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ICS Teaching Module: Ambulatory Urodynamic Monitoring

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Aim: To present the ICS Teaching Module on ambulatory urodynamics monitoring (AUM). **Methods:** This teaching module has been developed by the ICS Urodynamics Committee to assist ICS members in their routine clinical practice. A detailed literature search on studies published on the clinical role of AUM as well as expert opinions have been considered. A slide set on AUM has been developed, approved by all members of the ICS Urodynamics Committee and is available to the ICS membership on the ICS website. The final approved teaching module has been presented at the ICS Annual Scientific Meeting in Brazil 2014. **Results:** The scientific evidence on the clinical role of AUM in patients with lower urinary tract symptoms is summarized. The catheters and recording systems used, the patient preparation for the test, the technique, the instructions to the patient, the analysis, interpretation, and quality control assessment of AUM trace as well as the contraindications for AUM are described. **Conclusions:** The clinical role of AUM is still controversial. The scientific evidence on the usefulness of AUM is still limited but the ICS Urodynamics Committee recommends its use as a second line diagnostic tool when office laboratory urodynamics have failed to achieve a diagnosis. AUM has been showed to be more sensitive than laboratory urodynamics in diagnosing detrusor overactivity but the level of evidence for this measurement is not high. This manuscript summarizes the evidence and provides practice recommendations on AUM for teaching purposes in the framework of an ICS teaching module. *Neurourol. Urodynam. 36:364–367, 2017.*

Key words: ambulatory urodynamics; ICS teaching module; inconclusive urodynamics; lower urinary tract symptoms

INTRODUCTION

Ambulatory Urodynamic Monitoring (AUM) has been mentioned in International Continence Society (ICS) standards.[1–2] AUM may be considered a useful tool to investigate lower urinary tract dysfunction (LUTD) in patients with lower urinary tract symptoms (LUTS) and inconclusive results on laboratory urodynamic testing.[3,4] The clinical sensitivity and specificity of AUM are not very well established and the specific technical demands and the technical reliability are deliberated.[1–2,5] To date there is no clear consensus about the role of AUM in the assessment of LUTD.[6,7] Although the here above mentioned standards suggest some practical aspects, they do not cover all issues arising with clinical testing. The ICS Urodynamics Committee presents the teaching module "Ambulatory Urodynamic Monitoring" to serve as a standard education of Good Urodynamic Practice for everyone involved in indicating, performing, and analyzing urodynamic testing in general and more specifically, performing AUM. The teaching module consists of a PowerPoint presentation, in combination with this manuscript. This manuscript serves as a scientific background review; the evidence base for the ICS PowerPoint presentation, which is available via http://www.icsoffice.org/eLearning. The presentation explains testing requirements, clinical workup, and analysis. The presentation and this manuscript are based on the highest-level available published evidence, graded according to the modification of the Oxford Center for Evidence-Based Medicine levels of evidence as also used by the 5th International Consultation on Incontinence. Where evidence is unavailable, experts' opinion has been used and the sentence is marked as "eo" (experts' opinion). The aim of this ICS Teaching Module is to provide a summary of the published literature on the role of AUM in clinical research practice, including indications. Furthermore the technique and a practice protocol for AUM including troubleshooting and interpretation are presented.

Evidence and Philosophy of AUM

Conventional urodynamics is the standard clinical tool to investigate LUTD.[2,8] However, it has been reported that it can fail to precisely demonstrate the cause of (storage) LUTS in 19–44% of the cases.[2–4] This may be due to the shorter duration of the test, thus abnormalities are not detected before the end of recording. Lack of correlation between abnormalities detected and symptoms reported by patients may also play a role since it is well known that in LUTD, signs and symptoms are neither very specific nor sensitive towards the dysfunction.[9] When conventional urodynamics is inconclusive, AUM may be helpful in diagnosing the cause of the symptoms and guiding more appropriate management of patients. In particular, AUM has been observed to have an increased detection of detrusor overactivity.[10–16] However, the fact that AUM shows abnormalities, especially detrusor overactivity, in healthy volunteers may also be considered a sign of lesser specificity, apart from the fact that a person's perception of LUT function may be "false negative."[17–20] There is single center expert retrospective evidence that stress urinary incontinence became detectable during AUM with a leakage

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detector[15] (LE3). The sensitivity and or specificity of AUM towards voiding dysfunction or abnormalities is at present unknown.

AUM is performed in a similar way to conventional cystometry but differs in some specific elements: It uses natural (orthograde) filling of the bladder (the patients are usually asked to drink extra) and testing lasts for approximately 2–4 hr. Patients are fully dressed after the initiation of the test and are able to leave the urodynamic room, which may reduce embarrassment.[11,12] Disadvantages of AUM may be that the test and analysis are time-consuming and require specialized equipment with trained and dedicated personnel.

Catheters

The majority of the reported studies on AUM have used catheter-mounted microtip transducers since they allow greater patient mobility and have a lesser incidence of movement artifacts.[(eo)] Although it is possible to measure pressures during AUM with fluid-filled lines, with intravesical capsules or with air filled catheters, the evidence of their usefulness has still to be proven.[10]

Recording Systems

The oldest systems (Gaeltec Devices Ltd, Isle of Skye, Scotland) are mostly known for their catheters, made of flexible silicone-covered braided metal, with mounted electronic microtip transducers. The main disadvantage of this system is the large recorder box which has been awkward to carry around. The newer systems (i.e., Goby, Laborie Medical, Canada or Luna, Medical Measurement Systems, Mississauga, Canada) have a smaller remote control attachment that also allows data capturing of the important physiological events. These newer systems can also accommodate water filled, air filled, and electronic (microtip) options. (Comparative) evidence about the clinical or technical reliability of each system or combination is lacking.

Patient Preparation

The patient is asked to come to the department with an empty bowel if possible, with a comfortably full bladder and wearing comfortable (not too tight) clothes. If the rectum is loaded with feces at the start this may need to be sorted prior to commencement to prevent "fecal urgency" during the test. Active urinary tract infection must be excluded prior to commencing the test. There is no scientific evidence demonstrating that routine antibiotics before and or after the test are needed nor evidence supporting the use of routine bowel evacuation agents before AUM. Furthermore, laxatives can cause rectal activity and/or abdominal discomfort and therefore hinder the representativeness of the test.[eo]

To record episodes of urgency, incontinence, pain, start and end of voluntary voids, time and volume of fluid intake, feeling of catheter displacement as well any provocative manoeuvers (running, washing hands, coughing, sneezing etc) a remote control might be useful. Information leaflets explaining the test should be made available for patients prior to their appointment to explain what the test involves and how they can cooperate with the test. Preferably a uroflow and post void residual urine test are performed before AUM is started. If there are no signs of urinary tract infection the AUM test can be performed.

Technique

Before the test is started it is mandatory to ensure that the patient understands and is able to follow some important instructions (described more in detail in the following section) and will be able to record on a diary all the (LUT) signs and symptoms perceived during the AUM test. Since symptoms are compared against the pressures recorded, an accurate recording of symptoms and the times when they occur is essential for the final AUM diagnosis.[21–23]

Similar to conventional cystometry the catheters are inserted into the bladder and the rectal canal. Air-filled or microtip transducers catheters need to be zeroed prior to insertion at the atmospheric pressure by having the open end of three-way taps, attached to the catheters, at the level of the symphysis pubis. Via these three-way taps some gentle fluid flush can eliminate entrapped air and debris from the catheters and can also check them for leaks. Sufficient catheter length should be inserted into the bladder/rectum and the catheters must be securely taped adjacent to the anus and external urethral meatus to reduce the risk of catheters falling out as well as to reduce movement artifacts. The patient can then dress and the catheters can be connected to the AUM recording system.

Prior to commencing recording the patient is asked to cough to check the intravesical, abdominal, and subtracted detrusor pressures. If there is a prompt and steep increase of the vesical and abdominal pressures during cough and the subtracted detrusor pressure does not change then the test can be started. Otherwise any problem must be rectified.

The method of recording urine leakage has not yet been standardized. An electronic pad and/or the patient using a remote control and pressing an event marker button and/or completing a urinary symptom diary are possibilities. No evidence exists for any of the methods being more specific, predictive, or reliable.

Instructions to the Patient and AUM Test

As stated above, during AUM the bladder filling is accomplished with the patient's own urine production instead of filling the bladder through a catheter. The test may last from 2 to 4 hr. Patients should receive instructions prior to leaving the urodynamic room (See Table I) in an easy to understand manner. In order to maximize AUM diagnostic power, the use of a detailed patient diary is strongly recommended to improve the analysis of events occurring during AUM.[14,eo] However the availability of event markers on the newer AUM systems may replace the use of the diary allowing more freedom, ease, and flexibility for the patient.

Usually patients are instructed to drink extra during the test, to be able to record some storage to voiding cycles in a reasonable amount of time. Forced diuresis may unmask/provoke detrusor overactivity, however voiding an equivalent of 4 L/24 hr may be an unusual challenge for the LUT.[20]

The patient instruction includes advice to return to the urodynamic office in case of problems. If a catheter is displaced or evacuated, or the system is malfunctioning, the trace, the recorded pressures, subtractions, and quality of the trace the test duration may need to be reviewed. If a diagnosis has not be revealed, in case of malfunction and test prolongation the pressure transducers would need to be re-zeroed, re-inserted, and the test re-started.

Quality Control Assessment

There is risk of losing signal quality associated with AUM. Therefore, there are a number of additional precautions to consider while performing AUM compared to conventional cystometry. Obviously it is relevant to ensure that all the catheters are securely taped adjacent to the meatus and the

TABLE I. Outline of Patient Instructions for Ambulatory Urodynamic Test

How to you use the event buttons on the AUM device
Drink about 200–400 ml per hour or a fluid load up to 1 L drunk over 30 min.
If a fluid load is contraindicated the AUM time would take longer.[eo]
Register urgency, incontinence, pain, start and end of voluntary voids, time and volume of fluid intake.
Register activity and maneuvers that (usually tends to) provoke symptoms like example drinking, running, lifting weight, washing hands, coughing, sneezing etc.
Return to the urodynamic room every hour to allow to check the system is recording the pressures correctly.
Return to the urodynamic room whenever you need to void.
This may allow recording up to three pressure flow studies during the whole study.[eo]
Return to the urodynamic room when a catheter (or both) falls out, or is expelled during voiding (or defecation).

anus. The catheter's length should be fixed to the lower abdomen (stay inside the pants) and the rest of the length to the monitor box should be as short as possible and secured underneath the clothes to further avoid accidental displacement during the test.

To ensure good quality control it is important to check the signal quality by setting each transducer to zero prior to commencing to record the pressures and to ensure that the intravesical and abdominal pressures are similar by asking the patient to cough. Thus it can be checked that the subtracted detrusor pressure is within the normal range prior to commencing the test and this may be checked every hour to make sure that the pressures are correctly recorded and that the catheters are not displaced. The instructions should also preferably ask the patient to cough before and after each void when pressure flow studies are recorded (LE 2a).

Analysis and Interpretation of AUM Trace

The first step in the analysis of an AUM trace is the assessment of the quality of data (signal) recorded and to judge whether the trace appears "active" with clearly visible coughs and pressure variations due to the movement of the patient. A dead (flat) signal in one or both of the pressures indicates a problem and depending on the duration the test may not be evaluable. If both pressures have been recorded for a sufficient amount of time, the detrusor pressure should be evaluated. Evaluation of detrusor pressure is possible for the period that the movement and couch responses have been "balanced," without causing significant positive or negative deflections in this pressure; though inevitably rectal activity may play a role in (negative) deflections of detrusor "pressure" and these must be recognized.

Analysis and interpretation of the trace should be performed immediately following the test to allow discussion of the findings and management options with the patient, thus avoiding unnecessary repeat visits.[eo]

Contraindications for AUM

Poor patient mobility, cognitive impairment, or inabilities to follow instructions are relative contraindications for AUM. Severe constipation and active urinary tract infection may need to be treated before the test.

CONCLUSIONS

AUM may be performed when conventional urodynamic tests have failed to detect any underlying cause of LUTS and/or may be useful when conventional cystometry diagnosis does not explain the symptoms. AUM is a more time consuming test than conventional cystometry and requires expertise as well as specialized equipment. In order to make the most of its diagnostic capability a standardized workup and systematic analysis by a skilled physician is mandatory. Analysis should be built on an as reliable as possible measurement including a detailed record of lower urinary tract signs and symptoms. For this reason, it is also very relevant to ensure patient cooperation. We have presented an evidence based teaching module to support good clinical practice regarding AUM with recommended elements of standardization for the physician as well as for the instructions to the patient.

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