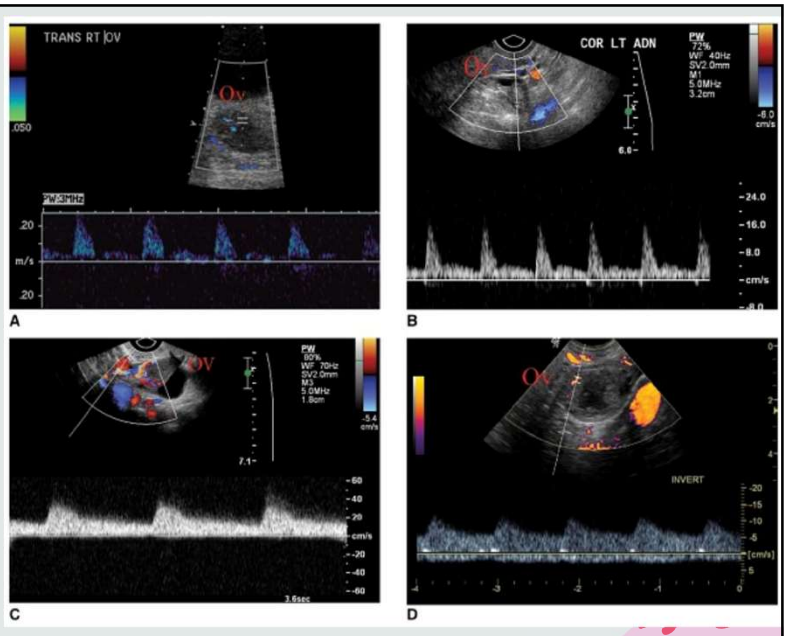


Figure 15: Normal arterial spectral Doppler waveform of the ovary in follicular (A), late luteal (B), follicular (C), and corpus hemorrhagicum states.[1]

26

Flow volume of the uterine artery changes with reproductive status.

Uterine artery RI drops throughout pregnancy.

27

Uterine Artery Doppler:

NON-GRAVID UTERUS:

- **Source of pressure:** heart
- **Force of resistance:** uterine vascular bed

WAVEFORM MORPHOLOGY

- Sharp upstroke
- **Low diastolic flow**
- **High RI**

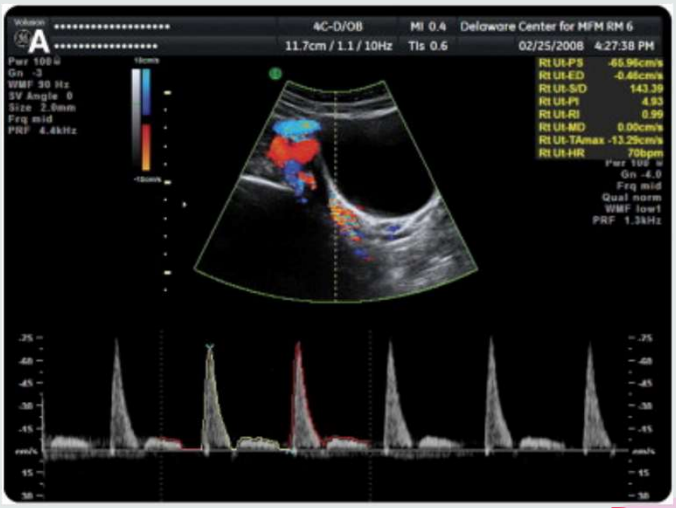


Figure 16: Spectral Doppler waveform of the non-gravid uterine artery.[8]

28

Uterine Artery Doppler:

GRAVID UTERUS:

- **Source of pressure:** maternal heart
- **Force of resistance:** spiral arteries and/or placenta

WAVEFORM MORPHOLOGY: Qualitative

- Sharp upstroke
- **High diastolic flow**
- **Low RI, decreases with gestational age[8]**

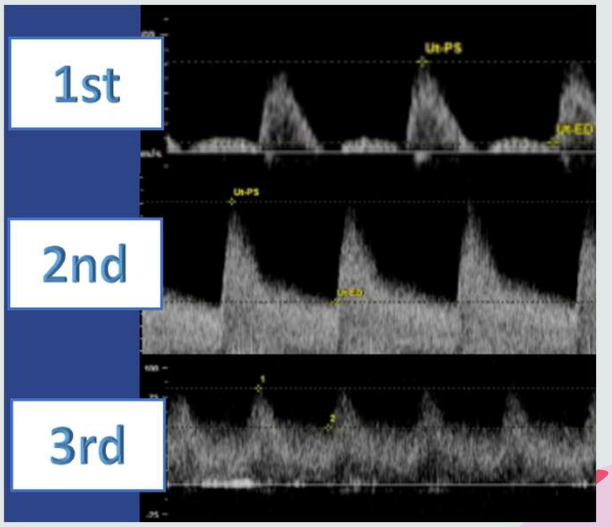


Figure 17: Spectral Doppler waveform of the gravid uterine artery in the first, second and third trimesters.[8]

29

Uterine Artery Doppler:

POST-PARTUM UTERUS:

- **Source of pressure:** maternal heart
- **Force of resistance:** uterine vascular bed

WAVEFORM MORPHOLOGY[9]:

- **High diastolic flow**
- **Low PI,**
- **Continues at least 14 weeks post-partum**

30

Variable Arterial Inflow = Variable Venous Outflow

31

Ohm's Law for Pelvic Veins[6]

PRESSURE

Capillary return/Venous tree structure

Hydrostatic pressure

Calf muscle pump

Respiratory motion

Cardiac motion

RESISTANCE

Blood viscosity

Hydrostatic pressure

Respiratory motion

Cardiac motion

32

33

Normal Ovarian Venous Waveform Morphology: Normal

ANTEGRADE

- Flow in the direction of the heart. (Centripetal)
- Antegrade flow is typically demonstrated below the baseline.

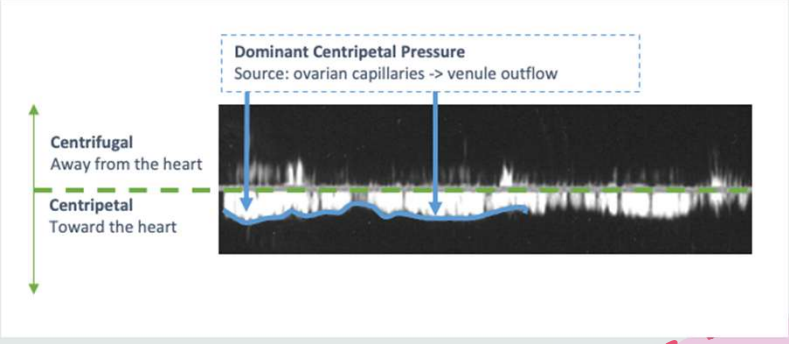


Figure 18: Normal ovarian vein waveform demonstrating antegrade flow.[10]

34

Lower Extremity Venous Waveform Morphology: Normal

RESPIROPHASIC

Increase and decrease in flow velocity that mirrors movement of the diaphragm.

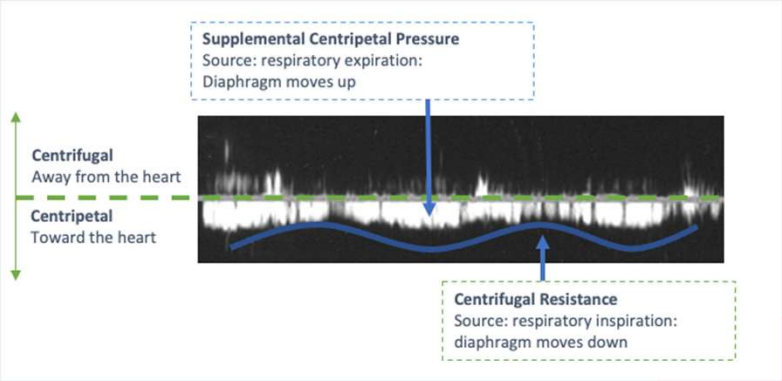


Figure 19: Normal ovarian vein waveform demonstrating respirophasicity.[10]

35

Venous Waveform Morphology: Normal

NON-REFLUXING

Cessation of flow on Valsalva maneuver.

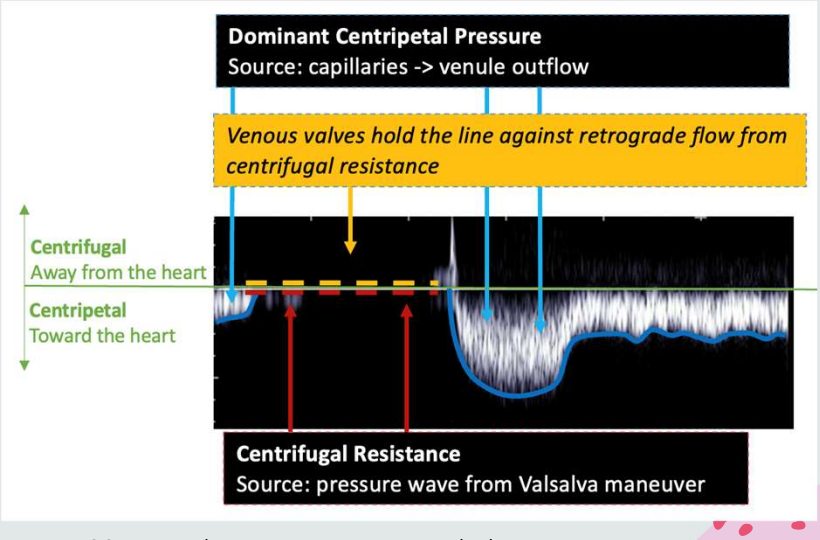


Figure 20: Normal venous response to Valsalva maneuver.

36

Pelvic venous outflow has multiple exits

Left sided anatomy predisposed to venous congestion.

37

Normal Renal Venous Waveform Morphology

ANTEGRADE & CONTINUOUS

- Flow in the direction of the heart. (Centripetal)
- Antegrade flow is typically demonstrated below the baseline.
- Normal velocity at aorto-mesenteric point: 40-80 cm/sec[11]

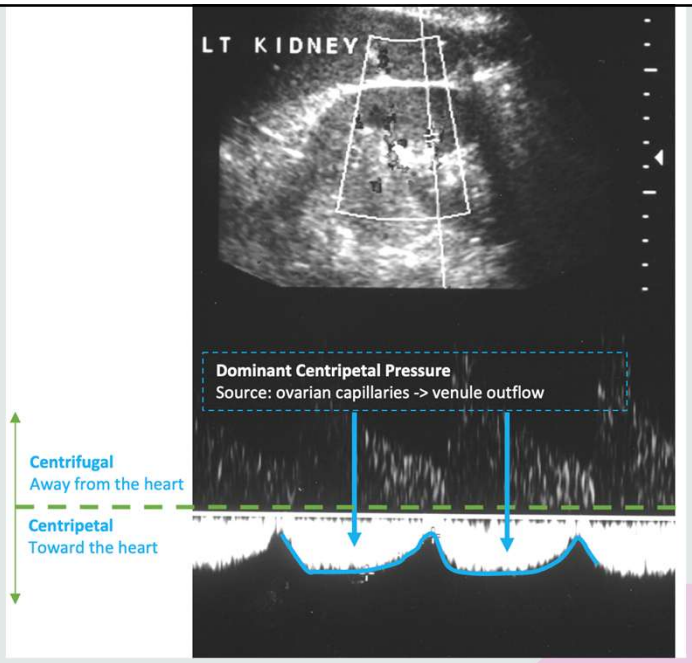


Figure 21: Normal renal vein waveform demonstrating antegrade flow.[12]

38

Normal Renal Venous Waveform Morphology

CARDIAC PULSATILITY

- Pressure transmitted from right atrium > IVC > renal vein.
- Decrease in flow velocity at atrial systole.

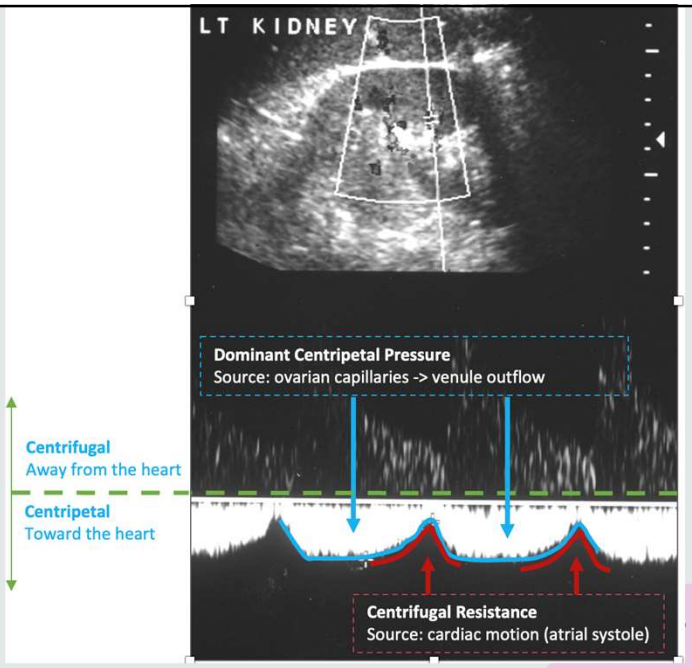


Figure 22: Normal renal vein waveform demonstrating antegrade flow with cardiac pulsatility.[12]

39

Normal Common Venous Waveform Morphology

ANTEGRADE & SPONTANEOUS

- Flow in the direction of the heart. (Centripetal)
- Active flow without any external augmentation maneuvers,
- Dependent on filling of venous chambers, and subsequent opening of valves.

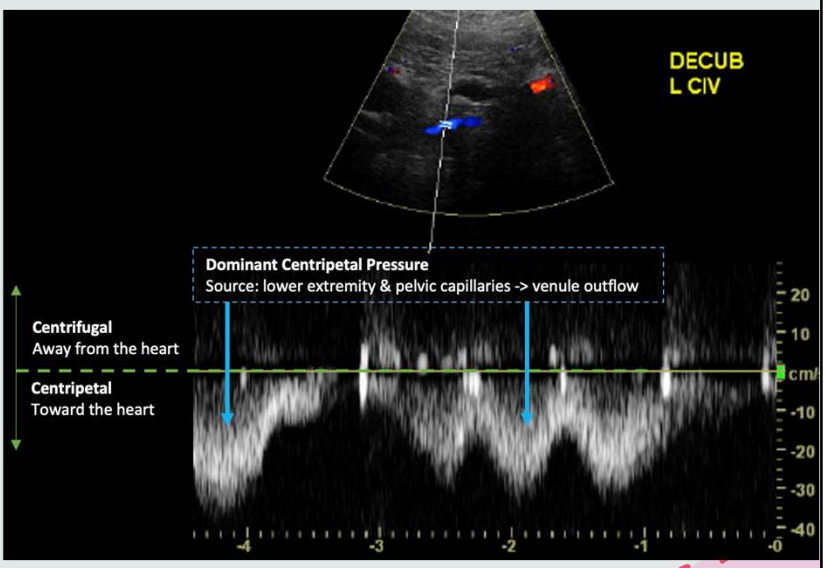


Figure 23: Normal common iliac vein waveform demonstrating antegrade, spontaneous flow.[13]

40

Normal Common Iliac Venous Waveform Morphology

(MILDLY) **PULSATILE**

- Pressure transmitted from right atrium > IVC > renal vein.
- Decrease in flow velocity reflects right atrial systole

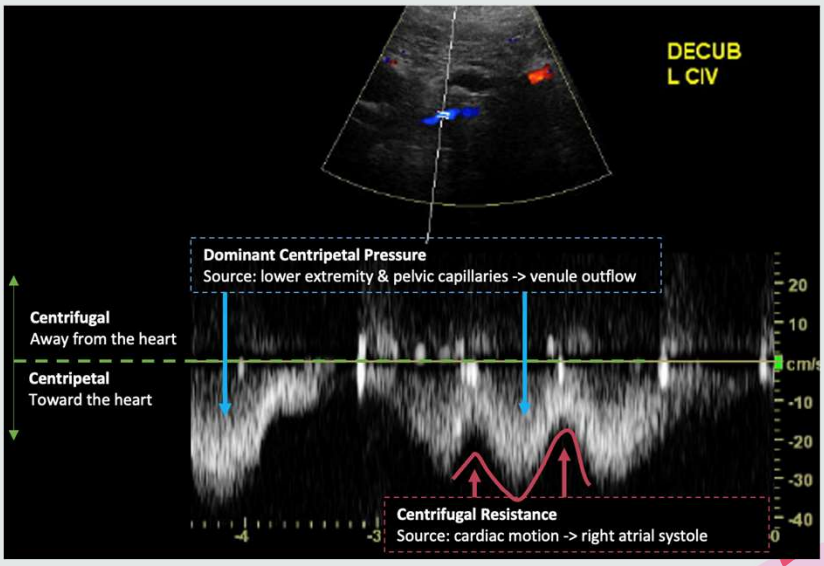


Figure 24: Normal common iliac vein waveform demonstrating mild cardiac pulsatility.[13]

41

Normal Common Iliac Waveform Morphology

RESPIROPHASICITY

Increase and decrease in flow velocity that mirrors movement of the diaphragm.

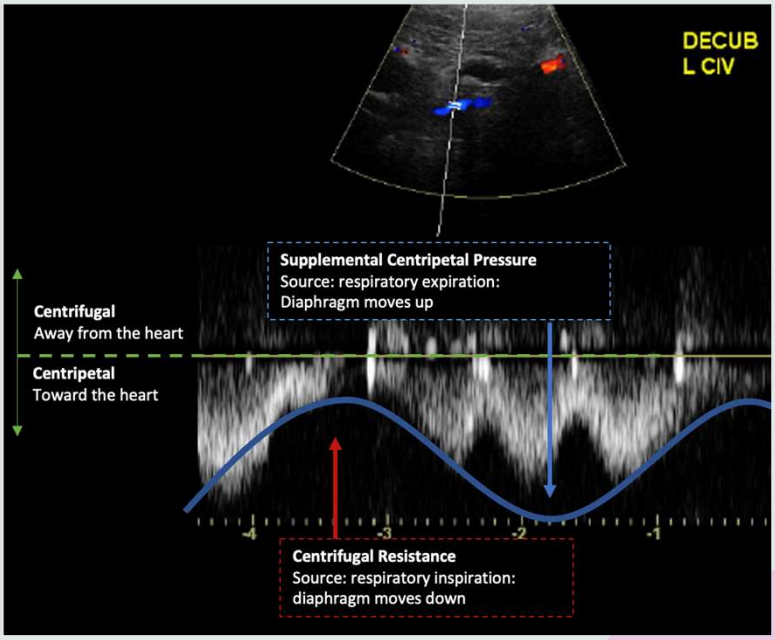
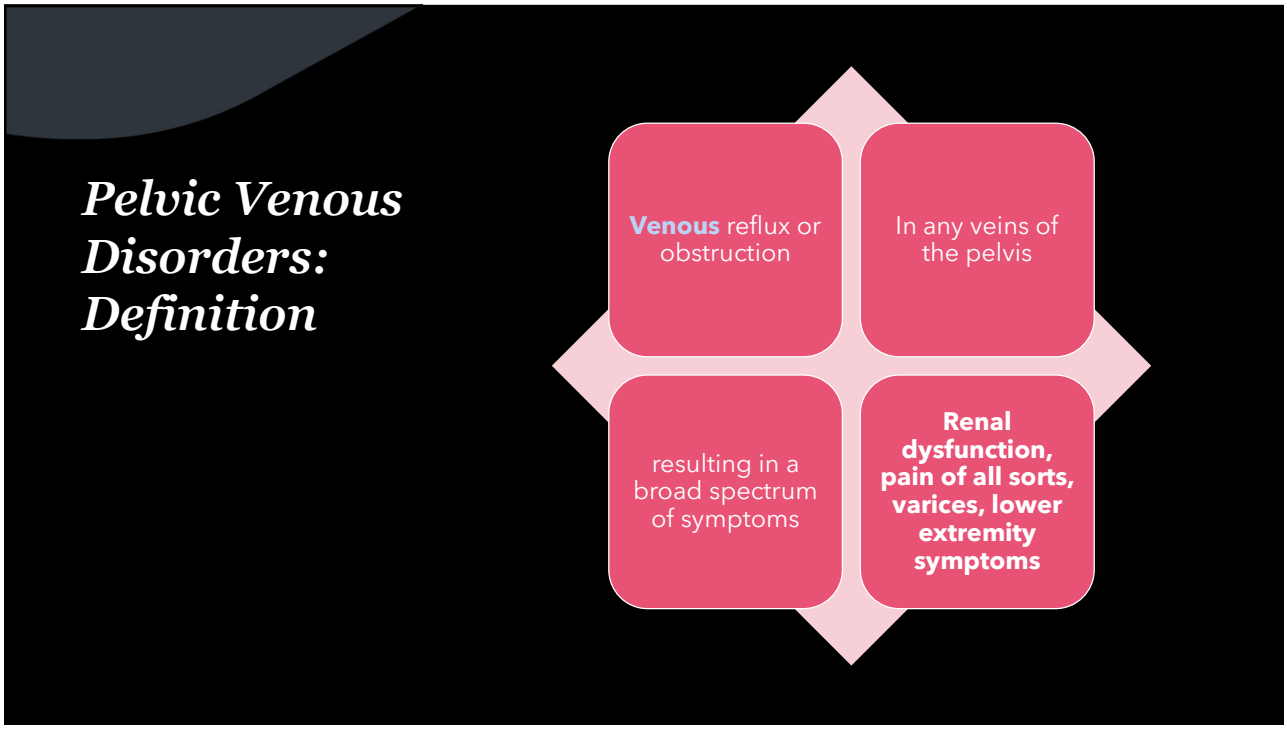


Figure 25: Normal common iliac vein waveform demonstrating respirophasicity.[13]

42



43

44

Pelvic Venous Disorders (PeVD): Background

Encompasses the spectrum of symptoms and signs arising from:

1. The veins of the pelvis (the gonadal veins, the internal iliac veins and their tributaries, and the venous plexuses of the pelvis)
2. And their primary drainage pathways (the left renal vein, the iliac veins, and the pelvic escape points).[14]

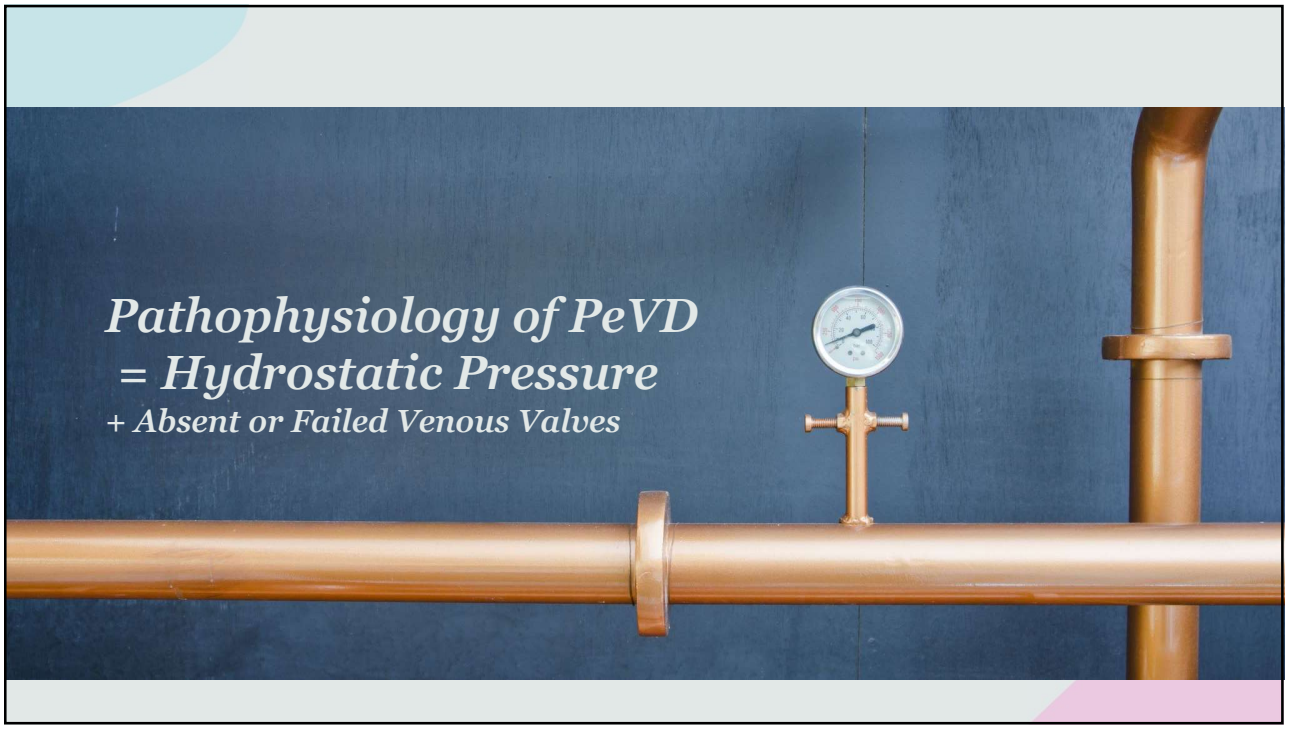
45

Pelvic Venous Disorders (PeVD): Background

Given their imprecise and overlapping nature, these historical terms should no longer be used:

1. May-Thurner Syndrome
2. Nutcracker Syndrome
3. Pelvic Congestion Syndrome[14]

46



47

Risk Factors

GYNECOLOGIC

- Pre-menopausal women
- Multiparity

VASCULAR

- Congenitally absent ovarian vein valves
- Venous overload
  - Portal hypertension
  - AV fistula
  - IVC thrombosis
  - Nutcracker syndrome
  - Extrinsic compression from tumors[15]

48

Risk Factors: Multiparity

- Increased serum progesterone levels by tens of times
- Increased volume of circulating blood by 15%
- Increased blood flowing through the pelvic veins by tenfold
- Pelvic vein dilation usually disappears after childbirth
- When pelvic varicose veins persist, reflux can develop
- 60 to 76% of women with PeVD become symptomatic[15]

49

PeVD - Background

Pelvic venous incompetence may impact the following 4 zones:

- Left Renal Vein
- Ovarian and Internal Iliac Veins with Pelvic Venous Plexuses
- Pelvic Origin Extra Pelvic Veins
- Lower Extremity Deep & Superficial Veins

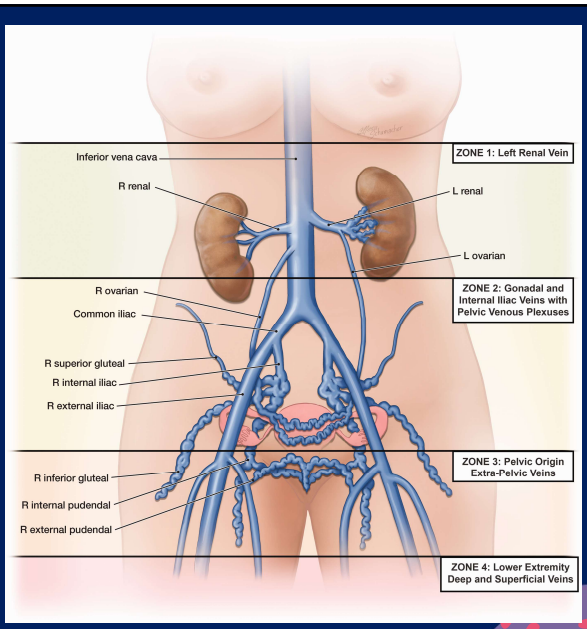
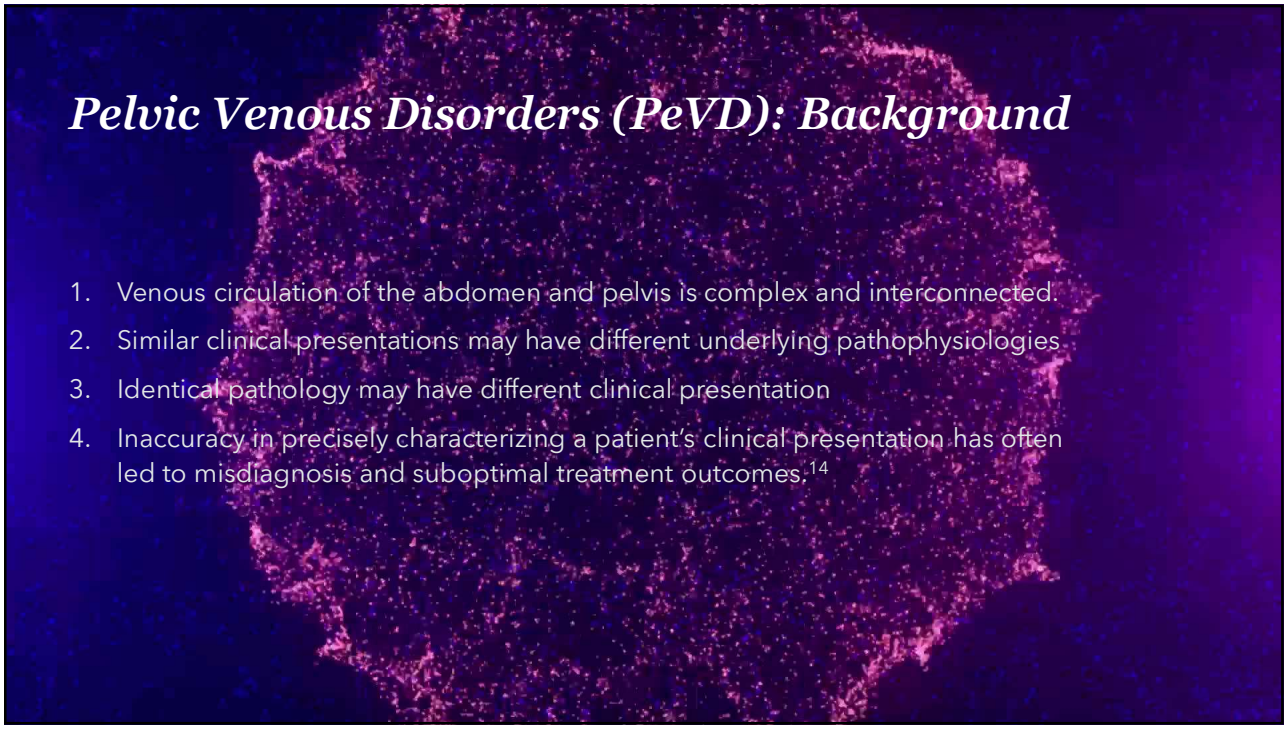


Figure 26. The four anatomic zones of the abdomen and pelvis which correlate with symptoms, signs (varices), and pathophysiologic manifestations of pelvis venous disorders (PeVD).[14]

50



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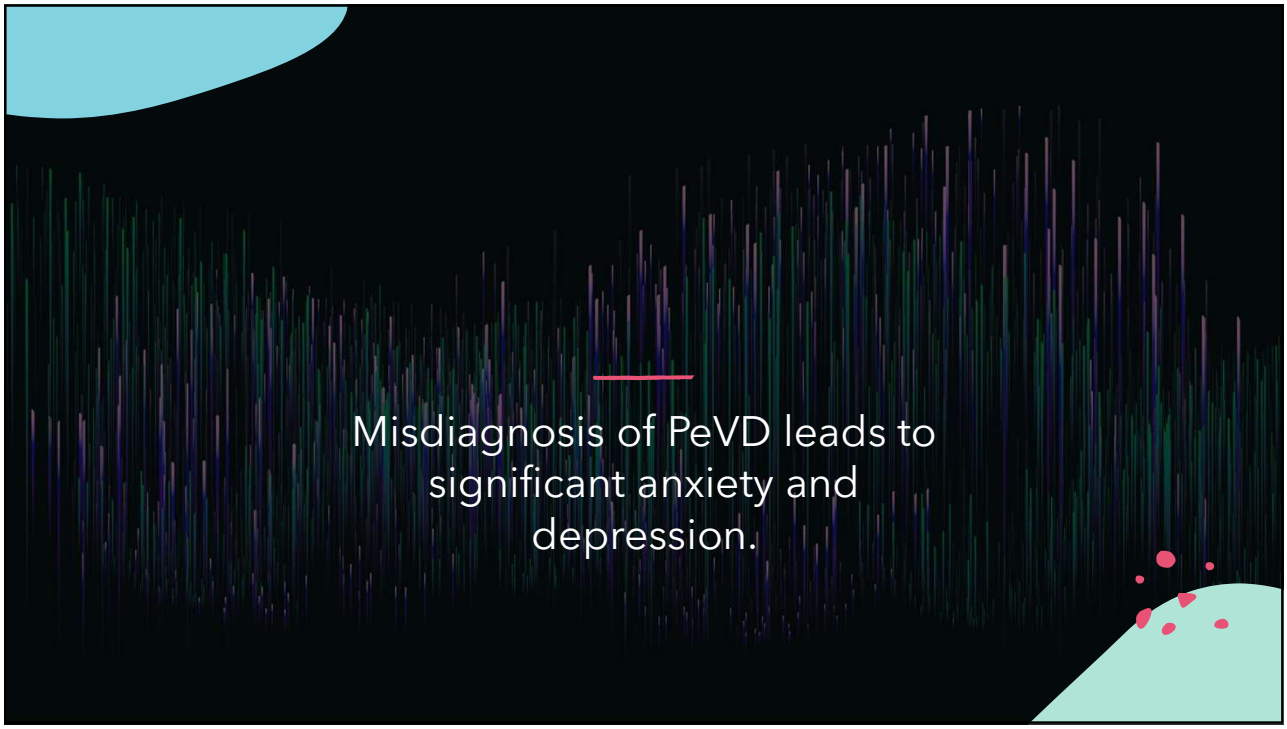

52

AVLS Classification Tool: Symptoms-Varices-Pathophysiology ("SVP") classification for PeVD

3 Domains:

- Symptoms (S)
- Varices (V)
- Pathophysiology (P)
  - Anatomic (A)
  - Hemodynamic (H)
  - Etiologic (E)

53

Symptoms

S_0	No symptoms of a PeVD (no renal, pelvic, or extrapelvic symptoms)
S_1	Renal symptoms of venous origin
S_2	Chronic pelvic pain of venous origin
S_3	Extrapelvic symptoms of venous origin

Table 1: Categorization of symptoms associated with Pelvic Venous Disorders for the "*Symptoms-Varices-Pathophysiology*" classification system created by the American Vein and Lymphatic Society.[14]

54

Varices

"Although some varices (eg, pelvic origin varices of the vulva or posteromedial thigh) may be apparent on physical examination, others (renal hilar, pelvic, and some pelvic origin extrapelvic varices) are identified only through imaging studies."

V_0	No abdominal, pelvic, or pelvic origin extrapelvic varices on clinical or imaging examination
V_1	Renal hilar varices
V_2	Pelvic varices
V_3	Pelvic origin extrapelvic varices.

Table 2: Categorization of varices associated with Pelvic Venous Disorders for the "*Symptoms-Varices-Pathophysiology*" classification system created by the American Vein and Lymphatic Society.[14]

55

Pathophysiology

A combination of 3 sub-categories:

1. Anatomy (specify vessel involved)
2. Hemodynamics (obstruction vs. reflux)
3. Etiology (identify cause as thrombotic or non thrombotic)[14]

56

Clinical Management & Diagnosis

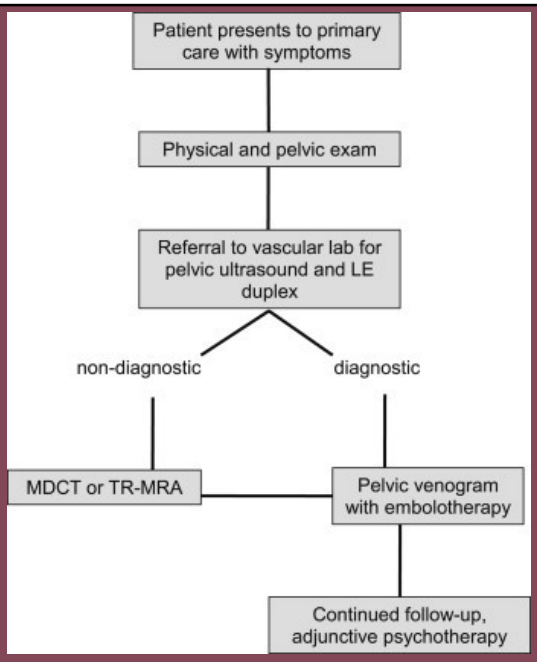

Figure 27: Algorithm for workup of Pelvic Venous Disorders (PeVD)[2].

57

Diagnosis

- MRI
- CT
- US
- Trans-catheter venography = gold standard modality for the definitive diagnosis and is undertaken as an immediate precursor to ovarian vein embolization (OVE)[17]

58

Clinical Management

Conservative, medical and surgical management strategies have been reported but have been superseded by OVE, which has a reported technical success rates of 96-100%, low complication rates and long-term symptomatic relief in between 70-90% of cases.[17]

59

The Role of Ultrasound in Diagnosis of PeVD

ZONE 1: Renal duplex

- Renal varices
- Renal vein compression

ZONE 2: Pelvic duplex

- Uterine and/or gonadal varices
- Pelvic vein reflux

ZONE 3:Lower extremity venous duplex

- Iliac vein reflux
- Iliac vein compression

60

Protocol: Diameter measurement and Spectral Doppler w & w/o Valsalva

Vascular Lab Protocol:

IVC
Common Iliac Veins
External Iliac Veins
Renal Veins
Ovarian (Gonadal) Veins
Peri and Trans-Uterine Plexus Veins
Pelvic Escape Points[18]

Renal Exam – Additional Images:

Left renal hilum
Left renal vein as it crosses between Ao and SMA

Pelvic Exam Protocol – Additional Images

Ovarian (Gonadal) Veins
Peri and Trans-Uterine Plexus Veins

Lower Ext. Venous Exam – Additional Images:

Internal iliac Left CIV crossing behind right CIA

61

Patient position impacts venous dilation.

Induce venous congestion by:

- Standing your patient for transabdominal imaging
- Tilting or propping your patient up for transvaginal imaging: half-sitting and half-standing positions (with trunk raised to 45°).[16]

62

Zone 1:

Left Renal Venous Reflux

63

Symptoms – (S_1) Renal Symptoms of Venous Origin

Symptoms arising from renal venous hypertension secondary to left renal vein obstruction

- Microhematuria
- Macrohematuria
- Left flank and abdominal pain that is worsened by activity (standing, walking, sitting)[14]

64

Varices – V_1: Renal Hilar Varices

- Ovarian vein drains through left renal vein
- Risk for aorto-mesenteric compression (formerly "Nutcracker Syndrome")

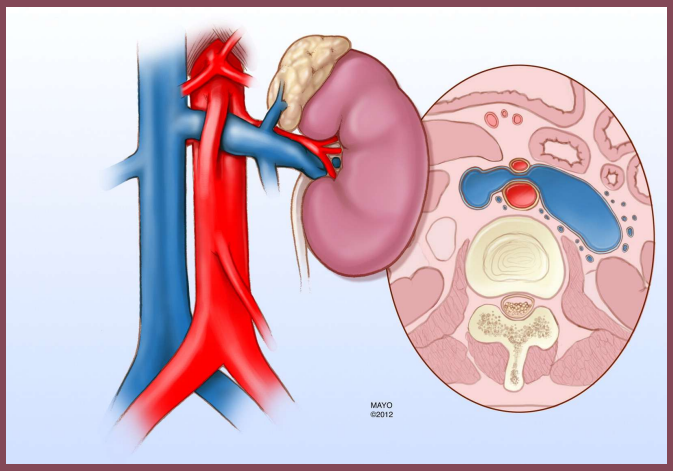

Figure 28: Course of the left renal vein in front and short axis views.[19]

65

Varices – V_1: Renal Hilar Varices

- Ovarian vein drains through left renal vein
- Risk for aorto-mesenteric compression (formerly "Nutcracker Syndrome")

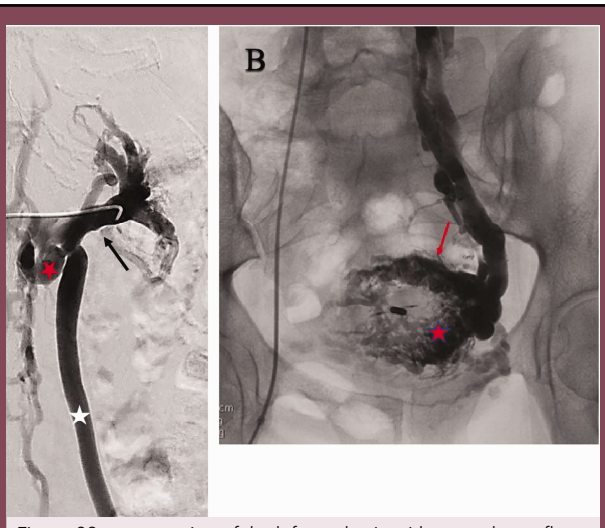

Figure 29: compression of the left renal vein with secondary reflux in the left ovarian vein. (A) Selective renal venography demonstrates compressive obstruction (white arrow) of the central left renal vein (black arrow) associated with renal hilar varices. The left renal vein is drained through the renal-azygous trunk (red star) and a refluxing left ovarian vein (white star). (B) Selective left ovarian venography demonstrates associated pelvic varices, myometrial veins (red star) and small arcuate veins (red arrow).[14]

66

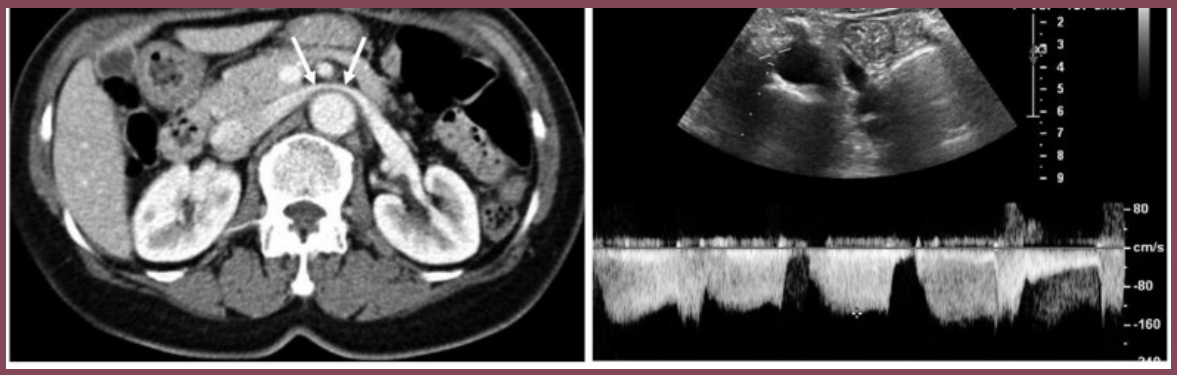

Figure 30: Renal vein compression at the aorto-mesenteric point as demonstrated be CTA (A) and Doppler Ultrasound (B).[11]

Varices – V_1: Renal Hilar Varices

- Ovarian vein drains through left renal vein
- Risk for aorto-mesenteric compression (formerly "Nutcracker Syndrome")
- Renal vein peak velocity to hilar velocity > 5.0 suspicious for compression/stenosis[12]

67

Zone 2:

Ovarian and Internal Iliac Veins with Pelvic Venous Plexuses

68

Symptoms – (S_2)
Chronic Pelvic Pain of Venous Origin

- Pain symptoms perceived to originate from pelvic organs/structures typically lasting more than 6 months.
- Often associated with negative consequences: cognitive, behavioral, sexual and/or emotional.
- Symptoms suggestive of lower urinary tract, sexual, bowel, pelvic floor, myofascial, or gynecologic dysfunction.

69

Symptoms – (S_2)
Chronic Pelvic Pain of Venous Origin

Large overlap with pelvic pain of non-venous origin. *However:*

- Dull, unilateral or bilateral pelvic pain
- Occasional sharp flare ups
- Manual examination reveals adnexal tenderness
- Symptoms worsen with activity, improve with lying down.
- Prolonged post-coital ache

70

Symptoms – (S_2)
Chronic Pelvic Pain of Venous Origin

The combination of:

1. postcoital ache and
2. tenderness over the ovarian point (the junction of the upper and middle thirds of a line drawn from the umbilicus to the anterior superior iliac spine)

has been reported to be 94% sensitive and 77% specific for distinguishing a venous origin from other causes of pelvic pain.

71

Pelvic Varices (V_2)

- Ovarian and uterine plexuses are interconnected
- Uterine plexus drains through internal iliac veins
- Vast network of visceral and parietal venous structures in the pelvis. (ALL CONNECTED)

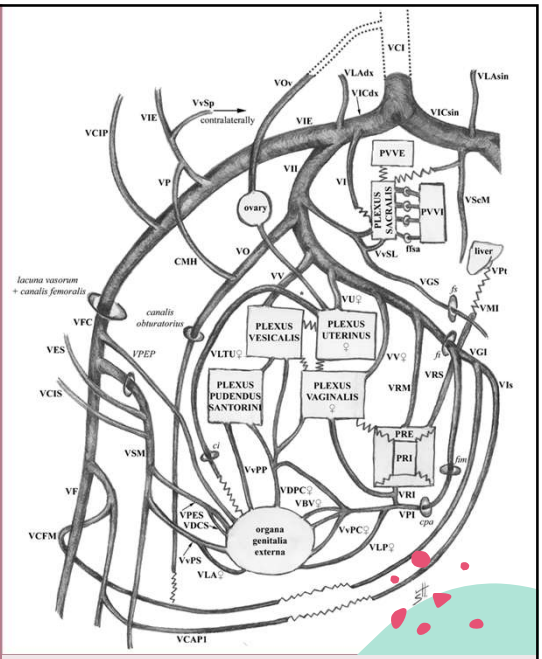

Figure 31: Schema of the veins of pelvis, their draining direction and communications (anterior view).[20]

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B-Mode Findings

Uterus:

Visibly dilated arcuate veins.

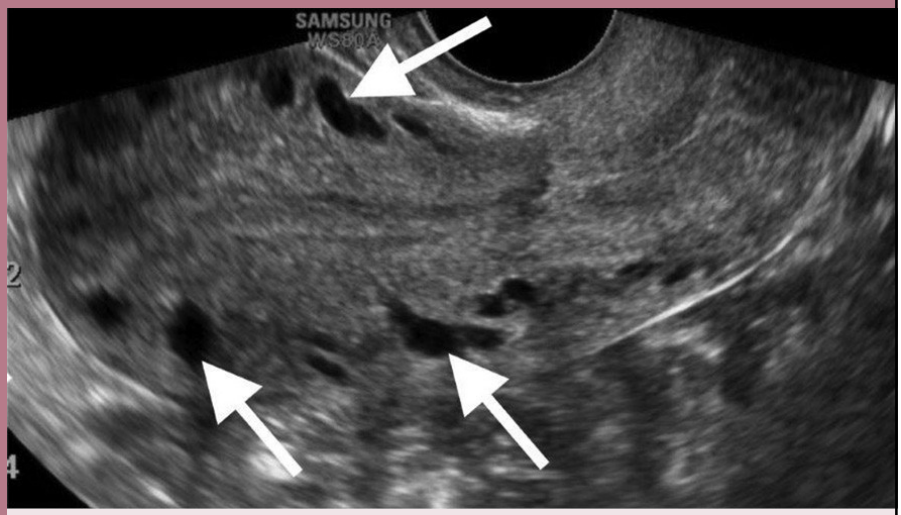

Figure 32: Transvaginal ultrasound image of the uterus. Multiple tortuous arcuate veins (arrows) were seen in the myometrium.[21]

73

B-Mode Findings

Uterus:

Para-uterine vessels > 6 mm in diameter

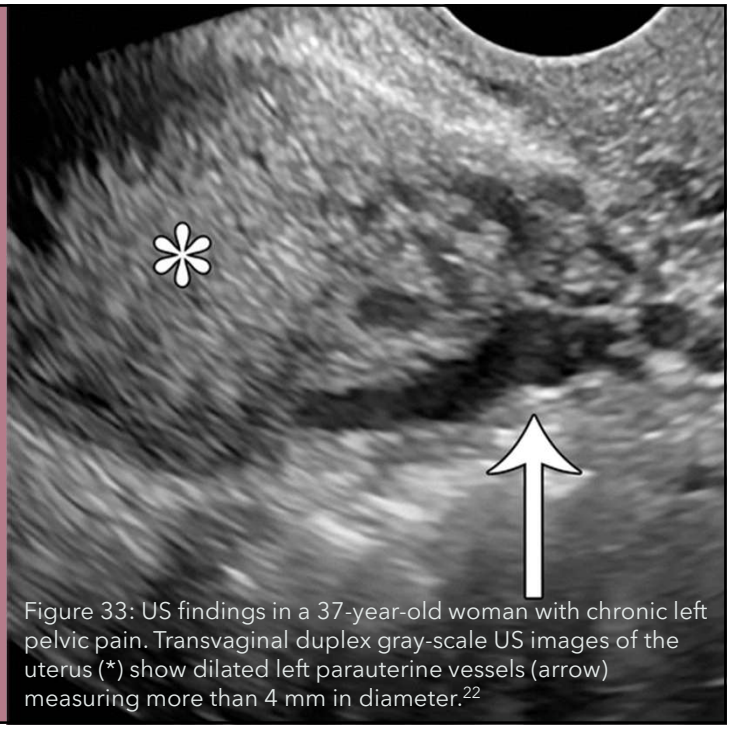

Figure 33: US findings in a 37-year-old woman with chronic left pelvic pain. Transvaginal duplex gray-scale US images of the uterus (*) show dilated left parauterine vessels (arrow) measuring more than 4 mm in diameter.[22]

74

B-Mode Findings

Ovarian:

Dilated ovarian veins > 6- 8mm in diameter

Figure 34: Measurement of a pelvic vein with a diameter larger than 8 mm.[23]

75

B-Mode Findings

Ovarian:

Dilated ovarian veins > 6 - 8mm in diameter

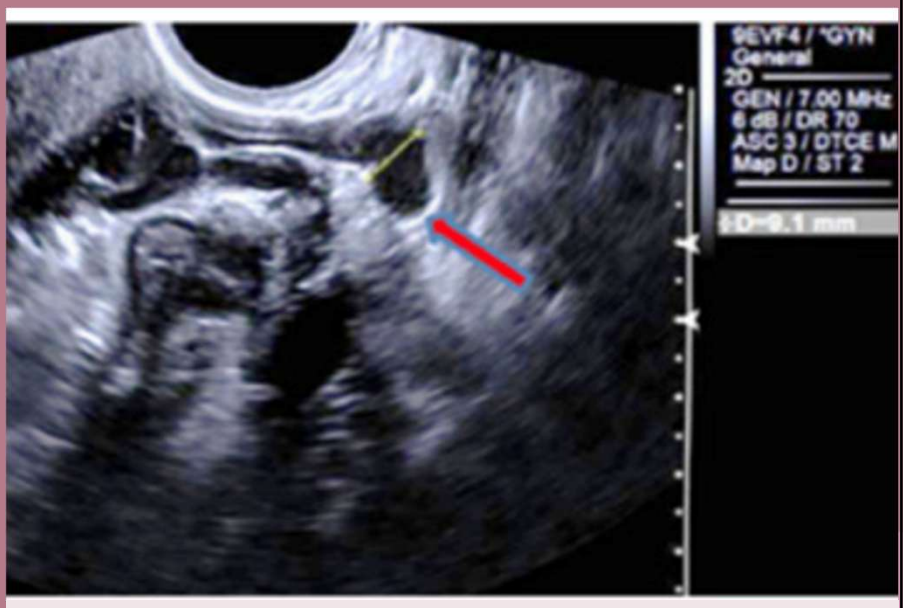

Figure 35: Measurement of a left ovarian vein with a diameter of 9.1mm.[17]

76

Color Doppler Findings

Uterus:

Visibly dilated arcuate veins with color fill.

May need to use power Doppler

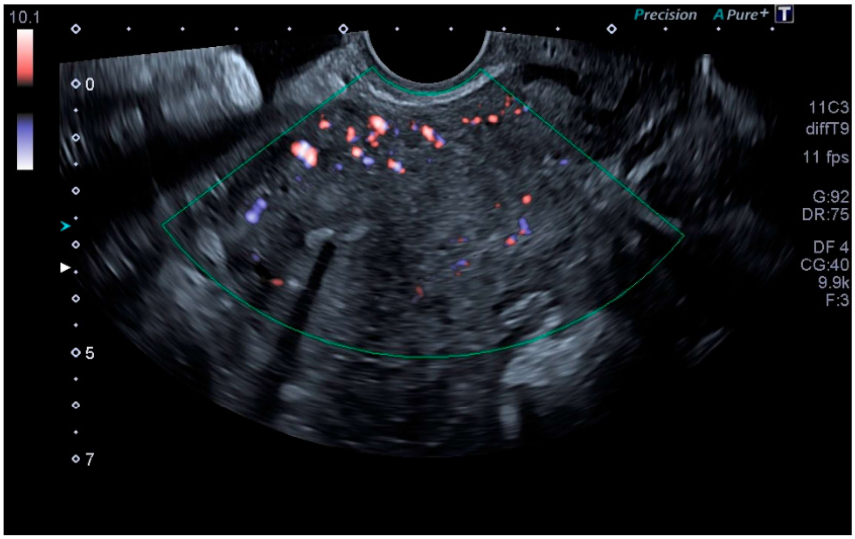

Figure 36: Transvaginal ultrasound image of the uterus. Multiple tortuous arcuate veins were seen in the myometrium on color Doppler.[24]

77

Color Doppler Findings

Ovaries:

Visibly dilated arcuate veins with color fill.

May need to use power Doppler

Figure 36: Transvaginal pelvic ultrasound image in axial section of a 33-year-old woman with the use of B-mode (**a**) and *color*-Doppler (**b**) demonstrates marked engorgement of veins surrounding the left ovary vein.[24]

78

Color Doppler Findings

Ovaries:

Visibly dilated arcuate veins with color fill.

May need to use power Doppler

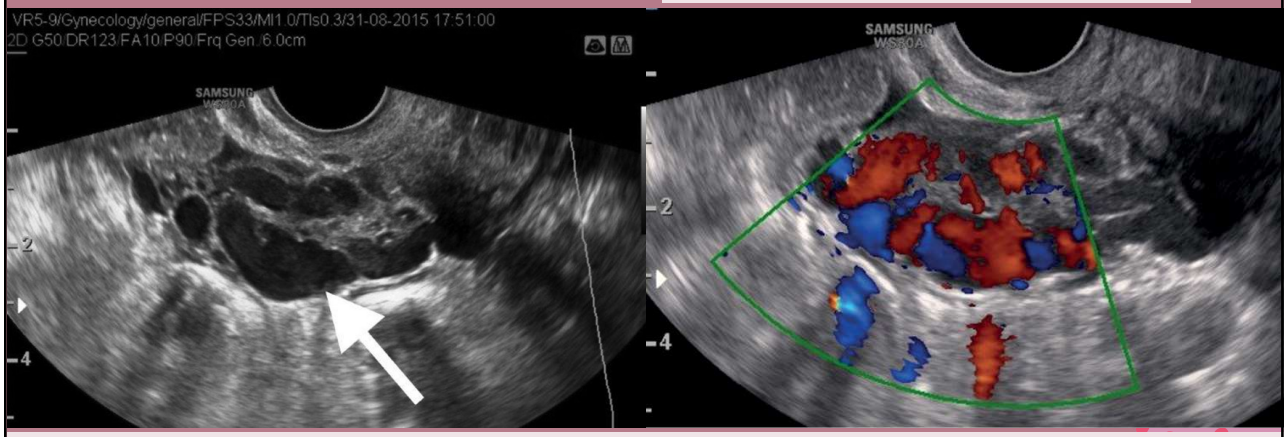

Figure 37: B- mode and color Doppler imaging of a dilated left parametrial venous plexus (arrow) initially misdiagnosed as a hydrosalpinx.[21]

79

Spectral Doppler Findings

Uterine Venous Plexus:
Venous reflux of the uterine venous plexus.
(with or without Valsalva.)

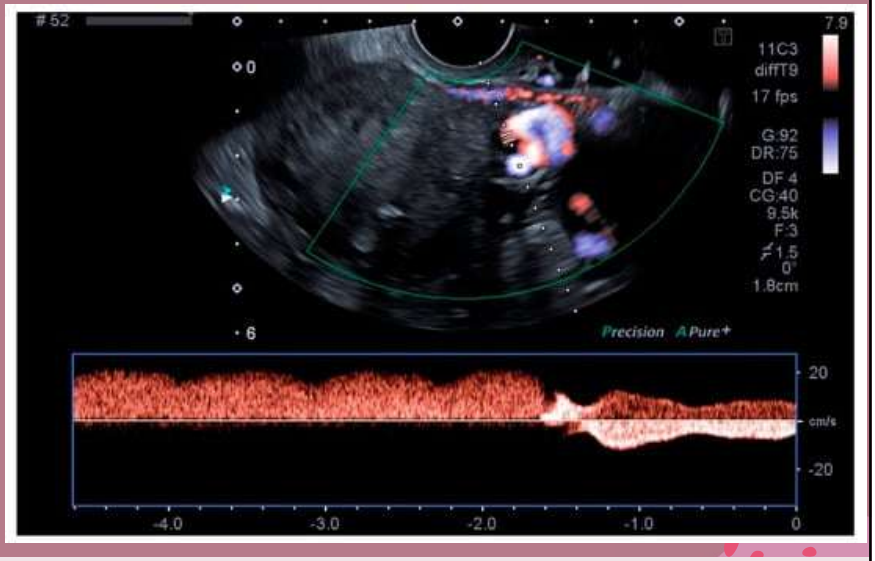

Figure 38: Transvaginal ultrasound imaging of the uterine venous plexus with Spectral Doppler tracing demonstrating reflux with Valsalva maneuver.[24]

80

Spectral Doppler Findings

Ovarian Venous Plexus:
Venous reflux of the ovarian venous plexus.
(with or without Valsalva.)

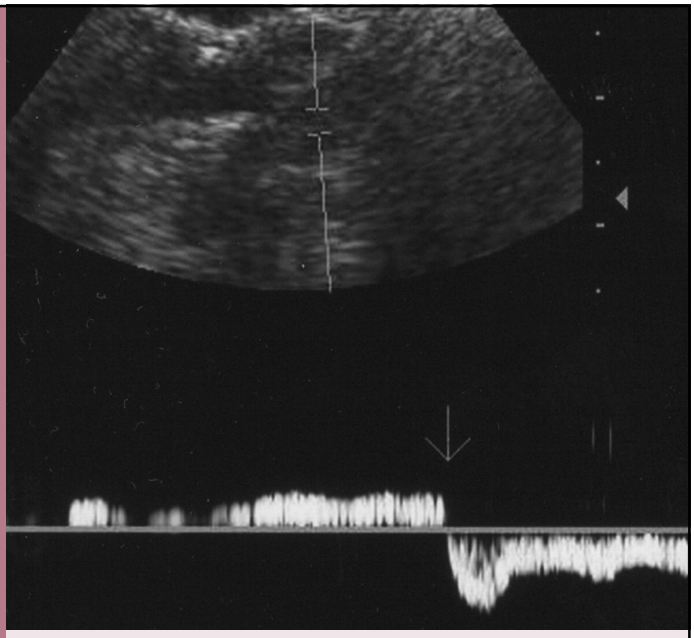

Figure 39: Spectral Doppler of dilated ovarian venous plexus with reversal of flow on Valsalva's maneuver that correlates with reflux on selective ovarian venography (not shown).[10]

81

Color & Spectral Doppler Findings

Internal Iliac Veins:
Reversed flow with or without vlasalva

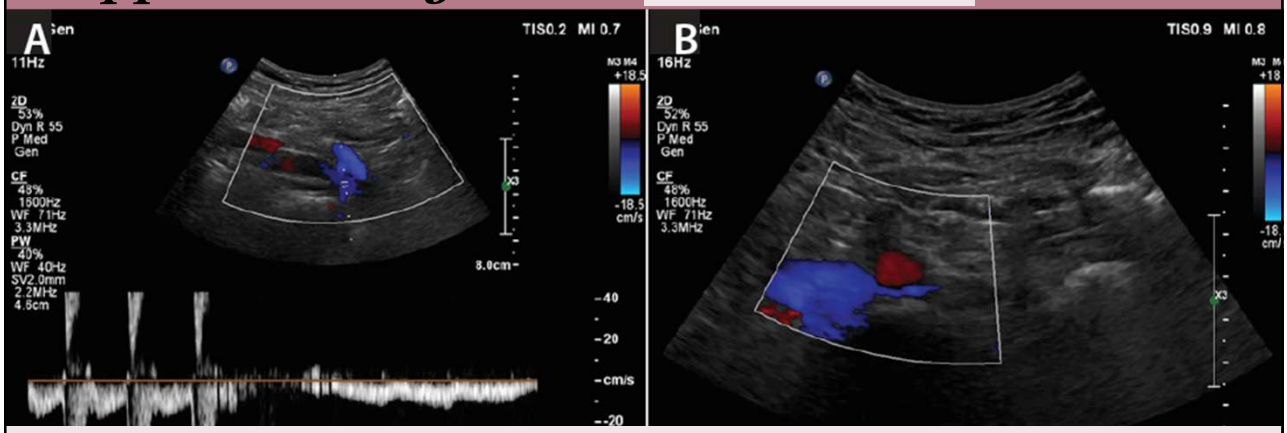

Figure 40: Transabdominal ultrasound imaging of the internal iliac vein with Spectral Doppler tracing demonstrating reflux.[13]

82

Venous exits for pelvic veins

Formerly "May-Thurner" syndrome

Left common iliac vein compression by overlying right common iliac artery.

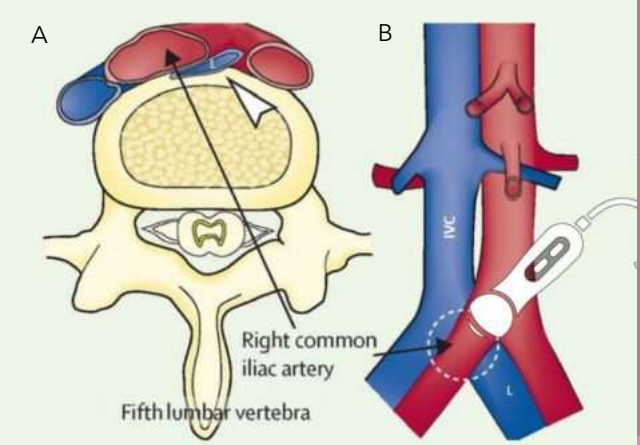

Figure 41: Schematic showing compression of the left common iliac vein by the overlying right common iliac artery.[4]

83

Color & Spectral Doppler Findings

Left Common Iliac Vein:
Elevated velocities posterior to RCIA.

Absent LCIV flow

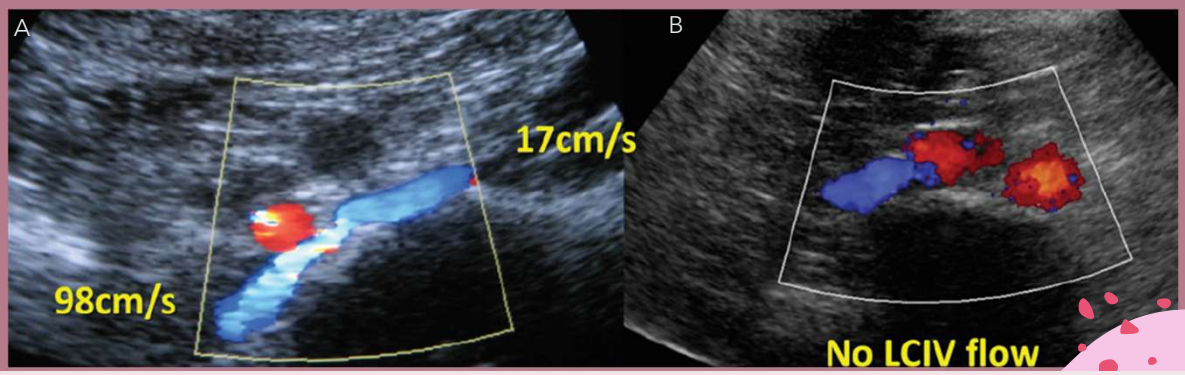

Figure 42: Transabdominal ultrasound imaging of the left common iliac vein demonstrating increased (A) and absent (B) flow on color Doppler imaging.[13]

84

Proximal Venous Obstruction

- Any significant narrowing or obstruction of proximal veins increases venous pressure distally.
- Capillary outflow into venules, and then veins, surpasses the reduced venous capacity.
- Venous vessels dilate to maximum size.
- Venous valves are forced to stay open.

85

Spectral Doppler Findings: Left Common Iliac Vein

Waveform Flow Morphology

- Antegrade
- Continuous
- Non-pulsatile
- Non-respirophasic

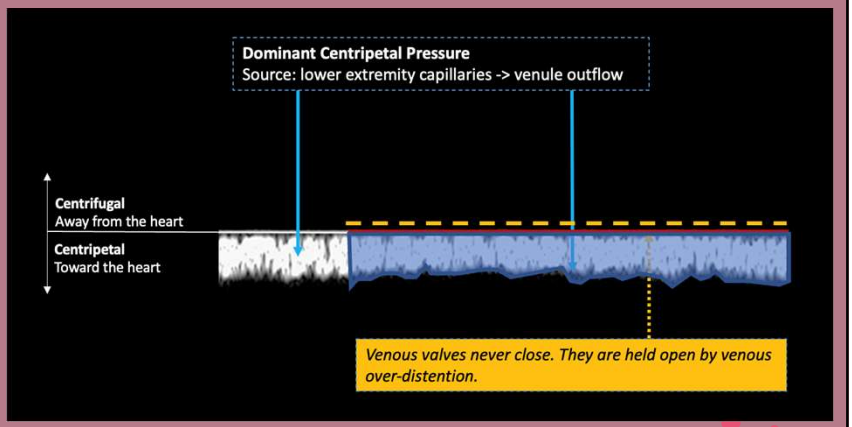

Figure 43: Abnormal common femoral vein waveform demonstrating continuous flow, suspicious for proximal obstruction

86

Zone 3:

Pelvic Origin Extrapelvic Veins

87

Symptoms – (S_3): Extrapelvic Symptoms of Venous Origin

Symptoms localized to the external genitalia or lower extremities due to reflux through recognized escape points in the pelvic floor[22] or from iliocaval venous obstruction.

- Vulva or posteromedial thigh symptoms:
  - Pain
  - Discomfort
  - Tenderness
  - Itching
  - Bleeding
  - Superficial venous thrombosis from non-saphenous varicosities.

88

Varices – (V_3) Pelvic Origin Extrapelvic Varices

4 leak points in the pelvic floor:

1. O: 'Obturator' point
2. I: 'Inguinal' point
3. P: 'Perineal' point
4. G: 'Gluteal' point

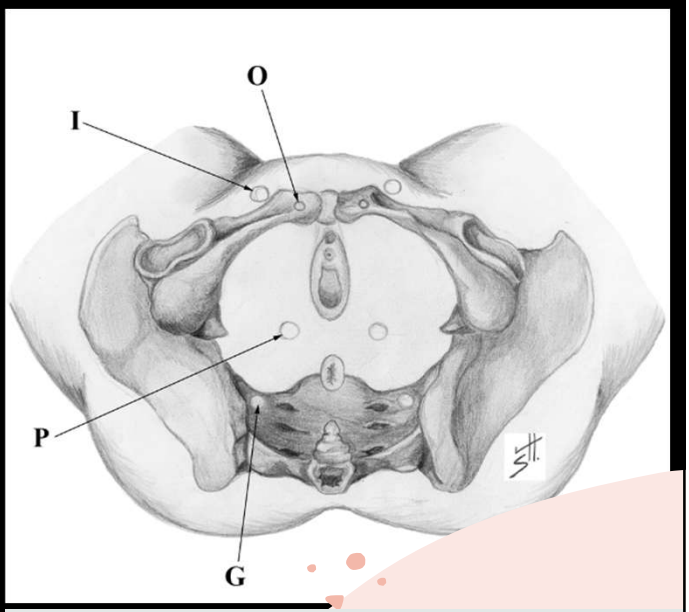

Figure 44: Scheme of pelvic leakage points (inferior view).[20]

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Varices – (V_3) Pelvic Origin Extrapelvic Varices

4 leak points in the pelvic floor:

1. **Obturator:** obturator vein > circumflex femoral veins > femoral vein. (deep system)
2. **Inguinal:** ovarian vein > greater saphenous vein. (superficial system)
3. **Perineal:** internal pudendal vein > greater saphenous vein. (superficial system)
4. **Gluteal:** inferior gluteal vein > medial circumflex femoral vein > femoral vein. (deep system.

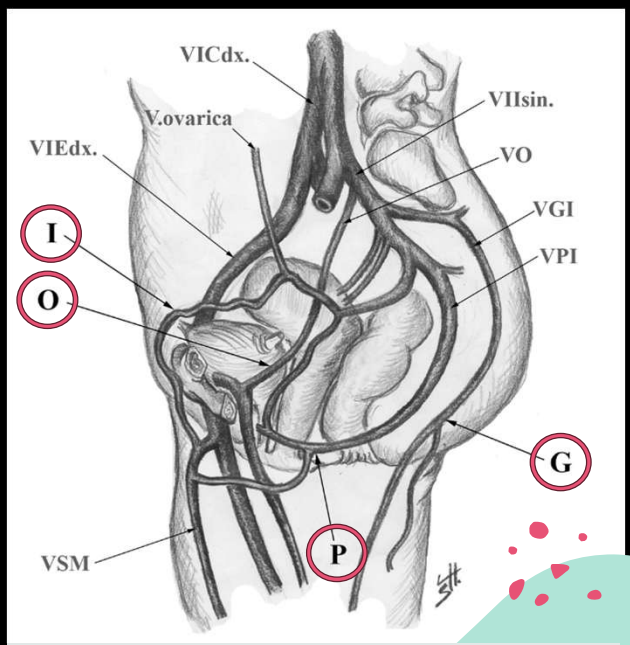


Figure 45: Scheme of pelvic leakage points (lateral view).[20]

90

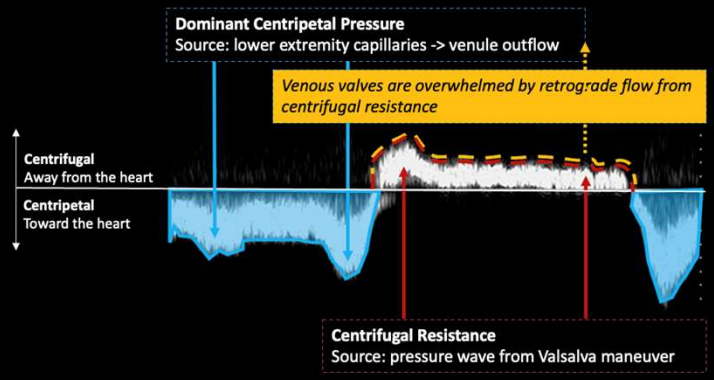
Lower Extremity Doppler
Secondary Venous Valvular Insufficiency

Increase in proximal pressure causes retrograde flow.

Valsalva

Proximal Compression

May be noted in superficial or deep venous vessels.



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The End.

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Anatomy

Specifies the vessel involved.

Abbreviation	Expansions
IVC	Inferior vena cava
LRV	Left renal vein
GV	Gonadal (testicular, ovarian) veins
LGV	Left gonadal vein
RGV	Right gonadal vein
BGV	Bilateral gonadal veins
CIV	Common iliac veins
LCIV	Left common iliac vein
RCIV	Right common iliac vein
BCIV	Bilateral common iliac veins
EIV	External iliac veins
LEIV	Left external iliac vein
REIV	Right external iliac vein
BEIV	Bilateral external iliac veins
IIV	Internal iliac veins
LIIV	Left internal iliac vein and tributaries
RIIV	Right internal iliac vein and tributaries
BIIV	Bilateral internal iliac veins and tributaries
PELV	Pelvic escape veins[22] ("escape points"); inguinal, obturator, pudendal, and/or gluteal

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Hemodynamics

Describes how blood flow is impacted.

Obstruction (O)	Thrombotic or nonthrombotic (venous compression) venous obstruction
Reflux (R)	Thrombotic or nonthrombotic reflux

99

Etiology

Describes the underlying cause.

Thrombotic (T)

- Venous reflux or obstruction arising from previous DVT.

Nonthrombotic (NT)

- Reflux due to degenerative process of vein wall or proximal obstruction.

Congenital (C)

- Congenital venous or mixed vascular malformations.

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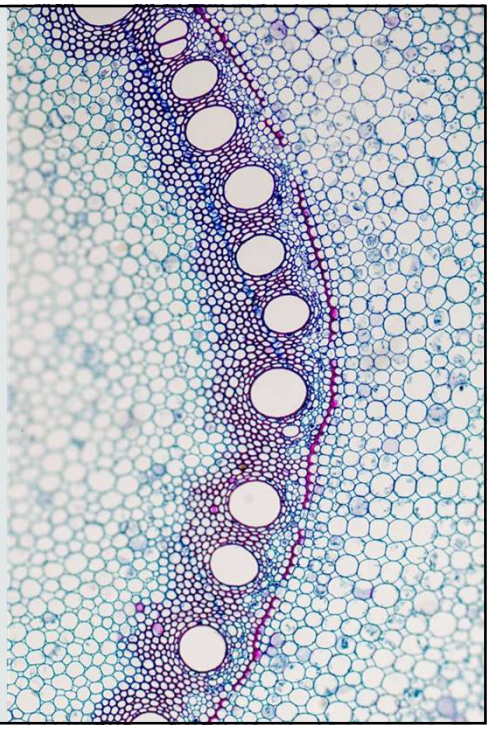
Vascular Physiology & Hemodynamics

Arterial hemodynamics examine the characteristics that contribute to in-going blood SUPPLY to tissues.

Venous hemodynamics examine the characteristics that contribute to out-going blood DRAINAGE from tissues.



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Uterine and Ovarian Vein Doppler:

- **Dependent vascular bed:** uterus and ovary
- **Force of resistance:** hydrostatic pressure

WAVEFORM MORPHOLOGY
- Antegrade (toward the heart)
- Continuous
- Respirophasic

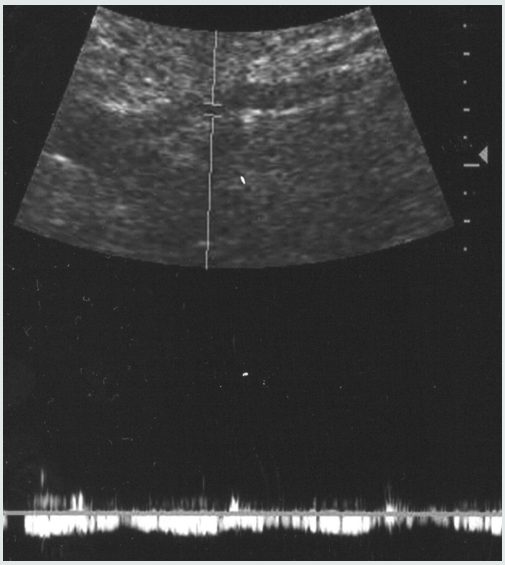

Figure 11: Spectral Doppler waveform of the ovarian vein in a non-gravid female.[9]

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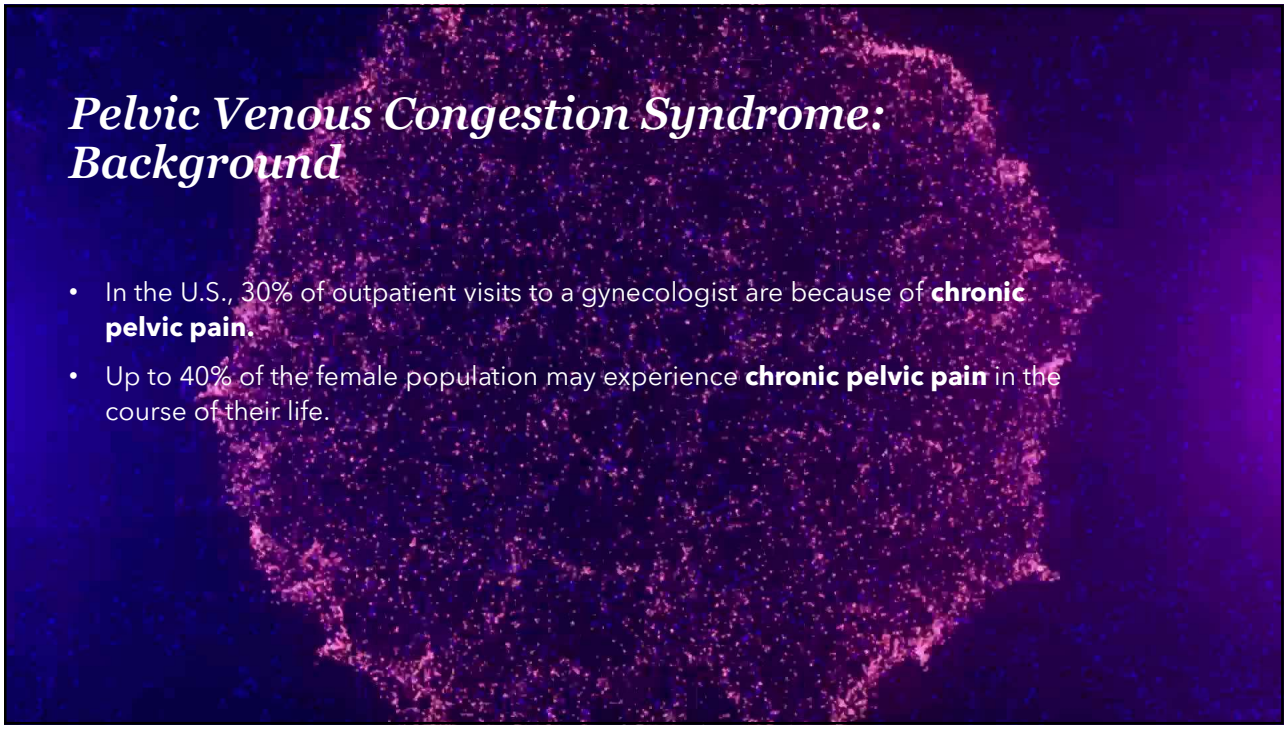

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