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Forensic Urology: A Sexual Medicine Approach

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Abstract

Introduction: Forensic urology is the sub-specialty of urology that focuses on dialectic applications of urology, especially in cases of rape and sexual offense, personal injury to the genitals, and paternity assessments.

Aim: To provide a comprehensive, up-to-date, review of contemporary and forthcoming forensic techniques used in the field of urology. The review will also provide guidance and workup methodology to produce expert medical evidence and testimony crucial to the development of case law.

Method: A review of the available literature from 1988 to 2018 was performed using Pub Med to identify case reports, clinical trials, epidemiologic studies, case studies, and reviews. Of the listed 227 articles, 54 were selected based on merit, quality, and relevance of material presented.

Main Outcome Measures: Publications that contributed to the body of knowledge involved in forensic urology with a sexual medicine inclination in order to develop algorithms for producing quantitative and reproducible assessments were reviewed. These included publications with potential to be used as testimony in cases such as rape and sexual offense, inheritance and paternity, workman's compensation, early military discharge, malingering, criminality, pedophilia and child abuse, homicide, and suicide.

Results: Understanding urologic applications in providing expert testimony can assist in the continued development of systematic guidelines and strategies for the presentation and use of medical data in case law proceedings, as well as streamline coordination between legal proceedings and jurisprudence.

Conclusions: Urologists with forensic competency and an understanding of the common forensic algorithms and technologies available, as well as their associated limitations, can better prepare medical testimony through evidence-based methods with minimal reliance upon summaries, abstracts, or opinions of previous experts.

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Introduction

There are several ways that the field of urology can assist in the acquisition of critical data with regard to the legal system. These range from sensitive physical exams to ultrasensitive laboratory testing (e.g. the ability to differentiate the contents of local drinking water based on urine samples [1]. Given the importance of a correct judgment in many legal cases, it is critical to have a broad working knowledge of all tools applicable to a given circumstance, as well as an awareness of the common limitations and pitfalls of each type of test. Fertility testing, semen analyses and paternity testing have applications in criminal cases, particularly in cases of rape and sexual assault. Urine isotope analysis to determine location of death has implications for testimony in homicide and suicide cases, whereas algorithms for excluding malingering while assessing for Erectile Dysfunction (ED) and Lower Urinary Tract Symptoms (LUTS) have pertinence in workman's compensation cases.

Background

Forensics and urology have been linked for far longer than most would expect, as the inspiration for Arthur Conan Doyle's most famous literary detective, Sherlock Holmes, was based on Joseph Bell (1837-1911), a Scottish surgeon who taught urology at the University of Edinburgh [2]. Dr. John Kingsley Lattimer (1914-2007), the urologist who helped establish pediatric urology and served as a US Army doctor during World War II, only strengthened this interconnection by assisting the testimonies during the Nuremberg trials [3]. Yet, as the patterns of warfare and civilian urogenital

injuries have changed throughout the centuries, so too have the technological advancements and availability of updated data [4]. This has opened new doors for urologists to utilize available technology, resources, and their unique expertise to offer expert testimony in cases of particular circumstance [5]. Resources available include male sexual dysfunction and lower urinary tract dysfunction assessments for workman's compensation cases, post-mortem assessment assays for suicide and homicide cases, as well as paternity and fertility tests in rape cases [6].

In this systematic review, sexual medicine technology and available algorithmic assessments available for the production of evidence in legal jurisprudence proceedings are discussed. The role of the expert urologist in a court of law is explored through the development of medical testimony through evidence-based methods [5].

Criminal Cases

The majority of cases that necessitate an expert urologist's testimony can be classified into criminal cases and workman's compensation cases. Criminal cases include: rape, sexual assault, homicide and suicide, and child abuse. The assessment algorithm and evaluation technology associated with these cases are discussed.

Rape and sexual assault

Cases of rape and sexual assault are a key area where a forensic urologist's expert opinion and testimony are in great demand. The National Intimate Partner and Sexual Violence Survey estimate that 19.3% of U.S. women and 1.7% of U.S. men have been raped during their lifetimes [7]. Such cases require careful deliberation and assessment, as well as a step-by-step methodology to determine which tools should be preferentially applied in each case.

The assessment and examination guidelines set by the World Health Organization (WHO) for individuals who have suffered from sexual violence involves obtaining informed consent for a medical history, physical examination with detailed genito-anal examination, recording, and classification of injuries, as well as the collection of indicated medical and forensic specimens for diagnostic purposes [8] (Figure 1). While a physical examination is of critical importance in these cases, the techniques for a proper physical exam are well documented and will not be the focus of this review. This preliminary assessment, however, provides the framework for the application of a combination of assessments, including paternity tests, male fertility assessments, basic sperm analysis, DNA fingerprinting, and specialized tests, to identify the perpetrator with significant accuracy [9-13].

In a rape case where there was no deposit of semen; Fluorescent *In Situ* Hybridizations (FISH) may be applied to detect Y-chromosomes found in male epithelial cells. Several studies have demonstrated the presence of epithelial cells of male origin in the post coital vaginal tract, identifying the cells up to 7 days after the assault, despite a lack of ejaculation [14,15]. However, it is critical to note that while FISH can detect male epithelial cells inside the female vagina and vaginal epithelial cells on the penis, thus suggesting intercourse occurred; it cannot identify the identity of the assailant and does not provide evidence as to whether consent was given at the time of intercourse. Lab contamination is also another possible downside of this assay. Altogether, this should be a test of last resort to assess if penetration had occurred, not to determine the identity of an alleged rapist or whether consent had been given or not.

Fertility testing and semen analysis

An important source of evidence in rape cases, especially those resulting in pregnancies, is the assessment of male fertility through physical examination, hormone levels, and semen analysis to properly evaluate potentially false testimonies by the defendant [16]. The chemiluminescence and colorimetry assays currently used for semen analysis obtain data *via* detection of reactive oxygen species and total antioxidant capacity, respectively. The future of male fertility diagnostics, however, involves a combination of current genomics, proteomics, transcriptomics and metabolomics that will increase the accuracy and precision for evidence abstraction [16]. Novel genetic biomarker analysis methods are currently being developed that would allow the diagnosis of infertility at earlier stages due to the high specificity and sensitivity of the tests, surpassing the existing accuracy of karyotyping and Y-chromosome microdeletion analysis studies [17]. Currently, the semen analysis is a powerful tool that provides quantitative evidence that could either convict or liberate an accused perpetrator of a rape that resulted in a pregnancy. While these tests may apply to azoospermic males in cases of rape that resulted in pregnancy, there are significant limitations due to semen analysis manipulation such as ejaculation beforehand or through the use of pharmaceuticals with fertility-altering effects. Collection bias and use of spermicides are another limitation of this test, all of which suggest that these test results should not be utilized as primary evidence except under specific circumstances such as to acquit a man who is found to azoospermic from an organic cause.

Paternity testing

Another test that can be used in cases of rape or sexual assault that result in pregnancy is paternity testing, allowing forensic urologists to offer insights similar to geneticists. Robust paternity testing can be applied to legal cases of inheritance as well [18].

The quality of genetic testing has risen dramatically in the past few decades, with the days of ABO blood typing, at 40% accuracy, long having been replaced by Short Tandem Repeat (STR) analysis which is far more powerful, at over 99% confidence *via* buccal cell sampling [19]. This analysis, colloquially known as "DNA fingerprinting," uses an array of common DNA repeats and compares them to the expected frequency in the population using Hardy-Weinberg principles to determine the likelihood of a man being genetically linked to a child. Each nation has their own standard for the STRs which are used, which affects the probability of the test; Germany currently boasts 99.999% accuracy [20].

However, the incredible sensitivity of Polymerase Chain Reaction (PCR) comes at the dreaded cost of easy cross contamination. One disastrous example was when an armed robbery was linked to a Georgia rape that occurred 30 years prior, due to the STR semen assays being contaminated by the same lab employee for quality control. Such cases serve as a stark reminder of the important role of the forensic urologist in court proceedings, as the power medical evidence holds in a court of law can be the difference between an innocent man being sentenced to life imprisonment or being exonerated.

In addition to PCR of semen samples, the gold standard of paternity testing, Laser Capture Microdissection (LCM) is a technology which involves cell separation techniques to distinguish fetal chorionic tissue from maternal decidua in abort us material [21,22]. This technology was first demonstrated to confirm paternity results after two men sexually assaulted an adolescent woman [23].

Previously, genetic linkage would be determined *via* cord blood; now advances in technology allow women to elect for termination at an earlier stage in pregnancy with the assurance that there will be sufficient evidence to determine or exclude paternity of a potential assailant [23].

Noninvasive techniques are also available that can determine paternity from a maternal blood sample as early as 6 weeks gestational age [24]. This process involves collecting cell-free DNA from the fetus that circulates in the mother and comparing an array of single nucleotide polymorphisms to a DNA sample of the father [24]. These tests are purportedly 99.95% accurate and can be performed earlier than both chorionic villous sampling (10-12 weeks gestational age) and amniocentesis (15-18 weeks gestational age) and carry no risk for fetal harm [24]. While this technology could eventually be applied to more complex cases, such as those involving twin pregnancies, one current drawback is that the test is unable to process data from multiple gestation pregnancies [24,25]. Additional downsides of this test involve complications resulting from variability in concentrations of cell-free DNA in maternal blood that vary between individuals, which may be too low to provide accurate results [26]. Furthermore, the variable regions of repeated DNA sequence must be known beforehand in order to correlate it to the cell-free fetal DNA collected. After the child is born, cell-free fetal DNA is rapidly eliminated from maternal circulation and is undetectable after two hours [26]. These critical limitations must all be considered when evaluating the quality of the evidence of the pertinent case, for it is through the understanding of the limitations of the tests that the soundest conclusions can be drawn. For instance, if a woman becomes pregnant with twins after being raped and the cell-free DNA test is negative for the father's DNA, additional tests may need to be performed due to the limitation of cell-free DNA testing in multiple gestation pregnancies.

Post-mortem sperm retrieval

An additional consideration in cases of paternity and inheritance, due to available technology, is post-mortem sperm retrieval. Techniques used to acquire viable sperm include testicular fine needle aspiration, percutaneous epididymal sperm aspiration, testicular sperm extraction, micro-epididymal sperm aspiration, and micro dissection testicular sperm extraction [27]. These practices pose novel medical, forensic, legal, and ethical implications with the advent of post-mortem sperm retrieval. Post-mortem sperm retrieval has been demonstrated to be effective when performed within 36 hours, with needle aspiration as the preferred method [28,29]. Normal pregnancies with developmental outcomes have been demonstrated with the harvested gametes [30].

While the methods of sperm retrieval and storage after death have been refined, there is much debate regarding the ethical implications of posthumously harvested sperm. This ethical dilemma, in turn, has sparked much attention from the court and legal system, with many countries, such as: Canada, Denmark, Egypt, France, Germany, Korea, Norway, Spain, Sweden and the Netherlands choosing to ban the practice altogether [31]. On the other hand, the United States of America, Israel, and Australia have chosen to leave this decision in the hands of the court system, thereby placing additional responsibility on healthcare professionals, and urologists in particular, to provide expert opinion in legal proceedings [31].

A set of guidelines have been proposed, including what is described in the literature as the "Pragmatic position," in which consent is presumed based on the surviving partner's wishes unless the deceased specifically opted out in a will during life [32]. Due to the occurrence of young or unexpected deaths, the proponents of the Pragmatic Position propose that it would be impractical to retrieve based only on prior consent; however, opponents claim that this position is an oversimplification that neglects more complex issues such as inheritance of potential offspring [33].

Homicide and suicide

Another considerable sub-category of criminal cases are cases of homicide and suicide. The geolocation and post-mortem interval assessment technologies are discussed below.

Post-mortem geographic origin assessment: Regarding cases of suicide and homicide, promising technologies would allow forensic urologists to be particularly useful in identifying the geographic origin of an unidentified cadaver [1]. Studies of stable Isotope Ratios (StIR) of oxygen, carbon, hydrogen, and nitrogen in urine samples collected from Japan, China, Australia, Finland, and the United States have shown that local drinking water alters the relative StIR composition of urine samples [1]. Of all the urine isotopes, oxygen and hydrogen StIR showed the greatest difference between location origin and thus were found to be more feasible than carbon and nitrogen StIR in estimation of geographic location of origin [1]. While this is not a primary area of expertise for an urologist, this possibility of being questioned about urine studies during court proceedings makes this information valuable to the practicing urologist. However, an important limitation to note is that urine oxygen and hydrogen StIR values between the regions became similar after a period of 8 days of drinking imported bottled water. Another limitation is that the exact amount of time during which it is possible to estimate a cadaver's origin is currently unclear. Although the technology is promising, it is not yet ready for use in forensics and thus, should not be considered priority evidence in court proceedings at this time [1].

Post-mortem interval assessment: Post-Mortem Interval (PMI) assessment is another important technique applicable to cases of homicide and suicide. In murine models, investigators discovered that evaluation of post-mortem Malon Di-Aldehyde (MDA) levels, a marker for oxidative stress, in renal and brain tissues shows significant utilization for estimation of PMI [34]. Measurements of MDA levels at hour intervals from 0-48 hours showed significant rates of change for both renal and brain tissues, while Superoxide Dismutase (SOD) and glutathione peroxidase (GSH-Px) did not show significant utility in predicting PMI [34]. An additional murine study showed a rise in renal glucose levels post-mortem, potentially due to proximity to the liver and free glucose diffusion down its concentration gradient as membranes lose integrity [35]. However, there is insufficient evidence to support the use of renal glucose levels to estimate PMI, especially due to lack of data on variability secondary to disease states such as diabetes mellitus [35]. This same study noted that among all tissues assessed, hepatic glucose levels provided the most robust slope of glucose change per unit time [35]. While this technology shows promising results in mice, there are no human evaluations to date. Currently, this technology represents a potential tool for the future. The existing body of literature regarding PMI, however, is not adequate to justify its use in legal proceedings currently. As such, the technology requires human trials before results can be accurately used as legal testimony in court proceedings.

Child abuse

A third type of criminal case involves child abuse, and as

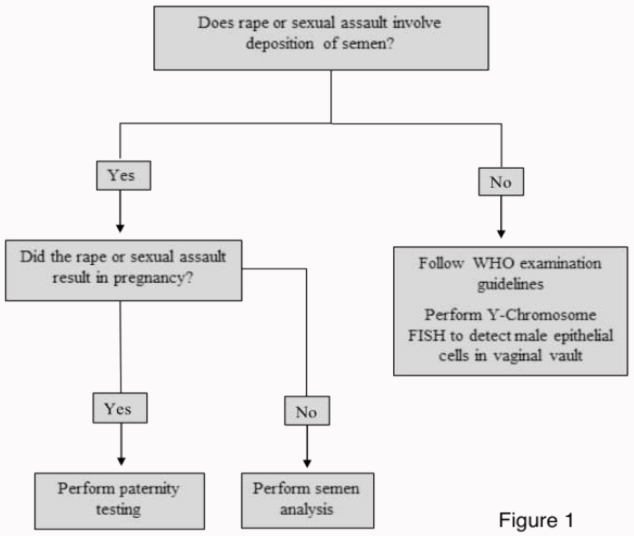

Figure 1: Workup and consideration for assessment of rape or sexual assault case victims [48].

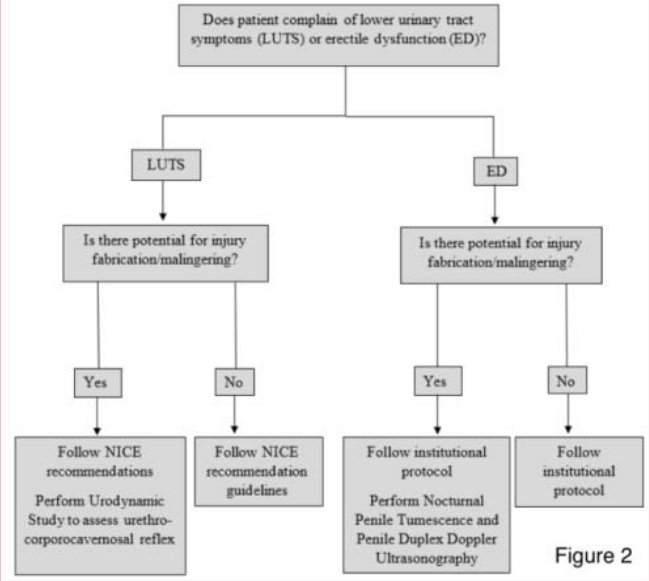

Figure 2: Workup and consideration for LUTS and ED with screening for fabricated injuries in cases of worker's compensation, military remuneration, and early military discharge [49].

mandatory reporters, urologists must maintain a high index of suspicion for sexual child abuse in cases of penile trauma, strangulation and tourniquet [8]. For example, a case of an 8-year-old boy with Penile Tourniquet Syndrome (PTS) due to his mother's hair coil solicits consideration for potential forensic evaluation of child abuse, as accidental causes are called into question [36]. Such evaluations are of paramount importance due to the serious consequences of missed diagnosis and volume of such cases in the United States. High level considerations that examiners should be aware of include signs that mimic abuse such as anal fissure scars, Mongolian spots, lichen sclerosis, congenital hymenal opening enlargement, and vaginal foreign bodies to name a few. However, this does not preclude a thorough history and physical examination of the child alone while drawing on the existing literature of key signs of urogenital child abuse that are highly suspect, including large scalding burn injuries and sharply demarcated borders. By maintaining an awareness of the common signs that mimic abuse, the evaluator will be more adept at elucidating valid evidence of child abuse.

Court-assigned chemical castration: In cases of child physical or sexual abuse, in which pedophilia is involved, the court system may choose to apply a sentence of chemical castration to a defendant found guilty of such crimes. In such cases, it is important for the forensic urologist to be well-versed in the methods of chemical castration set forth by the discretion of legal jurisprudence. In states where such practices are legal, leuprolide acetate, which results in a significant reduction in sexual desire and thoughts, is the pharmaceutical of choice for medical castration [37,38]. However, the pitfall that must be considered with this technique is the theoretical, initial surge of testosterone associated with leuprolide acetate administration before the man is chemically castrated, which could theoretically promote hormonally-driven illegal activity during this period. As such, careful administration with effective monitoring is of paramount importance and need to be assessed on a case-by-case basis.

Workman's Compensation

The second major category of legal cases necessitating an urologist's expert opinion involves workman's compensation or early military discharge due to the need for exclusion of injury fabrication or malingering. In a study of 130 cases claiming urologic and non-urologic injuries, 50 (38.46%) were found to be fabricated injuries after evaluation via clinical urologic assessments [39]. The workup of such patients involves deliberate and unconscious function testing, including detailed assessment of Erectile Dysfunction (ED) and Lower Urinary Tract Symptoms (LUTS), which would produce quantitative data that malingering patients would be unable to alter to their benefit (Figure 2).

Erectile dysfunction assessments

When assessing for urologic trauma and injury in cases of worker's compensation or early military discharge, while also screening for malingering, it is vital for the forensic urologist to test ED in a way that prevents purposeful manipulation of the results by the patient. Such tests could also be applied to criminal cases.

The most commonly used diagnostic test for ED in legal cases is Nocturnal Penile Tumescence (NPT) and Penile Duplex Doppler Ultrasonography (PDDU) [40]. NPT studies can be measured via the Stamp Test, Snap Gauges, Strain Gauges, and Rigiscan (Nocturnal Penile Tumescence and Rigidity, NPTR) tests [40]. Normal NPTR depends on both corticospinal efferent nerve integrity to the penis, and penile tissue vascular responsiveness to these neural signals. As such, nocturnal erections of appropriate duration and strength provide substantiating evidence of intact penile hemodynamic intra-corporal regulators as well as central and peripheral neuroregulators, without significant potential for malingering to skew the results [40,41].

While NPTR differentiates organic from psychogenic ED, it cannot assess the underlying etiology and has limitations, including susceptibility to psychological factors (e.g. erotic excitement inhibition), which are possible bias factors that cannot be corrected by clinical manipulation [42,43]. On the other hand, PDDU can quantitatively assess vascular impotence severity and is a relatively inexpensive and minimally invasive tool. By measuring peak systolic velocity (cm/s) and end diastolic velocity after intracorporal injection of a vasoactive agent, quantitative measures can be collected for

Table 1: Techniques and available assays for assessment in each type of legal case.

Case Type	Applicable Assessment	Goal of Expert Testimony	Special Considerations
Adult Rape/Sexual Assault, Pedophilia, Child Sexual Abuse	Genito-anal exam Y-Chromosome Epithelial Cell Fluorescent In Situ Hybridization (FISH) Semen analysis &male Fertility testing Paternity testing	Evidence to support or disprove innocence of defendant with semen analysis or paternity, if rape results in pregnancy, or Y-chromosome epithelial FISH if no semen is present	Leuprolide acetate is used in legal decisions for chemical castration Post-mortem sperm retrieval techniques include fine needle aspiration, percutaneous epididymal sperm aspiration, and microdissection testicular sperm extraction
Alimony	Paternity testing Male fertility testing	Evidence that supports or disproves paternity via current techniques with maximum accuracy	Current paternity tests include short tandem repeat (STR) analysis, laser capture microdissection (LCM), and cell-free DNA assay
Property Inheritance	Paternity testing Male fertility testing	Evidence that supports or disproves paternity via current techniques with maximum accuracy	Current paternity tests include short tandem repeat (STR) analysis, laser capture microdissection (LCM), and cell-free DNA assay
Worker's Compensation, Military Compensation/Benefits, Early Military Discharge	Nocturnal penile tumescence (NPT) Penile duplex Doppler ultrasonography (PDDU) Urodynamic study (UDS)	Evidence to support or disprove validity of injuries with screening for fabricated injuries	Screen for fabricated injuries and malingering via subconscious tests, such as UDS for LUTS complaints and NPT and PDDU for erectile dysfunction complaints
Criminal Charges, Assault & Battery, Child Abuse, Domestic Violence, Self-Mutilation	Nocturnal penile tumescence (NPT) Penile duplex Doppler ultrasonography (PDDU) Urodynamic study (UDS)	Evidence to support or disprove validity of injuries with screening for fabricated injuries	In cases of suspected self-mutilation, a psychiatric assessment must be attempted Suspected child abuse and domestic violence cases must be assessed and reported if indicated
Homicide, Suicide	Stable isotope ratio analysis Post-mortem interval (PMI) assessment	Evidence for time of death and location of death	Renal and brain malondialdehyde levels show significant utilization for estimating PMI

substantiating evidence, or lack thereof, of arterial insufficiency and venous incompetence, respectively [43].

Neurogenic ED can be surmised indirectly by measuring both somatosensory afferent dorsal and pudendal nerves, as well as autonomic pelvic and cavernous efferent nerves, *via* Somatosensory-Evoked Potentials (SSEP) and Bulbocavernosus Reflex (BCR) latency [44]. In addition, Penile Electromyography (P-EMG) has assessed penile autonomic nerves and lesions that influence cavernous smooth muscle [44].

Such precise evaluation and production of substantiating evidence offers critical legal indications in favor or against judicial decisions in a variety of cases, including but not limited to criminal, worker's compensation, early military discharge, domestic violence, sexual assault, and malpractice charges. At the same time, each of these tests are limited due to the subjective nature of penile measurements which may produce false positive results, as well as their limited use in self-inflicted injuries and self-mutilation, all dangerous downsides that must be acknowledged.

Lower urinary tract system assessments

Lower urinary tract assessment is also critical in cases of worker's compensation, early military discharge, and criminal cases. The 2010 National Institute for Health and Care Excellence (NICE) Clinical Guideline describes the evaluation and management of LUTS in men. The NICE currently recommends performing an initial assessment and physical examination, including digital rectal examination, as well as completion of urinary frequency and volume charts [45].

While these are the standard guidelines, more quantitative assessments may be necessary to evaluate a case of potential malingering which may require the production of substantial legal proof under jurisprudence. Quantitative assessments of LUTS include the International Prostate Symptom Score (IPSS) or Core Lower Urinary Tract Symptom Score (CLSS); however, reliance upon patient response-dependent questionnaires should be avoided due to the possibility of deceit and malingering [46].

Urodynamic Studies (UDS), which incorporate P-EMG, is used to qualitatively assess lower urinary tract function and ability for normal micturition. In a clinical trial of 30 healthy men (mean age 42.8 + 11.7 years), the EMG of the corpora cavernosa, corpus spongiosum, bulbocavernosus, and ischiocavernosus muscles were recorded and the micturition mechanism under reflex and voluntary control was assessed [47]. UDS assessment of the 'urethro-corporocavernosal reflex' involving the sinusoidal muscle relaxation and cavernous muscle contraction upon micturition, producing a mild degree of penile tumescence and stretch to assist in urinary flow, is the key factor in assessing lower urinary tract function and working up a patient for malingering [47]. As such, UDS in patients with LUTS can be applied to worker's compensation, early military discharge, and criminal cases with confidence to screen out malingerers. The astute clinician will also recognize that the limitations of each of the tests is similar to those of ED assessment in that the downsides are due to patient cooperation and therefore, can be prone to result manipulation, such as if a patient voluntarily urinates on themselves to simulate urinary incontinence. The inherent subjective nature and variable results have the potential to generate false positive results which would have disastrous consequences for the outcomes of legal trials.

Discussion

The existence of the vast array of technologies that assist in workup and clinical interpretation must not overshadow the inherent risks and limitations that come with each test. In sexual assault cases, performing Y-chromosome analysis may determine if intercourse occurred, but cannot determine whether consent was given at the time of intercourse [7,8]. Testing for paternity and fertility is limited

by the poor applicability due to variability in fetal cell-free DNA concentrations in maternal blood and rapid elimination of cell-free DNA after birth. Understanding these crucial limitations will guide the clinician's decision of which tests are applicable on a case-by-case basis. One example of such a limitation can be applied to a rape victim who gives birth to a child. After 2 hours after delivery, the child's DNA falls below threshold levels, resulting in unreliable test results after that time period.

Criminal cases involving homicide or suicide will one day benefit from post-mortem Malon Di-Aldehyde (MDA) levels in PMI assessments and stable isotope ratios for post-mortem geographic origin assessment; however, these technologies currently lack enough data to support their use in court. In years to come, once there is enough data backing up their use, these technologies have the potential to become invaluable to the expert clinician. Child abuse cases may also necessitate an urologist's expert opinion, especially in cases of potential pedophilia and/or child sexual abuse; yet presentations that mimic abuse must also be considered in the working differential diagnosis. For these reasons, the skill of an expert urologist is tested through the physician's unique ability to examine patients in meaningful, professional, and systematic ways to obtain critical information that would support or refute legal testimony while simultaneous taking care of potential victims [36].

Workman's compensation cases, including military remuneration, benefit from urological screening with special attention for exclusion of malingering, with unconscious tests like NPTR and PDDU in cases of reported ED, and UDS in cases of LUTS [40-49]. However, the subjectivity of measurements, confounding variables, and potential for patient manipulation which may skew results must not be overlooked; otherwise the effect of false positives or negatives on legal judgments could have disastrous consequences for all parties involved.

The legal cases, as well as the assessment techniques and technologies discussed (Table 1), exemplify the urologist's ability to assist in the critical data acquisition and ascertain the legitimacy and quality of results to facilitate just and fair court judgments. Not only is much of this data obtained directly by urologists, but they are also uniquely positioned to understand the limitations of each study. By having an in-depth understanding of the limitations, and thus the true applicability, of these tests, an expert examiner will be able to better prepare sound evidence that will offer reliable conclusions in court proceedings. This is where being a clinician and an expert witness can run parallel.

Conclusion

Forensic urology is a field with incredible potential for growth and expansion due to the myriad of assessment tools and techniques at the disposal of the knowledgeable urologist. The limitations are, in fact, part of the arsenal of the expert physician examiner as they are in a unique position to navigate the plethora of imperfect technologies that continue to overcrowd the medical field. This allows the expert to produce sound and conclusive evidence which cannot be undermined by intentioned legal professionals, attorneys, or cross-examiners seeking to perform their own due justice. Forensic competence with individual probity, minimal conflict of interest, and freedom from prejudice and bias all contribute to the overall quality of a forensic urologist in pertinent case proceeds [5]. This, in turn, allows for greater interprofessional collaboration between expert physicians, attorneys and the judiciary system while also maintaining and perhaps even heightening the physician's credibility in a court of law [5].

By appreciating the various technologies and associated limitations of each, accessible through a sexual medicine approach, the forensic urologist can take part in legal jurisprudence with confidence. Realizing limitations means that the examiner thoroughly understands the applicability of the imperfect technology at our disposal on a case-by-case basis and it is this feature that separates the forensic urology expert examiner from the clinical urologist. In turn, forensic urology expert examiners would be more equipped to extend the cornerstone of ethical responsibility and assist, but not replace the justice system in making more informed decisions.

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