Imaging in conditions of the male urogenital tract at Ernest Cook University, Kampala, Uganda

Kawooya et al provide an overview of imaging findings in male urogenital tract conditions at a selected center in Kampala, Uganda. They highlight the indications for imaging, the techniques employed, and both normal and abnormal findings observed in the patients studied.

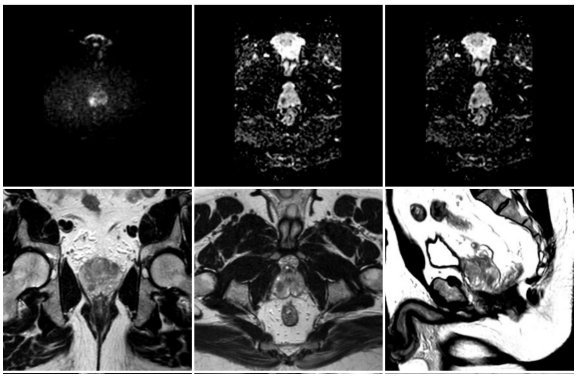
Introduction

Imaging of the male urogenital tract is becoming a common indication in Uganda given the increase in availability of Ultrasound, and MRI equipment in the country, increased awareness by the population and availability of more specialized doctors and health facilities. It accounts for approximately 2-5% of all imaging done at Ernest Cook University/Mengo Hospital Department of Radiology and 25% of all MRI examinations done at the Ernest Cook University/ Kampala MRI Center. These observations could imply the increasing dependency on imaging by referring clinicians for more targeted treatment of male urogenital conditions and the significant contribution to treatment outcomes.

Quality and usefulness of imaging studies of the male urogenital tract requires trained and experienced imaging personnel, Ernest Cook University (ECU), formerly Ernest Cook Ultrasound Research and Education Institute (ECUREI), has been training medical imaging personnel for the last 20 years. This includes training in ultrasound ranging from certificates to Masters degree training in imaging technology (radiography) from diploma to Masters degree and Training of specialist radiologists to Masters of Medicine in Radiology (M.Med). Together with Makerere University, ECU and Makerere University train the over 90% of Medical Imaging personnel in Uganda. This training base ensures constant provision of competent imaging personnel.

Awareness by the public of the need for early diagnosis and treatment of conditions of the male urogenital tract is on the increase especially in urban areas evidenced by the higher proportion of men presenting with prostate specific antigen (PSA) below 13ng/dl at the Ernest Cook University and Kampala MRI Center1. This awareness is intentionally being partly fostered by ECU through prostate cancer screening camps, radio talks, TV and newspapers. ECU in conjunction with the Buganda Kingdom are conducting 5-10 prostate and breast cancer screen camps in the central region in different locations yearly . Other players in the awareness campaign include other health facilities and institutions. During these camps, prostate and breast screening using ultrasound is performed in addition to PSA testing.

Michael G Kawooya[1] (Prof), kawooyagm@yahoo.co.uk, AMPURIIRE Nyakubaho[1,2] (M.D.), Ssebaggala Frank[1], Department of Radiology, Ernest Cook University (ECU)[1], Department of Anatomy, Ernest Cook University (ECU)[1], Kampala , Uganda



A suspicious nodule in the prostate in right apex posterior corner, with fluid restriction on the Diffusion Weighted Imaging (DWI) sequences.

Objectives

The objective of this paper is to give an overview of imaging findings in conditions of the urogenital tract in males at a selected center in Kampala, Uganda. The paper highlights the indications for imaging, the technique used, the normal findings and the abnormal findings in these patients.

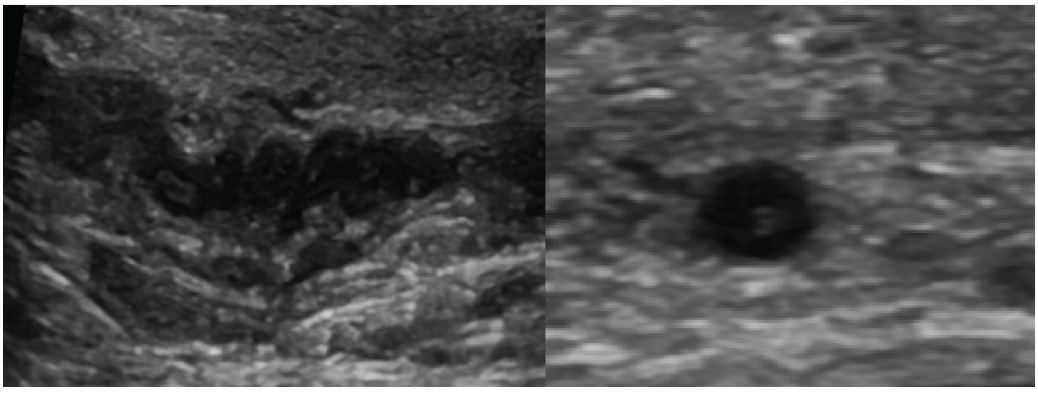
Inflammatory conditions

The commonly seen imaging impression of the male urogenital tract at ECU are epididymal-orchitis and chronic prostatitis. The primary imaging modality in imaging patients suspected to have prostatitis and orchitis is ultrasound. At ECU ultrasound machines from a variety of vendors are used; commonly using a 4-14 MHz Linear transducer.

Imaging in epididymal orchitis

Ultrasound is the imaging modality of choice for acute and chronic epididymal orchitis. Its sensitivity is about 78% or more and a specificity of 90% or more[2].

The commonest form of epididymal orchitis referred to ECU is the chronic type. Men with epididymal orchitis are commonly referred with scrotal pain or discomfort and scrotal swelling. Standard scrotal ultrasound examination is performed observing for tenderness, scrotal size, echogenicity and echotexture presence of calcifications, Doppler color flow, the tunica vaginalis/ albuginea, and presence of a hydrocele. Next, the epididymis is scanned noting the size and echogenicity of the epididymal head, body and tail. We search for the



Longitudinal and axial scans of the spermatic cord showing thick and tortuous vas deferens

appendix testis, and we do doppler ultrasound of the scrotal veins to look for varices.

The normal scrotal ultrasound may show a testis of 3-5 cm in diameter, with a volume of approximately 20cc and a texture which is homogeneous or slightly heterogeneous.

Imaging may not be necessary for patients suspected to have acute epididymal orchitis but may be done if the clinical picture is not certain or there are suspected complications.

Findings in acute epididymal orchitis include: testicular enlargement, patchy or uniform hypo-echogenicity, heterogenous echotexture, thickening of the tunica, increased blood flow in the testis at color Doppler, enlarged and rounded head of the epididymis, enlargement of the entire epididymis, increased blood flow in the epididymis, hydrocele or pyocelle. There may be thickening of the peri-testicular soft tissues and at times necrosis due to spermatic cord swelling and by the impairment of blood flow [3, 4].

In chronic epididymal orchitis, the testicular size may be enlarged, normal or small. The echo texture may be heterogeneous. There may be calcifications in the testicular parenchyma or in the tunica albuginea, the epididymis may be large or of normal size. There may be epididymal calcifications and a hydrocele.

Tuberculous epididymal orchitis is due to hematogenous and lymphatic spread. It is commoner in the tail of the epididymis possibly because it has a higher blood supply. It maybe unilateral or bilateral and may involve the epididymis and testis or just the epididymis. Involvement of the testis alone is rare. Initially the pathology is caseous necrosis and granulomas may heal by fibrosis or calcification. The patient may present with a painful or non-painful scrotal swelling. Diagnosis may be confirmed with fine needle aspiration of the suspected area and subjecting the specimen to ZN stain or culture 5,6,7,8. For the epididymis, the tail is usually the first part to be involved. The disease may spread to the rest of the epididymis or be limited to the tail. There may be diffuse involvement of the entire epididymis or there may scattered be nodular involvement. In most cases, the epididymis may be enlarged and diffusely and heterogeneously hypointense or enlarged and diffusely and homogeneously hypointense. It may be enlarged with foal nodular areas of hypo-echogenicity. Kim et all and Chung Et.al have suggested that an enlarged heterogeneously hypointense epididymis helps to differentiate TB from non-TB epididymal orchitis 8 ,9.

The testis is usually involved due to spread of the tuberculosis from the epididymis. At ultrasound, the entire testis may be enlarged and diffusely and heterogeneously hypointense or enlarged and diffusely and homogenously hypointense. It may be enlarged with nodular areas of hypoechogenicity. In some cases, the testicular involvement may be of miliary pattern with multiple small scattered hypointense areas. The tunica albuginea may be thickened or show areas of calcification.

Color doppler may show increased flow in the involved structures which may be the epididymis, testis or both.

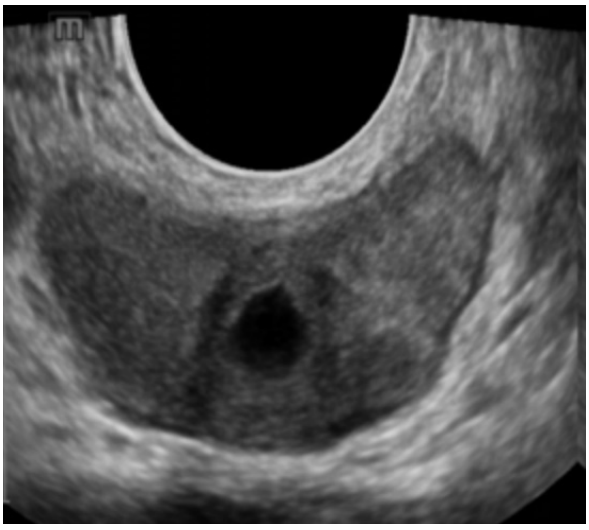
Epididymitis or epididymal orchitis may be accompanied by a hydrocele which may show septations. The peri-testicular areas may be thickened and may show areas of calcification.

Imaging in Chronic prostatitis

Chronic prostatitis often eludes diagnosis. This is because the clinical picture may be non-specific, laboratory analysis of urine or semen is usually negative and ultrasound findings have not adequately been explored. At ECU, referral for transrectal ultrasound of the prostate in patients with clinically suspected chronic prostatitis are relatively frequent especially following our work on transrectal ultrasound-guided intra-prostatic injection therapy for treatment of chronic prostatitis in which we not only detailed the technique and success of this method but also described the transrectal appearance of the prostate in patients referred to our center with symptoms pointing to chronic prostatitis10 .

In our series of 131 patients, the commonest findings in chronic prostatitis at transrectal ultrasound were heterogeneous echotexture of the prostate in all patients, ejaculatory duct thickening and dilatation (98%), prostatic urethral thickening (A77%), periurethral echogenicities (65%) and prostate calcifications (43%). A unique finding, which up to now had not been published is the thickened or and dilated ejaculatory duct, which we propose is characteristic for chronic prostatitis. We also noted that the left ejaculatory duct was most affected in comparison to the right.

Treatment of Chronic Prostatitis using



A coronal image showing a dilated ejaculatory duct in chronic prostatitis

Transrectal Ultrasound-guided Intra-prostatic Injection therapy

In our article we describe a novel and effective method of treatment of chronic prostatitis using trans-rectal ultrasound to guide intraprostatic injection of a cocktail of antimicrobial agents, steroid and local anesthesia 10 . Treatment of chronic prostatitis has been a challenge for decades. This is because most antimicrobial agents don't penetrate the prostate capsule enough to give therapeutic drug concentrations. Oral or parenteral administrative has been elusive for most patients. Building on the findings of Toth et al and Oishi et al, 11 ,12 we came up with a systematic method of treatment using a cocktail of antimicrobial agents, steroids and local anesthesia. Using the symptom index domains as a measure of wellness, for all the 131 patients in the study, the symptom index reduced following treatment. The 131 patients had started with either severe symptoms {score of 19-31} or moderate symptoms {score of 18-10}, but by one year following the treatment, the symptoms had fallen to the mild score {0-9}. The outcome score of 0-9 in all out 131 patients shows that this treatment is effective in almost all our patients who receive it.

Neoplastic conditions: Cancer of the prostate

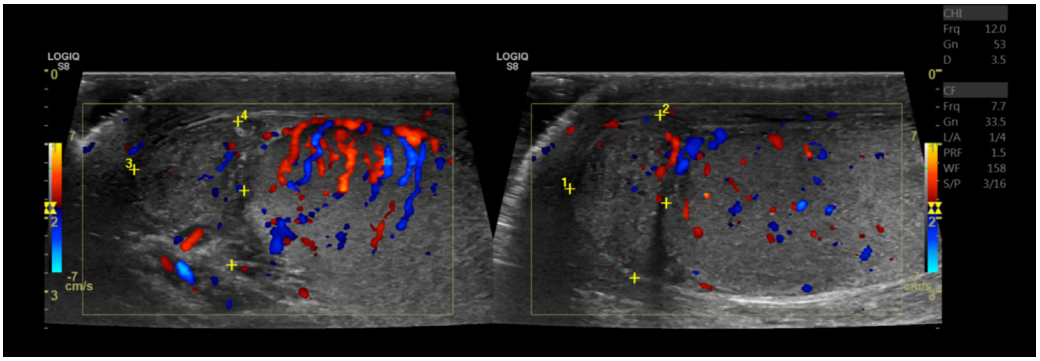
Cancer of the prostate is the commonest cancer among Ugandan men, and Uganda and Zambia have the highest incidence in Africa. Its incidence in Africa is 29.7 per 100,000 population and for Uganda, this incidence is increasing rapidly by 5.2 % per annum 13. ECU in partnership through a joint venture with Kampala Imaging Center acquired the first high field strength MRI in Uganda in 2014. Soon after the installation of the MRI, we started receiving referrals for prostate screening aimed at early detection of prostate cancer. We adopted the PIRADS screening protocol in 2017 and further transitioned to the PIRADS version 2.1 14 which further strengthened our ability for accurate detection of the cancer. This coupled with the fact that laboratory screening for prostate specific antigen (PSA) and prostate biopsy in the same facility, made ECU/Kampala Imaging Center a reliable facility for screening, diagnosis and biopsy for patients suspected to have prostate cancer. The Center has performed over 1000 prostate MRI since installation. Analysis of these results shows that the accuracy for detection of prostate cancer even in early stages, is almost comparable to that in other parts of the world with area under the ROC curve (AUC) of 0.71 to 0.73 1. Our findings show that the mean age of presentation of our patients is 65 years. The average PSA at presentation is 13ng/dl. Up to 48% of all the patients presenting for MRI screening turn out to have cancer prostate. The proportions of cancer in PIRADS, 3, 4, and 5 is 31%, 50% and 71 %, respectively. More than 50% of cancers are detected in the peripheral zone. Unpublished data from our center shows that most patients with histologically confirmed prostate cancer have a Gleason score of 6 { 55%}. Furthermore, the unpublished data suggests a high prevalence of changes due to chronic prostatitis in our patients. The low Gleason score in most patients coupled with a high prevalence of changes due to chronic prostatitis may be impacting the accuracy of our PIRADS scores in screening for cancer prostate. It is also postulated, though not confirmed that prostatitis may have an association with the high incidence of prostate cancer in the out-patient population 15 .

Spermatic cord and Male infertility

Up to 60 patients per year with symptoms related to infertility and some with laboratory evidence of low sperm count are referred to the department of radiology at ECU/Mengo Hospital for sonographic assessment of the urogenital tract. These undergo scrotal ultrasound, ultrasound of the spermatic cord and transrectal ultrasound of the prostate. The spermatic cord is scanned to look at the vas deferens (VD) using a "Hockey-stick" transducer of 8 to 18MHz. The proximal (juxta-testicular or supra-scrotal), mid and distal segments of the VD are examined for wall thickness, luminal diameter, echogenicity of the wall and mucosa and calcifications. At ECU, we consider the normal outer outer-to-outer diameter of the VD to be1.5-2.7 mm with a mean diameter of 1.9 mm. The luminal normal diameter is considered to be 0.2-0.7 mm with a mean of 0.4 mm.[16][17]. The wall should be uniformly and markedly and uniformly hypoechoic or anechoic to the surrounding structures and should have no calcifications or echogenic foci. The normal mucosa of the VD lumen is thin and moderately hyperechoic compared to the muscular wall and should not show any areas of calcification or echogenic foci. Soon to be published data shows that the commonest abnormality in patients with clinical and laboratory suspicion of vas deferens obstruction is luminal narrowing with about 12.88% cases on the right 82.59% on the left and about 4.56% having obstruction in both.

Penile ultrasound cavernosometry in erectile dysfunction

Up to 50 patients per year with symptoms of erectile dysfunction are referred to the department of radiology at ECU/Mengo Hospital for penile doppler ultrasound cavernosometry (PUC). These undergo Penile ultrasound



A cavernosometry waveforms indicating arterial insufficiency and venous leak respectively

cavernosometry which involves doppler assessment of the carvenosal arteries following intrapenile injection of alprostadil (Caverject) which is PGE1. The penis is scanned using a high frequency transducer 5-12 MhZ. The scanning is done with the penis in the ventral position noting the echotexture and echogenicity of the corpora carvenosa and any plaques, foci of echogenicity or calcification. The arteries and veins in the corpora carvenosa as examined noting their anatomical pattern, the diameters of the arteries, arterial wall thickness and echogenicity, presence of calcification of the corpora carvenosal arteries and the color and spectral wave pattern. At ECU we consider peak systolic velocities (PSV) of > 30 cm/sec as normal, 25-30 cm/sec as non-specific and below 25 cm/sec as arterial insufficiency. A difference of > 10 cm/sec between the left and right carvenosal artery PSV is also considered as arterial insufficiency. We consider end systolic velocity (EDV) of, 5 cm/sec as normal. EDV of > 5cm/sec as venous insufficiency (if the patient has normal arterial function). The resistive index >0.9 is considered normal and < 0.8 as venous dysfunction18, 19,20.

Soon to be published data shows that the commonest abnormality in patients with erectile dysfunction show that arterial insufficiency, followed by mixed pattern are the commonest cause of ED with venous insufficiency being the least contributor.

CONCLUSION

Imaging is a crucial diagnostic tool in male patients presenting with conditions of the urogenital tract. Ultrasound is used to image the major anatomical structures in the urogenital which include the scrotum, spermatic cord, prostate and the penis. MRI is useful in investigating the prostate in screening and diagnosis of prostate cancer.

References

1. M. Kawooya, S. Watya, S. Kaggwa, S. Kamya, and R. Malumba, "Value of PIRAD 2 Scoring System in screening for Cancer Prostate in a Sub-Saharan African Population," 2019.
2. T. Zitek, O. Ahmed, C. Lim, R. Carodine, and K. Martin, "Assessing the utility of ultrasound and urinalysis for patients with possible epididymo-orchitis – a retrospective study," Open Access Emergency Medicine, vol. 12, 2020, doi: 10.2147/OAEM.S234413.
3. A. Pilatz et al., "Acute epididymitis in ultrasound: Results of a prospective study withbaseline and follow-up investigations in 134 patients," Eur J Radiol, vol. 82, no. 12, 2013, doi: 10.1016/j.ejrad.2013.08.050.
4. M. Suciu, O. Serban, G. Iacob, C. Lucan, and R. Badea, "Severe Acute Epididymo-Orchitis Complicated with Abscess and Testicular Necrosis-Case Report," Ultrasound Int Open, vol. 3, no. 1, 2017, doi: 10.1055/s-0042-122149.
5. M. Muttarak, W. C. G. Peh, B. Lojanapiwat, and B. Chaiwun, "Tuberculous epididymitis and epididymo-orchitis: Sonographic appearances," American Journal of Roentgenology, vol. 176, no. 6, 2001, doi: 10.2214/ajr.176.6.1761459.
6. D. Andrew, J. Johny, and K. Shyam, "Ultrasound findings in a patient with tuberculous epididymo-orchits," 2020. doi: 10.1136/bcr-2020-237832.
7. Kollu R, Kala P, Ramprakash HV, and D. A. Varunya M, "Tubercular Epididymitis and Epididymo-Orchitis: Ultrasound appearances.," 2018.
8. J. J. Chung, M. J. Kim, T. Lee, H. S. Yoo, and J. T. Lee, "Sonographic findings in tuberculous epididymitis and epididymo-orchitis," Journal of Clinical Ultrasound, vol. 25, no. 7, 1997, doi: 10.1002/(SICI)1097-0096(199709)25:7<390::AID-JCU7>3.0.CO;2-5.
9. S. H. Kim, H. M. Pollack, K. S. Cho, M. S. Pollack, and M. C. Han, "Tuberculous epididymitis and epididymo-orchitis: Sonographic findings," Journal of Urology, vol. 150, no. 1, 1993, doi: 10.1016/S0022-5347(17)35404-6.
10. Michael G. Kawooya, Richard Malumba, Mary Kaakyo, Kasule Steven, Frank Ssebaggala, and Henry Dabanja, "Transrectal ultrasound-guided intraprostatic injection therapy for treatment of chronic prostatitis in a Ugandan population," 2024.
11. A. Toth, F. M. Guercini, D. M. Feldthouse, and J. C. Zhang, "Injection therapy for chronic prostatitis: A retrospective analysis of 77 cases," 2018. doi: 10.4081/aiua.2018.1.34.
12. M. Oishi et al., "PD62-02 INTRA-PROSTATIC INJECTION THERAPY FOR CHRONIC PROSTATITIS: A PILOT STUDY.," Journal of Urology, vol. 199, no. 4S, 2018, doi: 10.1016/j.juro.2018.02.2838.
13. F. Okuku, J. Orem, G. Holoya, C. De Boer, C. L. Thompson, and M. M. Cooney, "Prostate Cancer Burden at the Uganda Cancer Institute," J Glob Oncol, vol. 2, no. 4, 2016, doi: 10.1200/jgo.2015.001040.
14. B. Turkbey et al., "Prostate Imaging Reporting and Data System Version 2.1: 2019 Update of Prostate Imaging Reporting and Data System Version 2," 2019. doi: 10.1016/j.eururo.2019.02.033.
15. K. N. A. Nagel et al., "Differentiation of prostatitis and prostate cancer by using diffusion-weighted MR imaging and MR-guided biopsy at 3 T," Radiology, vol. 267, no. 1, 2013, doi: 10.1148/radiol.12111683.
16. W. D. Middleton, N. Dahiya, C. K. Naughton, S. A. Teefey, and C. A. Siegel, "High-resolution sonography of the normal extrapelvic vas deferens," Journal of Ultrasound in Medicine, vol. 28, no. 7, 2009, doi: 10.7863/jum.2009.28.7.839.
17. T. Puttemans, A. Delvigne, and D. Murillo, "Normal and variant appearances of the adult epididymis and vas deferens on high-resolution sonography," Journal of Clinical Ultrasound, vol. 34, no. 8, 2006, doi: 10.1002/jcu.20257.
18. C. G. Varela, L. A. Mateos Yeguas, I. C. Rodríguez, and M. D. Durán Vila, "Penile Doppler ultrasound for erectile dysfunction: Technique and interpretation," 2020. doi: 10.2214/AJR.19.22141.
19. D. Golijanin, E. Singer, R. Davis, S. Bhatt, A. Seftel, and V. Dogra, "Doppler evaluation of erectile dysfunction - Part 2," 2007. doi: 10.1038/sj.ijir.3901478.
20. J. Anderson, "Radiology Illustrated: Uroradiology," Australas Radiol, vol. 49, no. 4, 2005, doi: 10.1111/j.1440-1673.2005.01485.x.