GOOD URODYNAMIC PRACTICES IN A NON-SPECIALIZED CENTER: QUALITY CONTROL ANALYSIS

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Summary.- OBJECTIVES: To review the quality of urodynamic studies performed in one Center in order to assess adherence to the ICS Good Urodynamic Practice Guidelines.

METHODS: Sixty-two consecutive urodynamic studies performed between March 2012 and May 2013 were retrospectively reviewed. We followed a list of common features to analyze all records.

RESULTS: 10.17% of the studies showed a significant drop in Pabd not mentioned in the study report. We found straining in 15.25% of the traces that was recognized and informed in the reports. We did not find many equipment artifacts, only pump vibrations. Uroflowmetry performed previously to the test is very important to compare its results with the ones obtained at the pressure-flow study. 50.8% of the studies had a non-valuable uroflowmetry.

CONCLUSIONS: The high rate of non-valuable uroflowmetries was in most of the cases due to an insufficient voiding volume. We think we meet very good standards although this is not a reference unit; nevertheless we still need to improve in many aspects.

Keywords: Quality control. Artifacts. Standardization. Urinary bladder. Urodynamic.

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Resumen.- OBJETIVO: Evaluación de estudios urodinámicos realizados en un Centro no especializado para valorar su calidad en relación con las Guías de Buenas Prácticas en Urodinámica de la Sociedad Internacional de Incontinencia.

MÉTODOS: Se analizaron 62 estudios urodinámicos realizados entre marzo 2012 y mayo 2013 de forma retrospectiva. Se empleó para ello una serie de parámetros característicos comunes en todos los trazados. Se realizó una uroflujoanometría previa para su comparación posterior con la del estudio presión-flujo.

RESULTADO: El 10.17% de los trazados mostró un descenso significativo de la Pabd no informado en el estudio. En el 15.25% se constató “presión al orinar”, la cual fue reconocida e informada en las conclusiones. No hemos encontrado mayores artefactos, salvo vibra-
ciones por la bomba. Como hallazgo más relevante, el 50,8% de los estudios presentaba una urofluometría previa no valorable.

CONCLUSIONES: la elevada tasa de urofluometrías no valorables fue en la mayoría de los casos por un volumen miccional insuficiente. Creemos que alcanzamos una elevada performance en la realización de nuestros estudios, a pesar de no tratarse de un centro especializado. El análisis retrospectivo nos permite detectar nuestros errores para poder tomar las medidas de corrección pertinentes.

**Palabras clave:** Control de calidad. Artefactos. Estandarización. Vejiga. Urodinamia.

**INTRODUCTION**

Urodynamics is a well-known interactive diagnostic study to obtain functional information about bladder filling, urine storage and emptying. Quality control of urodynamics tests is very important to ensure a correct diagnosis; invasive treatments such as surgery are chosen according to their results. The International Continence Society (ICS) and many experts published papers about the common pressure features and artefacts found during an urodynamic examination and how to deal with them (1, 2, 3, 7). According to Sullivan (5) there are three main points to consider in the process to improve the quality of urodynamics studies so that standards are achieved: defining standards, periodic quality controls and quality assurance. In 2002 ICS published a paper from the Standardization Committee which was the first step to standardize and improve the quality of the urodynamics examination (1). The ICS identified a minimum of three criteria for ensuring quality control of pressure recordings:

- "Resting values for abdominal, intravesical and detrusor pressure are in a typical range: supine 5-20 cm H2O; sitting 15-40 cm H2O and standing 30-50 cm H2O".

- "The abdominal and intravesical pressure signals are live, with minor variations caused by breathing or talking being similar for both signals; these variations should not appear in pdet."

- "Coughs are used (every 1 min or, for example, 50 ml filled volume) to ensure that the abdominal and intravesical pressure signals respond equally. Coughs immediately before voiding and immediately after voiding should be included."

Urodynamics is an interactive study, where the patient plays a very important role in order to reproduce his symptoms at the moment of the test. There should be a continuous observation of the signals as the data register is collected to correct any artefacts that may occur immediately. It is also important, for the physician to be present at the moment of the test. Although a technician could perform the test, only an experienced physician can make the necessary corrections during the recording to obtain a study with the highest quality (6). The most common findings seen when reviewing urodynamics studies are an uncorrected initial intravesical or abdominal pressure and an uncorrected initial resting detrusor pressure. The recognition and correction of abnormal initial pressures are a basic point to ensure quality pressure transmission at the beginning of an urodynamics test. Furthermore a strict adherence to ICS standardization of zero pressure and reference height is also recommended; so that recordings could be compared between patients and different centres.

The aim of this study was to compare our practice to the ICS Good Urodynamics Practice Guidelines through a retrospective trace review allowing us to identify aspects of our quality control that could be improved, and to make a judgement on the quality of the studies. We used the criteria described at Hogan’s et al work (3) to analyse our studies.

**MATERIAL AND METHODS**

All urodynamics studies were performed by one of the authors (FLZ). At the clinic, at the moment when the urodynamics was indicated, we gave the patients instructions on how to present the day of the study: at home they must perform an adequate cleaning of their genitals, take a single oral dose of 500mg of ciprofloxacin, and arrive that day with an empty bladder. Neurogenic bladder patients were not excluded; there were free of neurological pathology, although neurogenic bladder patients were not excluded; there was no spinal cord injured patients in the study. The technique in the unit is to fill the bladder with room temperature saline solution at 50 ml/min through a 9 F dual-lumen catheter. They were held in position by taping to the penis. Abdominal pressure was recorded using a 7F rectal catheter protected from faecal blockage by a slit balloon. Urodynamics machine used was a Solar™ (Medical Measurement System). The two external pressure transducers are mounted
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on an adjustable stand, each connected to a syringe through a two way tap. A second tap connects each transducer to the correspondent catheter. All fluid-filled lines were routinely flushed and inspected to exclude bubbles and leaks. The superior edge of the pubis was used as the reference point for external transducers, adjusted by eye to the reference level (4). The external transducers were zeroed to atmospheric pressure. The measurements of initial resting pressures were taken after voiding and after drainage of any residual urine, but before the start of bladder filling. All studies were performed in the sitting position. If cough or live signals remained abnormal, corrective steps were taken such as checking connected tubes for bubbles or leaks, or repositioning or replacement of the catheter. This was continued until equal cough and live signal transmission was demonstrated and initial resting pressure in the range of 0 to +5 cm H2O was achieved remaining stable for 10-15 sec. Pressure transmission was controlled during the test by asking the patient to cough every 100 ml filled and by assessing live signals in the bladder and abdominal pressure traces. In all cases we performed an uroflowmetry previous to the urodynamic test, to compare them with the one obtained during the pressure-flow study. All the evaluations were made in the sitting position by Unit protocol.

We followed the list of common features proposed in Hogan’s paper, to analyse all the traces (3). The Hogan’s criteria consist of 21 different pressure events, which have been split up into 2 groups: equipment artefacts and physiological features. In the first ones we considered: descending pressure, pump vibrations, occluded and/or knocked catheter, displacement and/or expelled catheter. In the second group we evaluated: resting pressure, live signals, cough to assess trace quality, detrusor overactivity (DO), cough induced DO, rectal contractions, fall in Pabd at void, straining and after contractions. We added to these criteria the assessment of previous uroflowmetry and the register of perineal bioelectric activity.

RESULTS

From 62 urodynamic evaluations 1 was rejected due to the impossibility to progress a catheter. We analysed 61 traces. First we checked the three minimum criteria recommended by the ICS for quality control (1). Our baseline Pdet was between -5 cm H2O and +10 cm H2O and Pves - Pabd were 15-40 cm H2O. We found in only two traces that resting pressures were out of range at the beginning of the study: in one case was a negative abdominal pressure and in the other one there were a negative Pves and Pdet. All the 61 traces had correct pressure “live” signals. We found coughs every 100ml filled volume in all analysed traces. If we considered coughs immediately before and after voiding, we found that in 8 traces (13.11%) there were both coughs absent and in 16 (22.23%) there was only the after voiding cough missed. For the rest of the analysis we ruled out those two traces with resting pressures out of range, because we could not assure their quality. Therefore only 59 cases were evaluated for the study. Traces where coughs before and/or after voiding were

![Figure 1. Detrusor contraction after voiding without Pabd rising. Detrusor remained stable during the cystometry.](image-url)
missed were considered for the analysis too, because their “live” signals could be assessed during the study.

After this first evaluation, we analysed the 59 traces according to the criteria proposed by Hogan et al (3).

**Pressure transmission**

In all cases we confirmed a good pressure transmission. We found that changes in intraabdominal pressure were recorded equally in Pves and Pabd without any change in Pdet. In all traces we observed cough signals every 100 ml filled and “live” signals during the cystometry.

**Detrusor Overactivity (DO) and cough-induced DO**

In our review of the 59 traces, 33, 9% (20 traces) showed DO. In all of these cases we confirmed a rise in Pdet associated with a concomitant increase in Pves without any change in Pabd. As we know, there are various stimuli that can trigger a DO. We found only in four cases (6.78%) a cough-induced DO. The latency time between the cough and the detrusor pressure rise was between 5 and 10 sec previous to DO start.

**Rectal contractions**

They are raising peaks in Pabd that cause a simultaneous decline in Pdet pressure without any change in Pves. They can be mistaken for DO, although Pves does not change. In our review we did not find any rectal contractions.

**Fall in Pabd at void**

We detected a significant drop in Pabd in 10.17% (n=6) of the traces. This decrease in Pabd was not mentioned in the report of each study, and reviewing them retrospectively, they did not affect the diagnosis.

**Straining**

This is associated in most of the cases with bladder outlet obstruction. Many men usually strain during voiding as a habit, although they are not obstructed. This could provoke an unreal rise in Pdet pressure. Then, it is very important to separate straining from Pdet itself. In our review we found straining in 15.25% (9) of the cases. The range of duration of each contraction was 3 to 20 sec. In all cases straining was informed in the conclusions as part of the findings during the test.

**After-Contractions**

Defined as detrusor contractions after voiding. Their significance is not clear, because they can be recognized in the same way as DO but they are not. We found two traces with genuine detrusor contraction after flow ended; in both cases detrusor was stable during the cystometry (Figure 1).

**Expelled catheter**

We found an expelled bladder catheter in 5.1% of the traces and an expelled rectal catheter in one case.

When we considered other equipment artefacts such as poor pressure transmission, flushed catheter, displaced catheter, and tube knock or pump vibrations, we only found 8 traces with pump vibrations at the beginning of the test. These vibrations are small, easily detectable oscillations without any pathological relevance.

**Initial Uroflowmetry**

As we explained before, we performed one to all patients referred for an urodynamic study. As we reviewed our data, we found in 30 traces (50, 8%) a non-valuable uroflowmetry. In most of the traces (40, 68%) there was an insufficient voiding volume to draw conclusions (lower than 150 ml). The other cases were: one patient with a previous permanent catheter, 4 cases without voiding desire and the last one with a chronic urinary retention.

**Bioelectric activity registers**

In 5 cases (8, 4%) we found a lose of perineal bioelectric activity due to a detachment of the superficial electrode during the voiding phase.

**DISCUSSION**

Our work’s goal was to analyse in an organized and detailed way our urodynamics to evaluate their quality. For that purpose we used Hogan’s criteria as a guide (3). These criteria represent a comprehensive list of the most common pressure events found in urodynamic. Quality control relies on pattern recognition and knowledge of normal values. As said in the Good Urodynamic Practice Guidelines: “The effective practice of urodynamic requires:

a) A theoretical understanding of the underlying physics of the measurements.
b) Practical experience with urodynamic equipment and procedures.

c) An understanding of how to assure quality control of urodynamic signals.

d) The ability to analyze critically the results of the measurements”.

The role of urodynamic is trying to recreate as similar as possible the patients symptoms in a controlled situation to achieve a pathophysiological diagnosis of his complaints. It is important, therefore, to have reliable resting pressure at the beginning of the study (1, 2, 5, 7). Our baseline Pdet was between -5 cm H2O and +10 cm H2O and Pves – Pabd were 15-40 cm H2O. We were very careful at the beginning of the test trying to meet the standard criteria. In only two cases the studies were performed in disagreement with these criteria and therefore were not considered in the subsequent analysis. We found the work of Hogan et al very useful to evaluate the quality of our test [3]. Minimizing equipments artefacts and ensuring the quality of pressure recordings makes the traces easier to interpret and enables clear identification of pathophysiological features. Cough signal spikes were used to assess the quality of pressure recordings. Without regular cough signals, it is not possible to evidence consistency of data capture.

In the evaluation of other pressure events, we consider cough-induced DO to that rise in Pdet occurring between 5 and 10-sec after cough. This is an arbitrary range, since the only reference we had was Hogan’s work in which a maximum 5-sec interval between cough and pressure rise was established. Based on observation of our traces, we decided to take this interval as representative. We could not find any rectal contractions. A 10.17% of the traces showed a significant drop in Pabd not mentioned in the study report. Although this did not affect the study diagnosis, we have to remedy this in future evaluations. We found straining in 15.25% of the traces which was recognized and informed in the reports. We also could not explain the reason of the two contractions found in our review. In both cases there was a genuine detrusor contraction seconds after flow ended with detrusor remaining stable during the cystometry (Figure 1). We found an expelled bladder catheter in 5.1% of the traces and only one case of a rectal expelled catheter. It is important to reinsert the catheter when the diagnosis was not achieved before the misplacement of the catheter occurs. In our data, in only one case we needed to insert the catheter and repeat the test due to a lack of diagnosis. This must not be confused with the voluntary extraction of the catheter, for example in patients with severe bladder outlet obstruction or stress incontinence. In the first case when we cannot achieve a flow during the pressure-flow phase, sometimes we extract the double lumen catheter to release its resistance to voiding. In the second one, we extract the catheter to determine de cough leak point. We did not find many equipment artefacts, only pump vibrations. This is probably because we checked carefully all the equipment connections at the beginning of the test. This is one of the many reasons why we think the test should be ideally performed by a physician and not by a technician, because it is a dynamic evaluation in which different remedial actions can be taken in real time. We consider that an uroflowmetry performed previous to the test is very important, so we can compare its results with the one obtained at the pressure-flow study. As we reviewed our studies we found that the 50.8% had a non-valuable uroflowmetry, most of them due to an insufficient voiding volume. We intend to remedy this for future evaluations. This is probably due to our elderly population and to the lack of comprehension of the instructions given at the clinic. To improve, in the future, we will emphasize that the patient must have micturition desire the day of the study.

We do not have in our unit a polygraph to make EMG-register. We use the one provided by our urodynamic equipment. It is very useful to diagnose urinary dissonergia, but not so much for the assessment of sphincter contractions quality.

We think that Hogan’s criteria allow urodynamic studies to be analysed in an organized and reproducible way, and that they should be used in different Units to perform quality controls. This is regardless of the diagnostic that led to the indication of the urodynamic study, and it helps to unify criteria for quality control analysis. Probably these criteria are at this moment incomplete and the contribution of future research and consensus will give us an useful urodynamic validation tool. We add to Hogan’s criteria the evaluation of the initial uroflowmetry and the perineal bioelectrical activity records. These are very useful to diagnose dissinergias. Probably the use of an EMG-record will improve these registers, but we don’t have the necessary equipment.

CONCLUSIONS

After having analysed our urodynamic studies under Hogan’s criteria, we consider our center meets very good standards despite not being a reference unit. The retrospective analysis carried out for this paper allowed us to identify defects in our practise, and to correct them for future studies. We still have to
improve in many aspects. We think that Hogan`s et al criteria are a useful tool to monitor quality control of urodynamic studies in an organized and reproducible way at any center.

REFERENCES AND RECOMMENDED READINGS
(*of special interest, **of outstanding interest)


