

**Thursday, October 4<sup>th</sup> 2018**

**Session I - Normal anatomy of the scrotum-Imaging appearance**

**Moderator: L.A. Mouloupoulos**

**Normal Anatomy**

**M. Nomikos**

*Thiasio General Hospital, Athens, Greece*

The scrotum is a double spaced cutaneous pouch connected in median raphe and situated in front of perineum. It contains both testicles with epididymis and it is attached superiorly to the spermatic cord as it enters the inguinal canal and inferiorly to the scrotal wall with the gubernaculum.

The scrotum is derived from labioscrotal folds under the influence of testosterone in 5<sup>th</sup> week of gestation. Testis descent start from retroperitoneal space under gubernaculum guidance and is usually completed in 9<sup>th</sup> of gestation. During descent the fetal testis is enveloped by processus vaginalis, which become the tunica vaginalis.

Scrotal wall which is 2-8mm thick is composed of dartos fascia, external spermatic, cremasteric and internal spermatic fascia which invest the spermatic cord.

Testicular coverings consist first of tunica vaginalis with tunica and parietal layers. Hydrocele is the accumulation of fluid between both layers. The tunica albuginea is a dense layer which creates septa to the testis. Tunica vasculosa is the inner testicular covering.

The testis mediastinum is an invagination of tunica albuginea that forms septa inside the testicle. Each septa divide the testis in 250 to 400 lobules. Each lobule contains 1-

4 seminiferous tubules. The seminiferous tubules are lined with germinal epithelium which under the influence of testosterone produce spermatozoa. Spermatogenesis starts from germ cells in the basement membrane which they mature as they advance to glandular lumen. Sertoli cells support developing germ cells. Leydig cells promote steroidogenesis, mostly testosterone production.

Testicular artery is the main arterial supply to the testis derives from an abdominal aorta branch at the L3-L4 level, with cremasteric, epididymal and differential artery as secondary ones. Pampiniform venous plexous is the principal venous testicular drainage. Left testicular vein drain to left renal vein and right testicular vein drain to the IVC.

Testicular innervation consists of sensory fibers of ilioinguinal and genitofemoral nerve and autonomic fibers from renal and aortic plexi.

Testis is the male gonad which under the influence of testosterone promote during puberty the differentiation of male sexual phenotype and spermatogenesis

## **Normal appearance: multiparametric MRI**

### **A. Ntorkou**

*Department of Radiology, Hôpital Universitaire Robert Debré, Paris, France*

Although magnetic resonance imaging of the scrotum (MRI) cannot be considered the first imaging technique in the investigation of scrotal diseases, has been proved an efficient diagnostic tool for the morphologic assessment and tissue characterization in the work-up of testicular pathology.

Radiologists should be familiar to the normal appearance of the scrotum on conventional MRI sequences (T1WI and T2WI), DWI and DCE-MRI. Recently published data on functional MRI techniques, including magnetization transfer imaging, diffusion tensor imaging and proton MR spectroscopy report on the normal appearance of the testis.

## **Session II - Scrotal emergencies**

**Moderator: V. Dogra**

### **Clinical questions that can be addressed with imaging**

**P. Sountoulidis**

*1st Urology Department, Aristotle University of Thessaloniki, Greece*

Acute scrotal pain is the most common reason for an A&E visit and urgent urology referral in young males. Acute scrotal pain is usually non-traumatic therefore infectious or vascular conditions are sought.

Vascular causes of acute scrotal pain include torsion of the testicle or of the scrotal appendages and rarely testicular infarction while infectious scrotal conditions include epididymo-orchitis and Fourniers gangrene.

The management of the acute scrotum is dictated by the underlying cause which is not always easy to diagnose. History-taking and physical examination provide valuable information but are rarely pathognomonic as most cases of acute scrotal pain present with sudden onset of severe lower abdominal or scrotal pain, nausea or vomiting and sometimes fever.

As the management and prognosis differ dramatically between different causes of acute scrotal pain arriving at a correct diagnosis is crucial.

Toward this goal imaging is valuable as it can provide vital information on the cause of acute scrotal pain. Ultrasonography, either Gray scale or Color Doppler is the imaging modality of choice for the investigation of the acute scrotum in the emergency setting. Ultrasonography can distinguish between torsion of the testicular appendages, inflammation and torsion of the testicle thereby avoiding an unnecessary trip to the operating room. There are but a few exceptions where ultrasonography findings are non diagnostic, in those cases the threshold for surgical intervention should be low as all cases of acute scrotal pain should be treated as testicular torsion until proven otherwise.

### **Infectious scrotal conditions**

#### **M. Secil**

*Department of Radiology, Dokuz Eylul University Faculty of Medicine, Inciralti,  
Izmir, Turkey*

Scrotal inflammatory conditions may represent the scrotal wall, epididymal and/or testicular inflammations. Scrotal wall inflammations include folliculitis, cellulitis, abscess, fistula, Fournier's gangrene, and hidradenitis suppurativa. Imaging is necessary for severe conditions of scrotal wall inflammations and the findings include thickening and heterogeneity of the wall, dispersed areas in fluid echogenicity / intensity within the wall, increased vascularity, increased contrast enhancement, fluid loculations, and tract formations (sinus, fistula). Fournier's gangrene is a special type of inflammation as a result a necrotizing polymicrobial infection caused by *Clostridium perfringens*, *Klebsiella*, *Proteus*, *Streptococcus*, *Staphylococcus*, *Peptostreptococcus*, and *Escherichia coli*. Fournier's gangrene begins from perineal-

scrotal region extending beneath Scarpa's fascia to the abdomen, thorax, even neck. It is commonly seen in diabetic, debilitated, and immune-compromized individuals. Gas is the hallmark but not an invariable finding. Hidradenitis suppurativa is a chronic inflammation originating from the apocrine glands that may occur at genitofemoral region. It is clinically diagnosed and MR imaging is the method of choice if imaging is necessary to show the extension of inflammation and its complications, and for the planning of reconstructive surgery.

Acute epididymitis and epididymoorchitis is the most common cause of acute scrotum presenting with progressively increasing severe pain and tenderness. It is a descending infection which originates from the urinary tract, involves the tail of the epididymis first and the other areas. Testis is secondarily involved after epididymis. The most frequent causative agents are *N. gonorrhoea*, *C. trachomatis* in sexually active men and *E. coli* or *P. mirabilis* in children and elderly. On ultrasound enlargement of epididymis ± testis is seen, original echo of epididymis is lost and it becomes heterogeneous. Focal or diffuse ill-defined hypoechogenic and heterogeneous areas may be seen in testis upon involvement. On Doppler imaging the vascularity of the involved areas is typically increased. Reactive hydrocele, pyocele, scrotal wall thickening and increased vascularity of the scrotal wall may be the accompanying findings. The complications of infections are epididymal, testicular or intrascrotal abscess, formation of sinus and fistula.

Chronic infections and inflammations of scrotum and its content are chronic epididymitis and or orchitis due to tuberculosis and brucellosis, xanthogranulomatous epididymoorchitis and sarcoidosis. The presentation is commonly with vague symptoms and imaging findings represent enlarged heterogeneous epididymis, scattered or diffusely hypoechogenic areas in testis with variable vascularity.

Imaging is necessary for diagnosis of scrotal, epididymal and testicular infections. US and Doppler US are the major imaging modalities, MR and CT may be used in very rarely, in selected patients.

## **Other causes of acute scrotal pain**

### **J. Belfield**

*Royal Liverpool University Hospital, Liverpool, UK*

Testicular torsion and infections are the most common causes of acute scrotal pain. However, there are many other causes, including pain following trauma, scrotal hernia, an unusual presentation of a testicular tumour, varicoceles and referred pain from renal calculi or other abdominal abnormalities.

This talk will present 10 cases as seen in a real life situation, in order to discuss salient imaging findings of the other causes of scrotal pain.

Testicular trauma is often seen following a sports injury and may result in testicular contusion, rupture, fracture or a haematoma. Careful evaluation with ultrasound is the examination of choice in blunt trauma, to assess for any of the above findings.

Testicular tumours may present with acute scrotal pain, and may be found incidentally following testicular trauma during an ultrasound scan. If a patient is explored following testicular trauma, a scrotal incision is usually performed and if a tumour is subsequently found, it is important to remember that nodal drainage from the tumour will be into pelvic rather than para-aortic nodes.

Referred pain to the testis can be seen from ureteric obstruction and an ultrasound will be normal, but CT KUB may show ureteric obstruction or a calculus.

### **Session III - Scrotal masses**

**Moderator: V. Dogra**

#### **Clinical questions that can be addressed with imaging**

**P. Sountoulidis**

*1st Urology Department, Aristotle University of Thessaloniki, Greece*

Palpable painless scrotal masses in young adult are by definition considered as scrotal tumors until proven otherwise.

Although clinical examination is key to the diagnosis of a scrotal tumor imaging is mandatory as it can answer some very important clinical questions and guide management in specific clinical scenarios.

Scrotal ultrasound can differentiate between extratesticular scrotal masses the vast majority of which are benign lesions and intratesticular masses that are invariably malignant. In certain clinical settings imaging by either color doppler ultrasonography or scrotal MRI can guide management of indeterminate lesions that would otherwise have been treated as testicular tumors. Modern imaging has paved the way for testis sparing surgery in cases of testicular tumors in monorchid patients saving valuable testicular parenchyma.

## **Multiparametric US of testicular lumps**

**P. Sidhu**

*Department of Radiology, King's College London, King's College Hospital, London,  
United Kingdom of Great Britain and Northern Ireland*

The term multiparametric is often used in MR imaging to describe a number of different techniques to image a patient, and this can also be applied to the many aspects of the ultrasound examination, using the term multiparametric ultrasound or MPUS imaging. The use of B-mode, colour Doppler, spectral Doppler, contrast enhanced ultrasound and many different techniques of elastography add to the overall ultrasound examination. The application of MPUS in the assessment of testicular lumps will be illustrated, with examples where diagnosis is improved, and the many pitfalls of the use of just single aspects of MPUS will be detailed.

## **Multiparametric MRI (mp MRI) of scrotal lumps**

**L. Rocher**

*Departement of Radiology, Hôpitaux Universitaires Paris-Sud, Hôpital Bicêtre AP-  
HP, Paris, France*

Multiparametric MRI (mpMRI) has become an efficient tool to help characterization of testicular lumps. Most of testicular masses appear in hypo signal on T2, and in iso signal on T1, but diffusion and dynamic contrast enhanced MRI help to differentiate benign tumors such as Leydig cell tumors from malignant germ cell tumors. MRI help to manage the patient in the surgical strategy, in case of partial surgery, help to establish the location of the lesion in case of uncertain clinical exam or US.



## **Staging and follow-up strategies**

### **A. Turgut**

*Department of Radiology, Ankara Training and Research Hospital, Turkey*

Accurate clinical staging is critical for the management of testicular tumors because further treatment depends on the clinical stage of the disease. Testicular tumors metastasize by either the hematogenous or lymphatic route. Tumors from the left testis will typically metastasize to the left para-aortic nodal group just below the left renal vein, and right testicular tumors will typically metastasize to the paracaval, precaval, and aortocaval nodes. Cross-sectional imaging studies (CT, MRI) are useful in determining the location of metastases whereas tumor markers are useful for determining the presence of residual disease. Chest radiography alone is satisfactory in the initial staging whereas chest CT is indicated in cases with positive abdominal CT or abnormal chest radiography.

## **Paratesticular masses**

### **M. Secil**

*Department of Radiology, Dokuz Eylul University, Faculty of Medicine, Inciralti, Izmir, Turkey*

The paratesticular area includes a variety of anatomical structures that include the tunica vaginalis, epididymis, ductus deferens, spermatic cord, vessels, lymphatics, and other supportive tissues of the testis. As for the testes, the principal method of

examination for the extratesticular structures is ultrasound (US). The capability of US for detection of lesions of that area is almost 100%. However, the specificity of the method is not as much high as its sensitivity and is around 70-90%, depending on the location and character of the lesions. Magnetic resonance imaging (MRI) may be an alternative or additional method of examination for lesion characterization. Computed tomography (CT) may be used for the staging work-up of malignant lesions to demonstrate lung metastasis. Space occupying lesions originating from paratesticular structures may be non-neoplastic or neoplastic.

***Non-neoplastic lesions*** include the tunical cysts, epidymal cyst, spermatocele, fibrous pseudotumor, spermatic cord cyst, spermatic cord lipomatosis, and polyorchidism. Cystic lesions are easy to detect and diagnose as anechogenic masses on US, and in fluid signal intensity on all sequences of MRI. Lipomatosis seen as the echogenic thickening of the spermatic cord that may occur isolated or reactive process to accompanying hydrocele, MRI is very helpful for the diagnosis of lipomatosis by easy demonstration of fat content. In polyorchidism, the additional testis is almost in similar echogenicity/intensity with the original testes. Fibrous pseudotumor is solid, homogenous lesion which can be diagnosed by very low signal intensity on T2-weighted MR images.

***Neoplastic lesions*** may either be benign or malignant. *Benign neoplasms* are adenomatoid tumor, papillary cystadenoma and benign mesenchymal tumors, lipoma being the most common, followed by leiomyomas and by other rare lesions. Adenomatoid tumor appears as a homogeneous, avascular, well defined tumor at the juxta-testicular position. Papillary cystadenoma is a bunch-of-grape like cystic tumor with papillary projections inside, that develop at the epididymis and related to von Hippel Lindau disease in more than 60% of the patients. Lipoma has a characteristic

appearance on US, with echogenic interlobular septations in a homogeneous, well defined, avascular, compressible soft tissue lesion, which has typical fat signal intensity on MR images. Angiomyofibroblastoma-like tumor is the male counterpart of angiomyofibroblastoma occurring in the pelvis, genital tract, vulva or perineum of the female. Angioleiomyoma of the paratesticular area is extremely rare, with only a few case reports in the literature. Paratesticular hemangiomas may arise from the spermatic cord or the scrotal wall and they comprise less than 1% of all hemangiomas.

*Malignant neoplasms* are commonly mesenchymal in origin, namely the rhabdomyosarcoma, leiomyosarcoma, liposarcoma, malignant fibrous histiocytoma (undifferentiated pleomorphic sarcoma), and other extremely rare ones. Malignant mesothelioma is another type of primary tumor of the region, which originates from tunica vaginalis. Metastases to the paratesticular region may also occur secondary to various primaries. Lymphoma/leukemia and plasmocytoma may involve the paratesticular tissues, either alone or in combination with the involvement of the testis. Malignant tumors are commonly rapidly growing lesions that are big, sometimes huge in dimensions at the time of diagnosis. They are heterogeneous solid tumors that may contain cystic/necrotic areas, and they are commonly highly vascular lesions.

**Friday, October 5<sup>th</sup> 2018**

**Session IV - Male infertility**

**Moderator: N. Sofikitis, P. Ramchandani**

**Imaging of azoospermia and varicocele**

**M. Studniarek**

*Department of Radiology, Medical University of Gdansk, Gdansk, Poland*

Azoospermia is the inability to detect both spermatozoa and spermatogenic cells in semen and post-ejaculate urine due to either bilateral obstruction of the seminal ducts or spermatogenic failure. The main role of imaging in azoospermia is identification of the causes of azoospermia, such as disorders that obstruct sperm transport and may be correctable. Scrotal ultrasound is the most common non-invasive examinations used to image the male reproductive system including testes, epididymis and vascular structures in the scrotum. Magnetic resonance imaging is another non-invasive imaging modality enabling detection and assessment of scrotal and pelvic pathologies. The lecture presents imaging findings of obstructive and non-obstructive azoospermia and signs of present testicular spermatogenesis in non-obstructive azoospermia before TESE.

Varicocele is very common clinical problem that is associated with chronic pain, testicular atrophy and reduced fertility rates. Clinical grading is based on physical examination in standing position. Scrotal imaging using ultrasound enables much more detailed evaluation of varicocele and is very useful not only in the detection of early phases of the disease but also in the evaluation of persistent and recurrent ones

after surgical treatment. Lecture presents different systems of evaluation and grading of varicocele and sends the listeners to the new ESUR recommendations.

## **Non-invasive imaging of spermatogenesis: Could it be possible?**

### **A. Ntorkou**

*Department of Radiology, Hôpital Universitaire Robert Debré, Paris, France*

The management of patients with non obstructive azoospermia (NOA) involves microdissection testicular sperm extraction (mTESE) followed by intracytoplasmic sperm injection (ICSI). However there is no single clinical characteristic, except perhaps testicular histopathology that can accurately predict the outcome of TESE.

Several studies have reported the possible role of non-invasive imaging examinations, such as colour or power Doppler US to guide sperm retrieval techniques by means of the identification of regions with rich vascularization, possibly indicating foci of active spermatogenesis.

Furthermore a few authors have recently addressed the potential role of function MRI, including diffusion weighted imaging (DWI) and magnetization transfer imaging (MTR) in the work up of male infertility.

## **Session V - Emerging techniques**

**Moderator: J. Richenberg**

### **Scrotal elastography**

**P. Sidhu**

*Department of Radiology, King's College London, King's College Hospital, London,  
United Kingdom of Great Britain and Northern Ireland*

The use of elastography during an ultrasound examination has become more widespread over the last few years, finding a clinical role in the assessment of the liver, thyroid and the breast. Elastography can be used in the assessment of testicular abnormalities and adds to the overall confidence in establishing a diagnosis without using further imaging examinations. The different elastography techniques, both strain and shear wave will be explained with techniques explained and noted, and descriptions of the current use in testicular ultrasound illustrated. Evidence of the usefulness and future directions will be detailed.

### **Contrast - enhanced Ultrasonography**

**M. Bertolotto**

*Department of Radiology, University of Trieste, Trieste, Italy*

Despite US being the imaging modality of choice for examination of the scrotum, findings may be equivocal and misinterpretation can result in an unnecessary orchiectomy. A challenge is the unequivocal differentiation between hypovascular and avascular lesions, presuming that an avascular lesion implies benign disease, which may be impossible on color Doppler US. CEUS provides a practical solution by increasing the confidence of the interpretation of lesion vascularity and of scrotal

and cord vessels, allowing for appropriate clinical management. Indications are illustrated in patients with ischemic changes, inflammation, tumours and benign lumps, traumas, and complex cysts.

## **Functional MRI**

**A.C. Tsili**

*Department of Clinical Radiology, Medical School, University of Ioannina, Greece*

MRI although it cannot be considered the first imaging technique in the investigation of scrotal diseases, has been proved an efficient, supplemental diagnostic tool for scrotal imaging. Functional MRI techniques, namely DCE-MRI and DWI should be included in the routine MRI protocol of the scrotum. Recently published data on diffusion tensor imaging, magnetization transfer imaging and <sup>1</sup>H-MR spectroscopy presented new data in the understanding of testicular microstructure and pathophysiology. Main clinical applications include lesion characterization and infertility.

## **Session VI - Imaging of the scrotum-How we do it**

**Moderator: C. Kalogeropoulou**

### **Contrast-enhanced Ultrasonography**

**P. Sidhu**

*Department of Radiology, King's College London, King's College Hospital, London, United Kingdom of Great Britain and Northern Ireland*

Contrast enhanced ultrasound of the testis has an established role in a number of testicular abnormalities and is supported by the EFSUMB guidelines on CEUS of the

scrotum. The technique is somewhat different from the application in other areas of the body, with technical limitations of the microbubble requiring a modification of the usual technique as applied to abdominal organs. The physiology of testicular enhancement will be discussed and the application to assessing pertinent disease processes will be illustrated.

## **Scrotal elastography**

### **L. Rocher**

*Department of Radiology, Hôpitaux Universitaires Paris-Sud, Hôpital Bicêtre AP-HP, Paris, France*

Testis are soft (about 2-3 kPa with quantitative shear wave elastography), with the hilum harder. High stiffness lesions can occur both in intra or extra-testicular lesions. Malignant tumors are mostly stiffer compared to benign lesions, but overlapped values still exist. Benign tumors such as dermoid cysts and Leydig cell tumors may be as stiff as malignant germ cell tumors. Burned out tumors may be difficult to identify on conventional US, and increased stiffness found inside a hypoechoic hypovascular blurred margins area increase the suspicion. Testis in men with non-obstructive azoospermia are softer compared to normal patient, and obstructive azoospermia, but the overlapped values limit this tool. Extra testicular process such as focal epididymitis, adenomatoid tumors and fibrous pseudo tumor may also have an increased stiffness.

## **MRI of Scrotum: Basic Imaging Protocol**

### **V. Maliakas**

*Department of Clinical Radiology, University Hospital of Ioannina, Ioannina, Greece*



MRI of the scrotum has emerged as a valuable complementary imaging tool for the evaluation of scrotal pathology. The aim is to improve the ability to characterize scrotal lesions, helping to reduce the number of unnecessary radical surgical explorations. The use of appropriate coil, adequate support and correct positioning of the scrotum are essential key elements when performing scrotal MRI. The minimum requirements for the MRI protocol include: axial T1WI, axial and coronal T2WI, axial DWI and coronal subtracted DCE-MRI.

## **Functional MRI**

### **L. Astrakas**

*Department of Medical Physics, University Hospital of Ioannina, Ioannina Greece*

Many studies have shown that advanced MRI techniques can be a benefit for scrotal imaging. Among them, magnetization transfer imaging (MTI), Dynamic Contrast-Enhanced (DCE) perfusion imaging and magnetic resonance spectroscopy (MRS) have demonstrated their diagnostic value and their potential to enter standard clinical protocols. However, their applications is not trivial and all of them require careful post-processing and data analysis. For MTI and DCE imaging there are available software packages in the MR scanners which can facilitate their analysis. Scrotal MRS analysis requires third-party packages based on prior-knowledge techniques and customized metabolite databases.

## **Session VII-Recommendations/guidelines issued by the working group**

**Moderator: M. Bertolotto**

### **Incidentally detected non-palpable testicular nodule**

**L. Rocher**

*Department of Radiology, Hôpitaux Universitaires Paris-Sud, Hôpital Bicêtre AP-HP, Paris, France*

Color Doppler is the basic exam. The size, the presence of microliths/microlithiasis/macrocalcifications, the vascular architecture are major semiological findings to suggest the benign or the malignant nature of the lesion. Other techniques like multiparametric MRI, contrast enhanced sonography, sonographic elastography are still in evaluation. The frequency of benign tumors such as Leydig cell tumors lead to preservation management, through improved characterization, monitoring or tumorectomy.

### **MRI of the scrotum**

**A.C. Tsili**

*Department of Clinical Radiology, Medical School, University of Ioannina, Ioannina, Greece*

MRI is becoming established as a worthwhile second-line diagnostic tool for scrotal pathology. The Scrotal and Penile Imaging Working Group appointed by the board of the European Society of Urogenital Radiology has produced recommendations for MRI of the scrotum. The recommended MRI protocol should include T1WI, T2WI,

DWI and DCE-MRI. Scrotal MRI can be clinically applied for lesion characterization (primary), including both intratesticular and paratesticular masses, differentiation between germ-cell and non-germ-cell neoplasms (evolving), characterization of the histological type of TGCNs (in selected cases), local staging of TGCNs (primary), acute scrotum (in selected cases), trauma (in selected cases) and undescended testes (primary).

## **Varicocele**

**M. Bertolotto**

*Department of Radiology, University of Trieste, Trieste, Italy*

Varicocele is a common urological problem, defined as dilation of the pampiniform venous plexus draining the testicle, with reflux of venous blood. The clinical significance and the effects on fertility are still debated, but evidence shows that there is an improvement in semen parameters in infertile men following varicocele correction. Given the current uncertainties in varicocele assessment, the ESUR SPIWG prepared a systematic review of the current imaging approach to varicocele assessment in Europe. A number of questions addressing the imaging approach to varicocele are discussed, and recommendations made based on current clinical evidence or expert opinion when established evidence is lacking.

## **Penile implants**

**S. Ramanathan**

*Consultant Clinical imaging, Hamad medical corporation, Doha-Qatar, Weill*

*Cornell Medicine-New York (Qatar campus)*

Penile prosthesis (PP) is currently the treatment of choice for irreversible organic ED when medical therapy is ineffective or contraindicated and when vacuum devices are unsatisfactory or unacceptable. There are two major types of penile prostheses currently in use: malleable penile prostheses and inflatable penile prostheses. In this lecture, the following will be discussed: Indications & contraindications for penile prosthesis, the role of various imaging modalities in the evaluation of PP, imaging technique and protocols, the normal imaging appearances of different types of PP and the imaging pitfalls

**Saturday, October 6<sup>th</sup> 2018**

**Session VIII - Normal anatomy of the penis - Imaging evaluation**

**Moderator: V. Koutoulidis**

**Normal Anatomy**

**J. Varkarakis**

*2nd Department of Urology, Athens Medical School, Sismanoglio Hospital, Athens*

*Greece*

The human penis consists of three cylinders. A pair of vascular chambers called corpora cavernosa, which consist of spongy vascular tissue and are responsible for penile erection and a third cylinder; the corpus spongiosum which is also a vascular

structure surrounding the urethra and ending distally to the glans of the penis. The two corpora cavernosa are surrounded by a fibrous fascia known as the tunica albuginea, while all three structures are enclosed by another fibrous fascia called Buck's fascia.

The arterial supply of the penis is provided by the internal pudendal artery which provides three main branches: the cavernous artery coursing through the center of the corpora cavernosa, the dorsal penile artery located between the tunica albuginea and the Buck's fascia, and the bulbourethral artery responsible for the arterial supply of the corpus spongiosum and the urethra. Venous drainage is from the sinusoids by way of emissary and circumflex veins to the deep and superficial dorsal veins which finally drain into the periprostatic plexus. Innervation is provided by the dorsal nerves coursing on the dorsal surface of the penis just laterally to the dorsal penile arteries.

## **MRI evaluation of the penis - How we do it - Imaging appearance**

**M. Bertolotto**

*Department of Radiology, University of Trieste, Strada di Fiume 447, I-34149,*

*Trieste, Italy*

Although multiparametric US is the primary modality for imaging the penis, the superior soft-tissue contrast and spatial resolution afforded by magnetic resonance (MR) imaging provides an opportunity to advance imaging evaluation of this organ. Clinical questions that remain unresolved after US examination can often be answered with penile MR imaging. In this lecture the MR anatomy of the penis is reviewed, and anatomical variations described. Strategies for optimal MR imaging of the penis are discussed, including technical requirements, organ and coil positioning, pulse sequence selection, vasodilator injection, and gadolinium administration.

## **Session IX - Multimodality Imaging of Penile Pathology**

**Moderator: P. Pavlica**

**Multimodality imaging of patients with erectile dysfunction and Peyronie disease**

**P. Pavlica**

*Department of Radiology, Villalba Hospital, Bologna, Italy*

### ***Peyronie Disease***

Peyronie's disease (PD) is a benign disease of the penis of unknown cause. It is defined as an acquired disorder of the tunica albuginea with the development of a plaque of fibrous tissue, associated with progressive penile bending and shortening. As the result of progressive penile deformity difficulties of penetration can develop with impairment of erectile capacity.

Ultrasonography with Color-Doppler and MR imaging performed in advanced tumescence or erection, after pharmacologic stimulation, are the imaging modalities employed in the clinical practice to confirm the clinical diagnosis, evaluate the extension of the disease and to assess associated erectile dysfunction.

### ***Ultrasonography***

Sonography permits noninvasive, objective and detailed analysis of the penis anatomy and allows to define disease severity, monitor disease evaluation and assess the response to medical therapy, that can be missed with clinical evaluation. Tunical thickening, septal thickening, subalbugineal fibrosis and penile calcifications must be measured along the penis. The tunica albuginea of patients with PD shows focal areas

of thickening and increased echogenicity, compared to normal adjacent albuginea . US has a superior accuracy compared to clinical examination in the detection and definition of the plaques and has a high sensitivity in the identification of calcifications.

### ***Magnetic Resonance Imaging***

The clinical results have shown that MR imaging is at least as sensitive as sonography in the assessment of the site and extension of the plaques. It is very useful in the follow-up of patients undergoing medical treatment as an objective method to evaluate therapeutic response.

Payronie's plaques appear in T1 and T2-weighted images as focal or diffuse thickening of the dorsal albuginea , with low signal intensity. Sometimes the plaques have a nodular aspect and are associated to fibrotic stripes due to the extension of the disease into the corpora cavernosa.

### ***Erectile Dysfunction (ED)***

Ultrasonography and Color-Doppler are the most widely used, non invasive and readily available imaging modalities for diagnostic purposes in studying erectile dysfunction (ED). In fact, after clinical examination, it is the first tool in imaging algorithms used for the evaluation of the anatomic and functional status of the penis and of the penile vessels in patients who complain of erectile problems. Intracavernosal vasoactive substances injection (dynamic penile ultrasonography) is one of the most important phases in the examination of patients with ED.

Afterwards Color imaging is performed using a reduced field of view, to maintain a high frame rate. The spectral analysis is the most important parameter used to characterize the severity and the nature of the ED. There is a general agreement that

the Peak Systolic Velocity (PSV), measured at the level of the peno-scrotal junction, is the best parameter for a clinical judgment of the arterial perfusion. PSV superior to 35 cm/s is considered expression of normal functioning arterial tree even if arteriography can detect atheromatous parietal lesions which are hemodynamically non significant. When the Doppler examination reveals a PSV inferior to 25 cm/s, the ED is considered of arteriogenic origin with a sensitivity of about 100% and a specificity of 95%

Much more complex is the clinical evaluation of patients who show a PSV values between 25 and 35 cm/s. This range of values is commonly observed in older subjects with mild ED. Probably they have a stiffness of the arterial walls with intimal thickening and reduced response to PGE1 stimulation, secondary to an endothelial lesion and reduced NO production.

The ED secondary to veno-occlusive dysfunction is more common in the clinical practice and it is usually observed in younger patients without arterial disease. The diagnosis is made on the basis of a high and persistent end diastolic velocity (EDV) which is superior to the cut-off values of 3-5 cm/s, in subjects with normal PSV, as cavernosography and cavernosomanometry have confirmed and with a sensibility of 90-94%. The disappearance or inversion of the diastolic flow is indicative of functioning veno-occlusive mechanism and the ED is probably of different origin (hormonal, psychological).

### **Multimodality imaging of penile emergencies**

**M. Bertolotto**

*Department of Radiology, University of Trieste, Trieste, Italy*



Penile emergencies are rare, but often require urgent or emergent diagnosis. Infectious conditions are usually well evaluated at ultrasonography. MRI is a problem-solving technique. In expert hands, traumatic injuries of the penis are initially imaged with US, which depicts whether the penile corpora are contained by the tunica albuginea; herniation of content and discontinuity of the tunica albuginea indicate rupture. MRI should be performed because of its ability to directly depict discontinuity of the tunica albuginea with higher sensitivity and specificity compared to US. Clinical examination and history are often adequate for diagnosis of high-flow priapism, but Doppler US helps confirm the diagnosis and guide the treatment.

### **Multimodality imaging of penile lumps**

**M. Bertolotto**

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Penile lumps are commonly encountered in the clinical practice. Most of patients actually have Peyronie's disease, but differential diagnosis is needed with a wide series of benign and malignant pathologies. Patients are usually given a preliminary diagnosis based on history, onset of symptoms, and physical examination. Penile tumor is a histological diagnosis. Imaging is indicated for staging. For this purpose, MRI is preferred because compared to US it is more panoramic and provides a better tissue contrast resolution. With the exclusion of primary penile malignancies ultrasound is the imaging modality of choice to evaluate penile lumps. MR imaging is a problem-solving technique.

## **Postoperative penis**

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A variety of surgical procedures that change significantly the penile anatomy have been developed to manage penile diseases and malformations. Multimodality imaging allows investigation of the normal postoperative anatomy, presence of scarring, hematomas, and other pathologic changes that can occur in cases of surgical complications. They are also effective in evaluating the cause of erectile dysfunction and other unsatisfactory long-term results. After penile revascularization multimodality imaging allows direct evaluation of flow characteristics of the penile vessels, shunt patency, and integrity of the anastomoses. After sex-reassignment surgery the new female/male anatomy is depicted effectively, as well as early and late postoperative complications.

## **Imaging complications in penile implants**

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Complications of penile prosthesis can be categorized into three groups: (1) Malpositioning -buckling, floppy glans, erosion, migration, and crossover; (2) Mechanical failure - fracture, aneurysm, and leakage; (3) Infection. All the three types of complications can be seen in penile cylinders, reservoir and scrotal pump. Radiography, ultrasound, CT, and MRI are useful in the detection of these

complications and complement each other. Clinical history and meticulous physical examination remains the mainstay in the diagnosis of PP complications. Imaging, especially MRI can be an adjunct to clinical examination in deciding between surgical and conservative management.