

Penile Colour Doppler Ultrasound Scanning

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Qualifications of Dr CSK.

- M.B.B.S., Bangalore Medical College,
- M.Sc., In Infertility in Bristol university of England,
- Ph.D., From University of Mysore.(Male Infertility).
- FECSM, Fellowship in European Committee of Sexual Medicine.
- FPSM, Fellowship in Psycho Sexual Medicine, JSS Medical College.
- D.R.C.O.G. From Royal college of Obstetrics and Gynecology , UK,
- D.G.L.S., Diplomat in Gynecological Laparoscopic surgery, Germany,
- D.M.R.D. from Karnataka Medical college of Hubli.
- DYN., Diploma in Yoga and Nature cure New Delhi
- C. Sc., From Scanning from Holland .
- FCGP, From Indian Medical Association.

Fellowship/ Membership of Professional Organisations:

1. IMA : Indian Medical Association
2. ISAR : Indian Society of Assisted Reproduction
3. IRIA : Indian Radiological and Imaging Association.
4. FOGSI : Federation of Obstetrician and Gynecological Association.
5. ICGLP: Indian College of Gynecological Laparoscopy.
6. ISSM : International Society for Sexual Medicine
7. ESSM : European Society of Sexual Medicine.
8. SASSM : South Asian Society for Sexual Medicine.
9. IASMPMM: International Association of Sexual Medicine Practitioners
9. IFS : Indian Fertility Society.
10. CSEPI: Council of Sex Education and Parenthood International (India)
11. NARCHI : National Association for Reproduction and Child Health International.
12. MUSK : Medical Ultrasound Society of Karnataka.

Professional Services

- **Dr Sharath Men's Clinic**
34, 20th main, Basava Mantapa road, Near City Hospital, Rajajinagar, Bengaluru 10.
080 41570100, Mob: 78294 47100, 99805 25100.
- **Director & Chief Fertility Surgeon:**
Mediwave IVF & Fertility Research Hospital, City X-Ray Complex, Sayyaji Rao Road, Mysore.
0821 2444441. / 4255019, Mob: 80888 90724.
- **Consultant Sexologist and Fertility Surgeon**
Apollo B.G.S Hospital, Kuvempunagar, Mysuru.
New Priyadharshini Hospital, Brindavan Extension, Mysuru.
- **Principal, Professor and Head of the Dept of Reproductive Medicine and Surgery:**
Mediwave Institute of Medical Sciences, Sayyaji Rao Road, Mysore 1.
(Affiliated to Karnataka State Open University).

Services Rendered in Professional Organisations:

1. Served as : Secretary, Vice President & President : IMA Mysore. Conducted several Health check up camps and organized state IMA conferences at Mysore. Conducted several CMEs.
2. Founder Secretary: Karnataka Chapter for Indian Association for Assisted Reproduction. Conducted State KISAR conference at Mysore.
3. Vice President: IR & IA, Karnataka State Branch< conducted State IR & IA Conference at Mysore.
4. Editor : Karnataka Medical Journal. Brought out quarterly issues regularly.
5. Registrar : National Association for Reproduction and Child Health International.
6. State Central Council Member from past 40 Years; IMA, New Delhi.
7. Member : Karnataka Private Medical Establishments Authority, Government of Karnataka.
8. Presented more than 1300 Scientific papers in State, Central and International Medical Conferences.
9. President: Mysore Clinical Society: Conducted several Health check up camps for Women, Children and Aged persons.

Awards Received:

1. Dr BC Roy Award from IMA Mysore Branch.
2. German Remedies Travel Fellowship Award, IR & IA, New Delhi.
3. Best Research Award in the field of Sexual Medicine, 2016, World Association of Sexology, Conference held at Singapore.
4. Karnataka Rajyotsava Award from Mysore District, Govt of Karnataka.
5. Kannada Sahitya Parishath Award for best Kannada Book : Mysore District
6. Dr PS Shankar Prathistana Award for Best Kannada Literature Award fro Gulbarga.
7. Yogacharya Award from Mysore District Yoga Association.
8. Abhinandan Grantha for my services to the Society by Vaidya Vartha, Mysore.
9. Vaidya Rathna award from Mysore Clinical Society.
10. Vaidya Rathna Award by Karnataka Health & Wealth, Signature Media, Bangalore.

Chapters

- Introduction
- Equipment
- Anatomy
- Indications for PDS
- Technique
- Interpretation
- Disorders
- Complications
- After care
- Conclusion

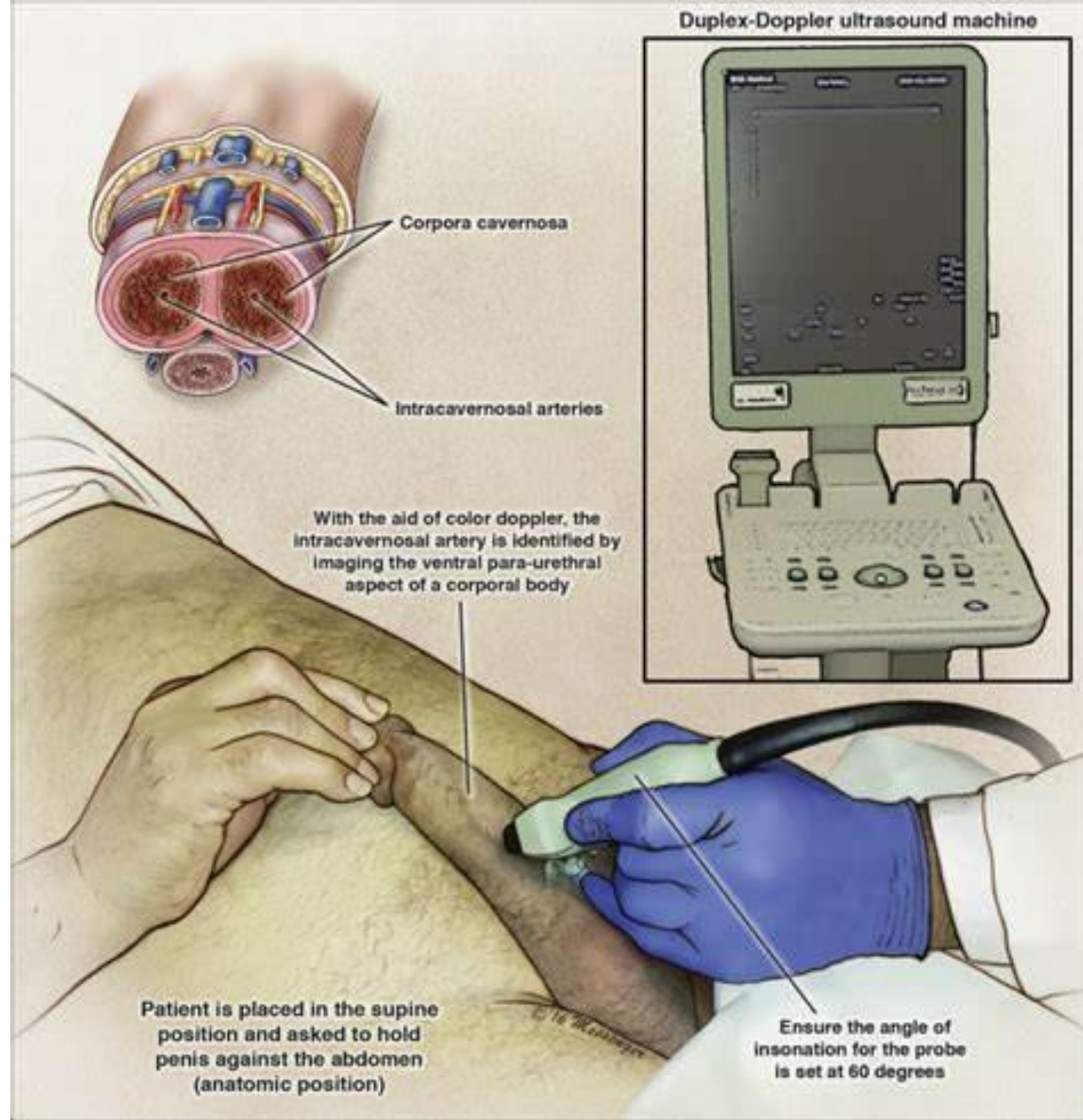


Penile Color Doppler Ultrasound Scanning (PDS): Diagnosis and Management of Penile Disorders.

- Penile Color Doppler Ultrasound Scanning, also known as **Penile Doppler Scanning (PDS)** or Penile Vascular Ultrasound, is a medical imaging technique used to assess the **Anatomy & Blood flow of the Penis.**
- This non-invasive procedure is primarily employed to diagnose and evaluate various conditions related to **Erectile Dysfunction (ED) & other Penile Disorders.**
- PDS should be performed by a **Trained Radiologist, Sonologist, Urologist or a Sexologist** in a clinical or hospital setting.

PDS

In this lecture, I will give general and up-to-date information about the use of PDS, which I frequently use in my clinical practice.



Equipment

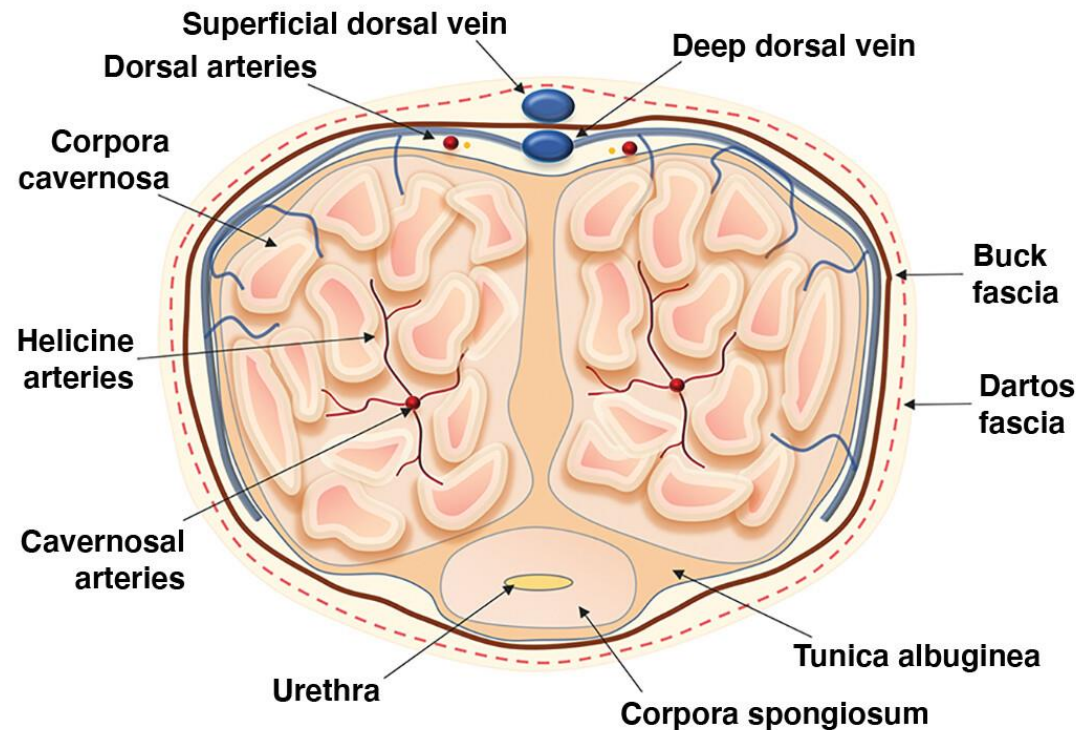
- Transducer (probe) specifically designed for PDS is used.
- Small Parts probe can also be used. High Frequency Linear array 7.5 to 12 Mh. Probes are ideal.
- The probe is gently moved over different areas of the penile skin to obtain images and assess blood flow.



Image Acquisition:

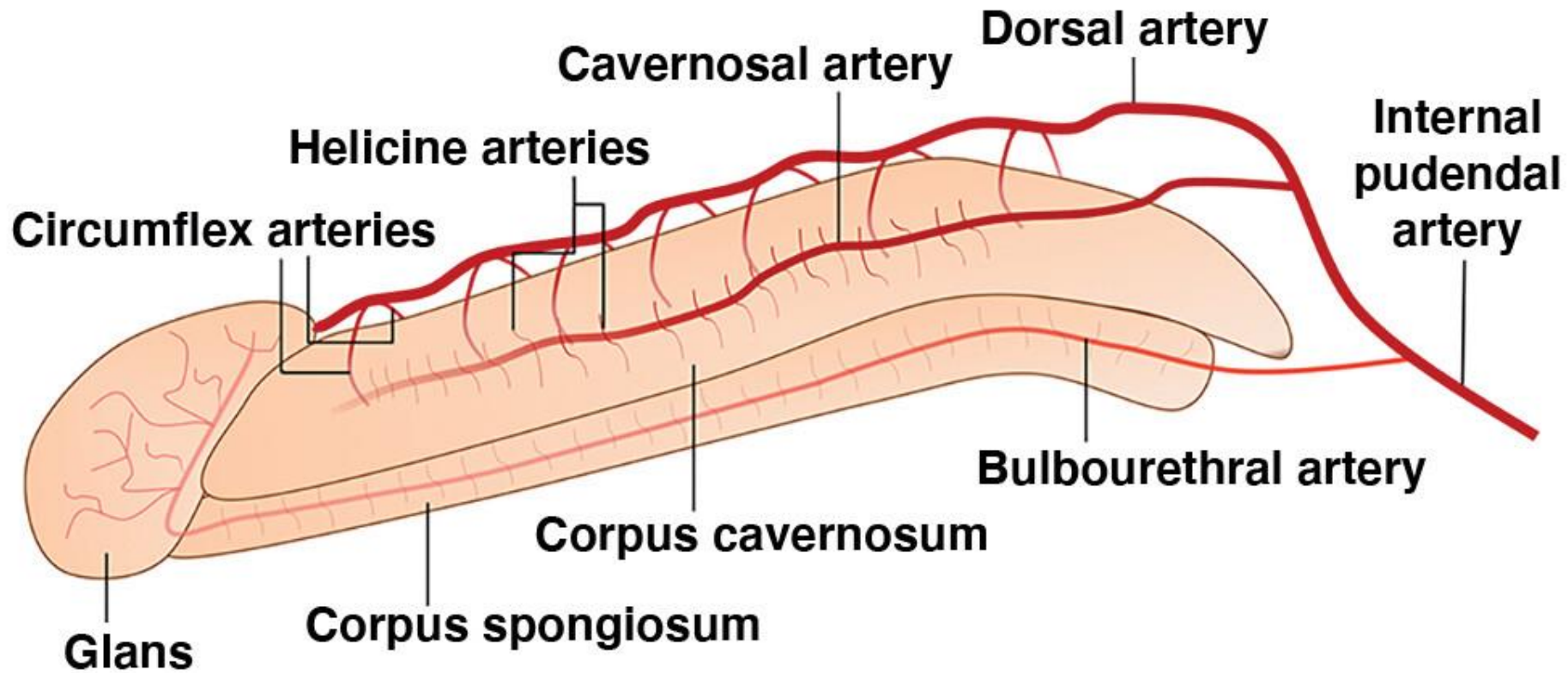
- The ultrasound machine emits high-frequency sound waves (ultrasound) that penetrate the tissues of the penis.
- As the sound waves bounce off the blood cells within the penile blood vessels, they are reflected back to the probe.
- The reflected sound waves are processed by the ultrasound machine to create real-time images on a monitor.

Sono - Anatomy



- Transverse drawing shows **Corpora Cavernosa** and **Corpus Spongiosum** surrounded by **Tunica Albuginea**.
- **Cavernosal Arteries** and **Helicine Arteries** are located within corpora cavernosa, and corpus spongiosum contains **Urethra**.
- **Buck fascia** encircles three corpora, deep dorsal vein, and dorsal arteries, and **Dartos Fascia** encompasses all components of penis.
- **Superficial Dorsal Vein** is located between Buck fascia and Dartos fascia.
- Between the corpora cavernosa, a region of posterior acoustic shadowing is seen, which is **Penile Septum**.

Arterial Supply : Within both Corpora Cavernosa, the **Cavernosal Arteries** are seen as narrow tubular structures with an echogenic wall in the longitudinal plane and as echogenic dots in the transverse plane.



Venous Return : The **Dorsal Veins** appear at the dorsal aspect of the penis as anechoic compressible tubules and usually have detectable flow on PDS.

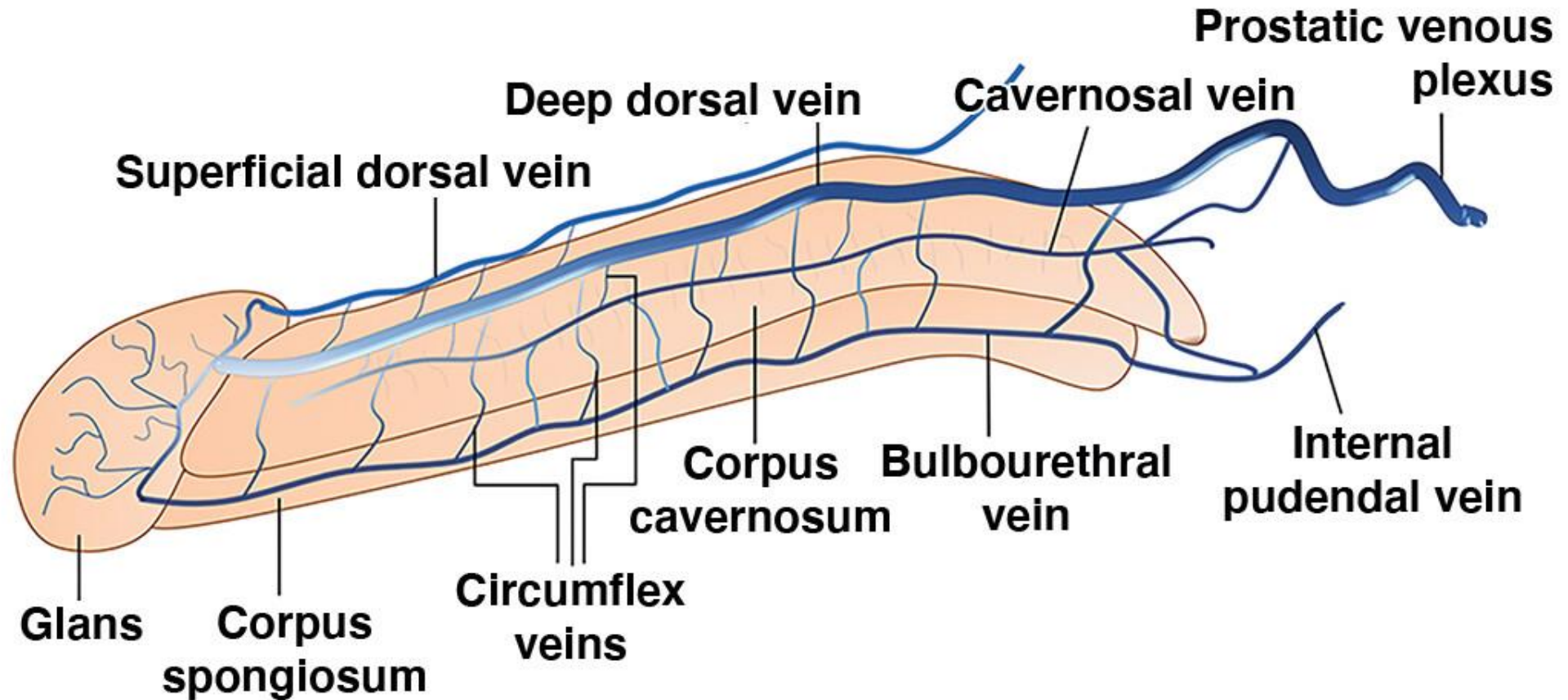
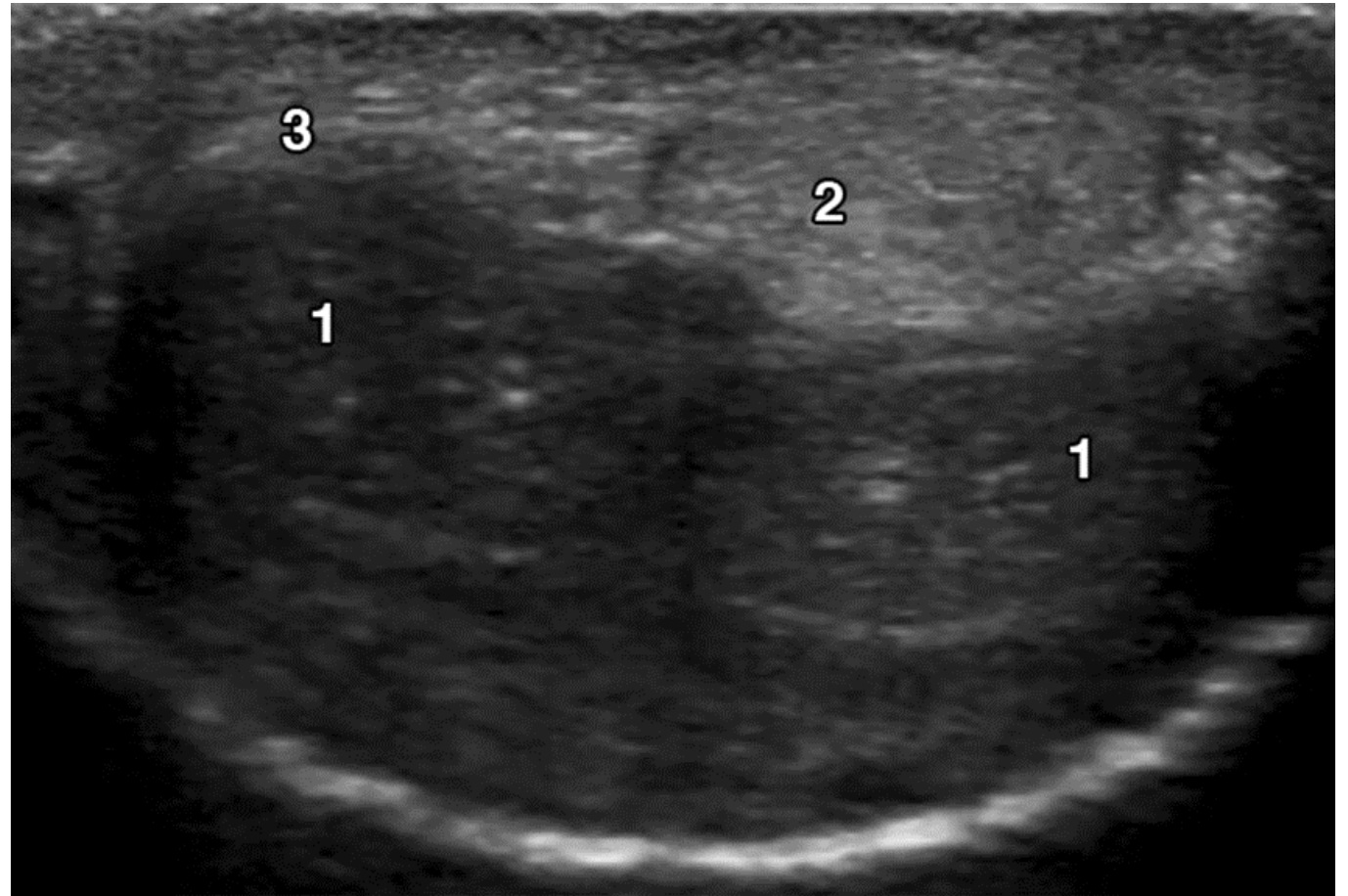


Image of Penis

PDS image obtained in
Transverse Plane show:

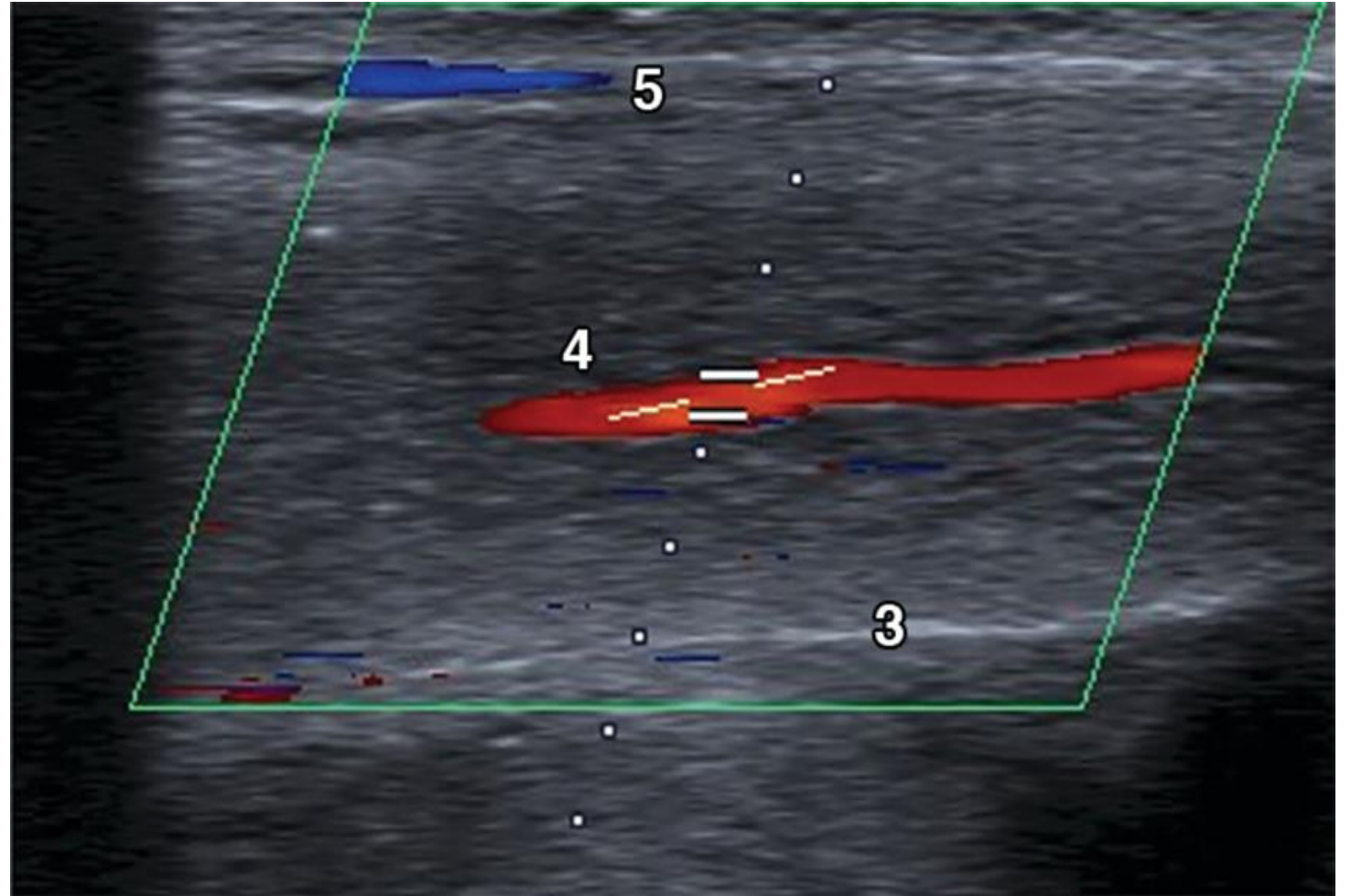
- Corpora Cavernosa (1)
- Corpus Spongiosum (2)
- Tunica Albuginea (3)



Longitudinal Section

PDS image obtained in longitudinal planes show:

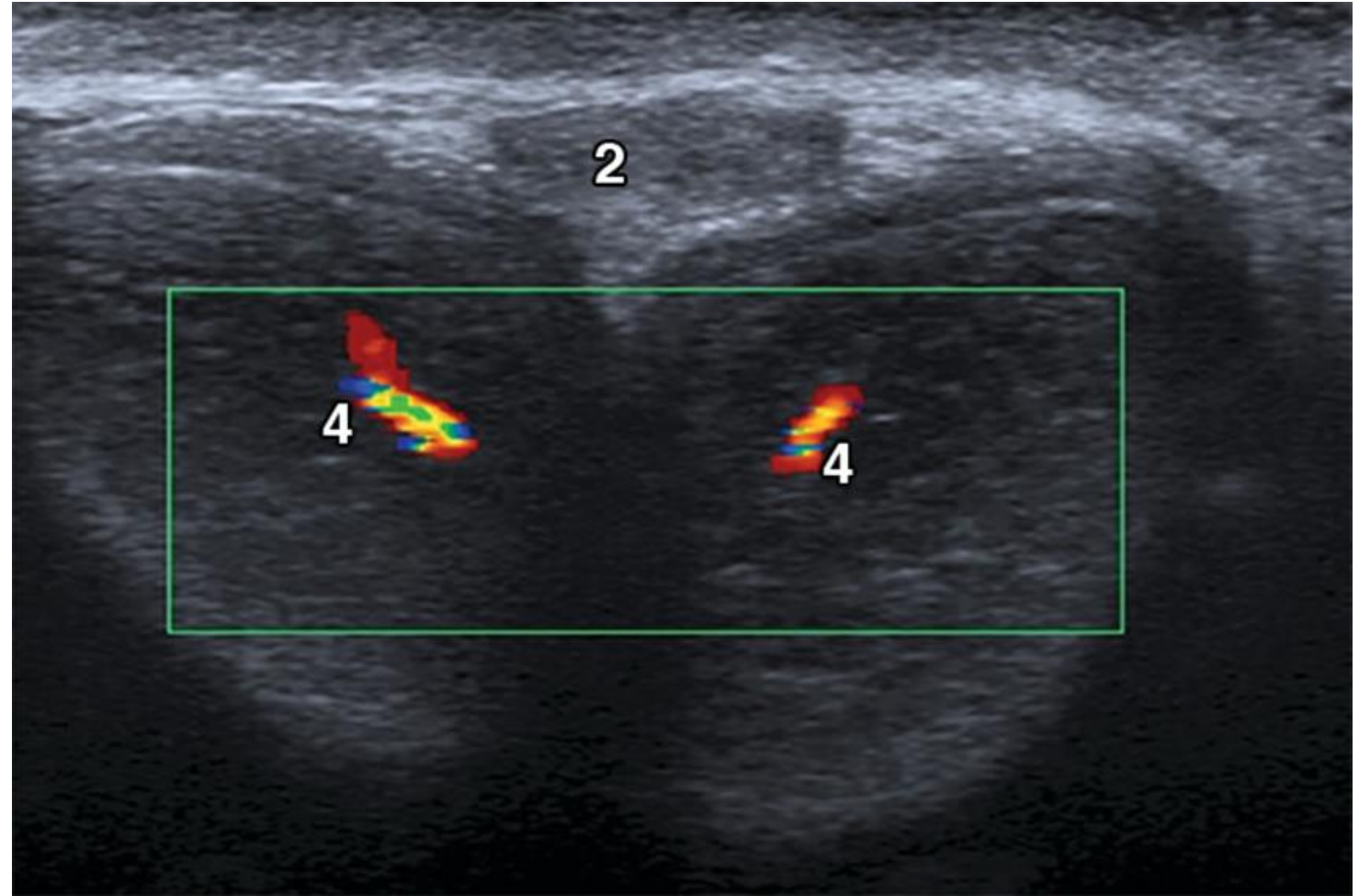
- Tunica albuginea (3),
- Cavernosal artery (4),
- Deep dorsal vein (5).



Transverse Section

PDS image obtained in
transverse plane show:

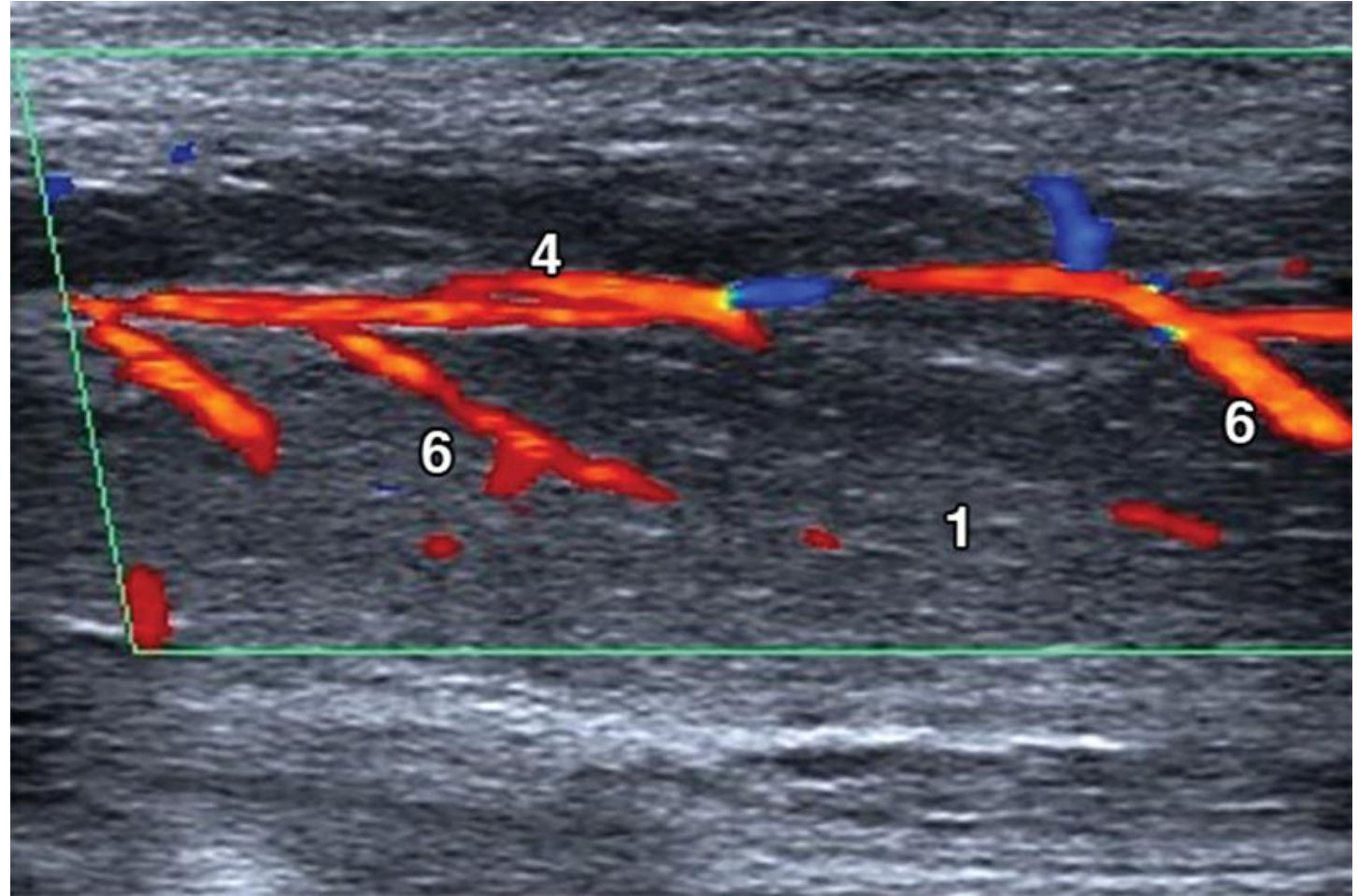
- Corpus Spongiosum (2)
- Cavernosal Artery (4)



Longitudinal Section

Image obtained in longitudinal plane show:

- Corpora cavernosa (1)
- Cavernosal artery (4)
- Helicine arteries (6)



PDS Protocol

- Method and possible complications should be explained in detail to the patient, and written informed consent must be obtained, especially with regard to the **Risk of Priapism** developing after **Intra-Cavernosal Injection (ICI)**.
- A calm, private, and comfortable environment is essential.
- Scanning must be performed with the penis in **both flaccid and erect states**. ICI is required to induce erection.
- If the patient refuses injection, **mouth dissolving Sildenafil Citrate tablet or Spray** can be used. Results may not be satisfactory. Patient is encouraged to see sexually stimulating audio Visuals, when oral medicines are used.

Technique

- Patient in supine position.
- The entire penis should be scanned through its ventral aspect in longitudinal and transverse views.
- First, morphologic evaluation of the penis is performed using gray-scale or B-mode US to rule out anatomic abnormalities.
- Then, **erection is pharmacologically induced by ICI drugs** into the lateral side of the proximal third of the penis.

Vasoactive Injections

- The most common ICI used is 10–20 µg of **Prostaglandin E1**.
- **Trimix** is a mixture of three medications: **Papaverine, Phentolamine, and Prostaglandin**.
- **Bimix** is made up of **Papaverine and Prostaglandin**.
- These medications can be used in varying concentrations, which allows for a wide range of options and makes it possible to customize ICI for each patient.

Technique

- During the induced erection, dynamic assessment with color and spectral PDS is performed at the **Origin of both Cavernosal Arteries**.
- Arteries typically appear in red or blue, depending on the direction of flow, while veins are typically shown in a different color.
- Spectral sampling of the cavernosal arteries is obtained at **5-minute intervals until Maximal Peak Systolic Velocity (PSV) and Minimal End Diastolic Velocity (EDV) values are reached** which generally requires up to **20 minutes, with a maximum of 30 minutes**.
- Maintain the narrowest possible box sampling and use a **PDS angle of 30–60°** during the examination.

Doppler Ultrasound Diagnostic Criteria

The spectral waveform of the **Cavernosal Arteries** undergoes normal variations during erection. Following phases are seen:

- **Flaccid Phase** : In this phase, the spectral waveform is **Monophasic** with minimal diastolic flow.
- **Filling Phase**: There is an **increase in both Systolic and Diastolic flow**.
- **Tumescence phase**: There is the appearance of a **Dicrotic notch at the end of systole**; hence, a low-resistance waveform is obtained.
- **Full Erection Phase**: The **End-diastolic velocity decreases to zero**, leading to **Diastolic flow reversal**.
- **Rigid Erection Phase** : Reduction in the **Peak systolic velocity (PSV)** and **Disappearance or inversion of diastole** are seen.

PDS – Hemodynamic Parameters

The **Hemodynamic Parameters** commonly used in PDS are:

- **Peak Systolic Velocity (PSV),**
- **End Diastolic Velocity (EDV),** and
- **Resistance Index (RI).**
- The PSV and EDV are expressed in **Centimeters per Second.**
- The PSV corresponds to the maximum flow rate during systole.
- The EDV defines the residual flow in a vessel at the end of the diastolic phase.
- The RI reflects the **Peripheral Resistance** to blood flow and is expressed using the following formula:
- **$RI = (PSV - EDV) / PSV.$**

Pulsatility Index (PI)

- Pulsatility is an intrinsic property of the cardiovascular system, governed by the resistance differential across the arteriolar bed.
- When evaluated as a derived flow parameter using **Pulsed Wave Doppler**, it is calculated by the following equation:
- **$PI = (PSV - Minimal DV) / (Mean Velocity)$**
- The Sonologist measures the maximum (v_{max}) and minimum (v_{min}) velocities, while the mean velocity (v_{mean}) is calculated by the machine.

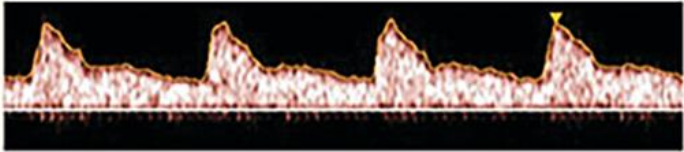
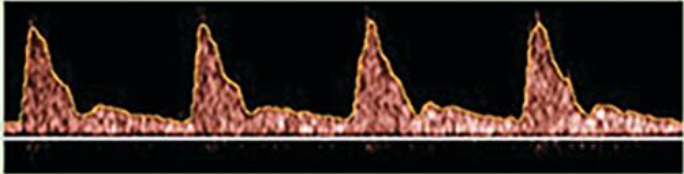
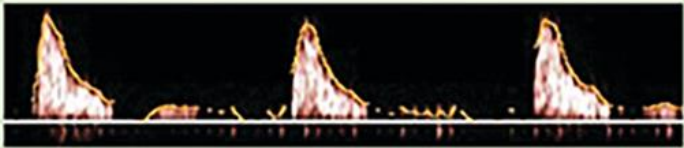
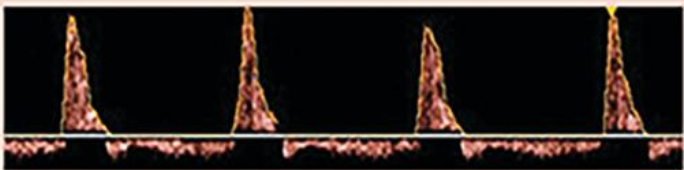
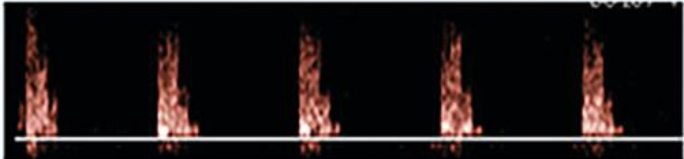
Normal PDS values after ICI

Normal values obtained from a PDS with ICI can vary depending on the specific parameters measured and the equipment used.

- **PSV:** **PSV of 30 cm/s or higher is normal.** This reflects the maximum velocity of blood flow during erection.
- **EDV:** This represents the velocity of blood flow during the resting phase of the cardiac cycle. **EDV less than 5 cm/s is normal.**
- **RI and PI** are measures of resistance to blood flow within the penile arteries. **RI & PI value Less than 0.8 is normal.**

Blood Flow Patterns:

- Abnormal blood flow patterns may be observed, such as **Retrograde flow (backward flow) in the veins.**
- Retrograde flow can be indicative of **Veno Occlusive Insufficiency** or **Venous Leakage**, a condition where blood escapes from the penis too quickly, preventing the maintenance of an erection.
- The images obtained can provide information about the overall anatomy of the penile blood vessels, including the presence of any abnormalities or blockages.
- Narrowing or stenosis of the penile arteries may indicate **Arterial Occlusive Disease.**

ERECTION PHASES	SPECTRAL DOPPLER PHASES	SPECTRAL DOPPLER WAVEFORM
FLACCID	Phase 0: monophasic with minimal diastolic flow	
FILLING	Phase 1: increased peak systolic velocity and end-diastolic velocity	
TUMESCENCE	Phase 2: decrease in diastolic flow with classic diastolic notch	
	Phase 3: decrease in diastolic flow approaching 0 cm/s	
FULL ERECTION	Phase 4: diastolic flow reversal	
RIGIDITY	Phase 5: decrease in peak systolic velocity and end-dystolic velocity	

HEMODYNAMIC INTERPRETATION DOPPLER ULTRASOUND WAVEFORM

Normal

PSV > 30 cm/s

EDV < 5 cm/s

RI > 0.9

Arterial Insufficiency

PSV < 30 cm/s

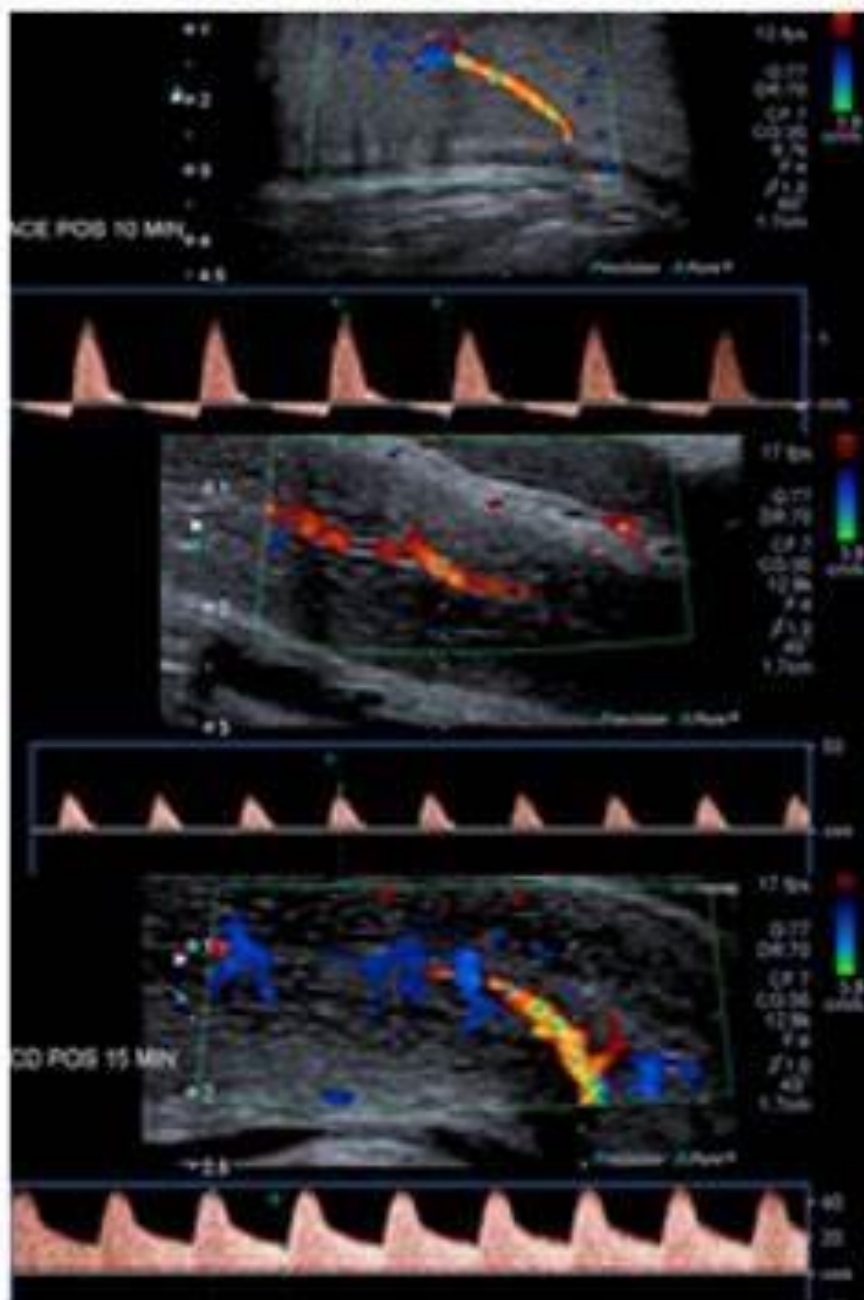
EDV < 5 cm/s

Veno-occlusive Cavernous
Dysfunction

PSV > 30 cm/s

EDV > 5 cm/s

RI < 0.75



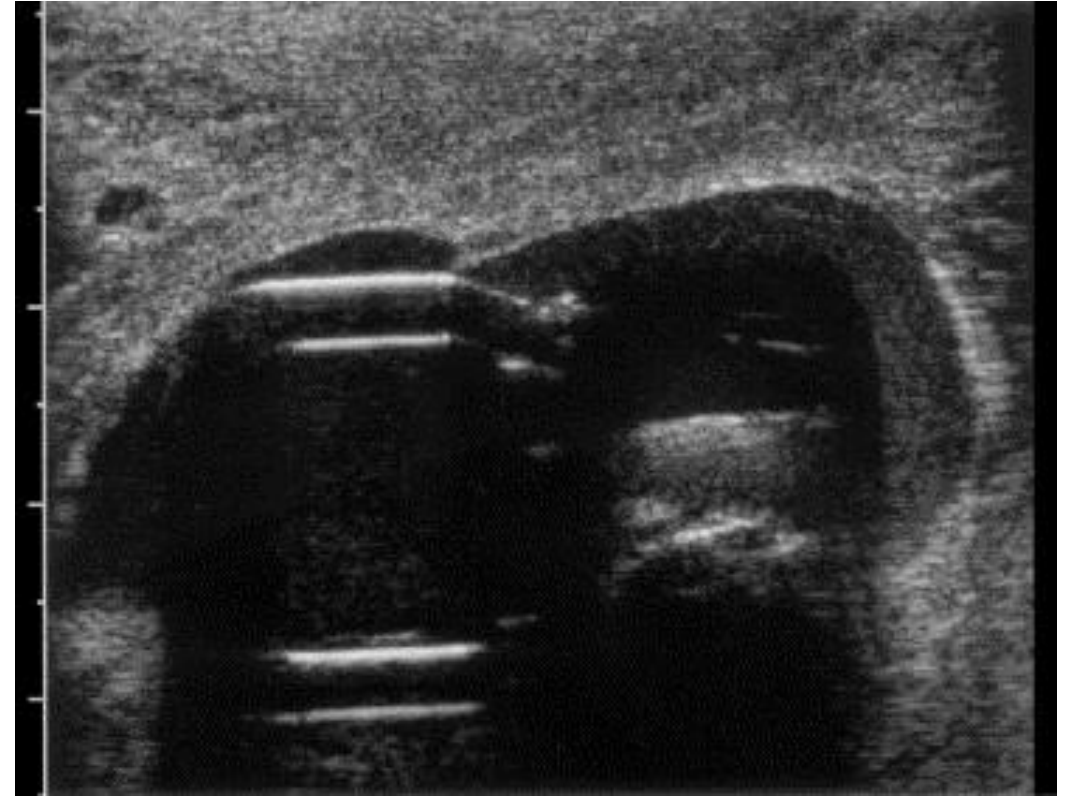
Peyronie's Disease

- **PDS** images may reveal the presence of **Plaques** or **Scarring** within the penile tissues in **Peyronie's Disease**.
- The size, location, and extent of the plaque or scarring may be assessed, as it can contribute to penile curvature and impact erectile function.



Penile Implant Surgery

- **Penile Implant Surgery:** Pre-operative or post-operative Doppler ultrasound to evaluate the penile vascular status and suitability for the procedure.
- Post-operatively, PDS can confirm the proper functioning of the implant.



Other Indications

- **Treatment Monitoring:** Men undergoing medical treatments for ED, such as medications (e.g., PDE5 inhibitors) or ICI, may undergo periodic PDS to monitor treatment efficacy and make necessary adjustments.
- **Unexplained Penile Pain:** Individuals experiencing unexplained penile pain or discomfort may have a PDS to rule out vascular issues or other structural abnormalities within the penis.
- **Research and Clinical Studies:** PDS is also utilized in research and clinical studies to gather data on penile vascular health and its relation to various conditions, potentially leading to advancements in treatment options.

Erection Hardness Scoring after ICI

- In PDU ICI for erectile dysfunction, erection scoring involves assessing the quality and rigidity of the induced erection.
- The scoring system commonly used is called the **Erection Hardness Score (EHS)**, which provides a simple and standardized way to categorize the rigidity of an erection.
- The EHS scale typically ranges from 0 to 4, with each score corresponding to different degrees of erection hardness:

Scores

- **EHS 0: No erection** – Penis is completely flaccid.
- **EHS 1: Slight tumescence** – Penis is larger than when flaccid but not hard.
- **EHS 2: Sufficient for penetration but not rigid** – Penis is hard enough for penetration but not completely rigid.
- **EHS 3: Firm enough for penetration and rigid** – Penis is fully rigid and suitable for penetration but not as hard as it could be.
- **EHS 4: Fully rigid and fully hard** – Penis is completely rigid and maximally hard.

Risks

- It's essential to remember that the Sonologist performing the PDS is trained to minimize the risk of complications and ensure the safety and well-being of the patient.
- The procedure is typically brief and well-tolerated.
- The Sonologist should ask for any underlying medical conditions, **Allergies, or Medications** they are taking, as this information can be essential in assessing the individual's suitability for the procedure and minimizing the risk of complications.

Priapism:

- **Priapism** is a rare but potential complication that can occur after PDU.
- Priapism is a prolonged and painful erection that can last for several hours or more.
- It may be triggered by the procedure due to factors such as the manipulation of penile tissues or the use of ultrasound gel, Viewing Porn during examination.
- Immediate medical attention is essential to address priapism and prevent complications.

Complications

- **Mild discomfort or Pain:** during the procedure, particularly if there is pressure applied to the penis, pain may be felt while the ultrasound probe is being maneuvered.
- **Infection:** While the risk of infection is extremely low, any invasive procedure carries a minimal risk of introducing infection.
- **Psychological Discomfort:** Some patients may experience anxiety or psychological discomfort due to the nature of the procedure, particularly if they feel embarrassed or self-conscious.
- **Allergic Reactions:** Rarely, Patient may experience an allergic reaction to the ultrasound gel.
- **Bruising or Hematoma:** Rarely, the application of pressure or manipulation of the penile tissues during the procedure can lead to minor bruising or a small hematoma (a localized collection of blood).

Summary

- PDU is a minimally invasive medical imaging procedure used to assess blood flow within the penis.
- It is primarily performed to diagnose and evaluate conditions related to ED or other penile vascular disorders.
- **Complications**, such as **Mild discomfort or Allergic reactions** to the gel, are rare but possible.
- Rarely, **Severe complications like Priapism** can occur.
- In summary, PDU is a valuable diagnostic tool in urology for assessing penile blood flow and diagnosing conditions like ED and Peyronie's disease.
- It helps Sexologist to tailor treatment plans to address vascular issues and improve patients' quality of life.

**Thank You for
Your Kind
Attention**

**Dr C Sharath Kumar
Sexologist
Bangalore**

