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Urodynamic Profile in Patients with Benign Prostatic Hyperplasia (BPH) with or Without Inguinal Hernia

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Abstract: ***Lower urinary tract symptoms(LUTS) are commonest conditions seen in elderly males which may be a manifestation of bladder outlet obstruction due to various causes such as increased prostate mass , bladder wall thickening, stricture urethra etc. which can be evaluated by urodynamic study and IPSS score. BPH can be associated with inguinal hernia. Hence this study was taken up to find the correlation between BPH, inguinal hernia and LUTS.Urodynamics studies the lower urinary tract function according to the urinary complaints of the patient.This article focusses on invasive urodynamic studies and its interpretation.***

1. Introduction

Lower urinary tract symptoms are the commonest condition seen in elderly male in the surgery out-patient clinics. It may be the manifestation of bladder outlet obstruction due various causes such as increased prostate mass, bladder wall thickening, stricture urethra etc.

To document bladder outlet obstruction, objective parameters such as urinary flow rate, post-void residual urine etc can be measured in symptomatic patients using urodynamic studies.

Multiple etiologic factors have been described with the genesis of urinary symptoms, including the effect of aging on the nervous system and bladder, metabolic derangements, changes in fluid regulation, obstruction and autonomic over activity.[1,2]
Traditionally, the diagnostic evaluation of patients with Lower urinary tract symptoms (LUTS) suggestive of bladder outlet obstruction (BOO) includes symptomatic evaluation. Symptom scoring systems have proved to be a useful tool to quantify clinical symptoms, however several studies have shown that none of these scores correlate with Bladder outlet obstruction (BOO) and BPH related complications, furthermore they are not disease specific.[3]

A variety of factors are responsible for development of Inguinal hernia. These include obesity and work related physical activity. It is not uncommon for Urologists to face patients presenting with LUTS associated with Inguinal Hernia. However, the studies showing the correlation of BPH with Inguinal Hernia are scant in the world and also in India. Hence, this study has been taken up in order to find the correlation between the BPH, Inguinal Hernia and Lower urinary tract symptoms (LUTS) related to BPH quantified through the International Prostate Symptom Score (IPSS).[3]

2. Review of Literature

Benign Prostatic Hyperplasia (BPH) is the most common benign tumour in men. The prevalence of benign prostatic hyperplasia is strongly related to age, ranging from 8% in men in their 50s to roughly 90% in men older than 80 years. The prevalence of LUTS/BPE depends on the age of the patients. The prevalence of LUTS/BPE depends on the age of the patients. In fact, the disease is present in about 8% of men between 31 and 40 years old, and it reaches 90% within 90 years old. Moreover, the presence of LUTS is also associated with more complications like acute urine retention, showing 6.8 episodes per 1000 patients per year in the general population, reaching 34.7 episodes in patients over 70s. The odds of developing moderate to severe LUTS also increased gradually after age 50 and were 3.5 and 2.4 times more frequent in men with a prostate volume greater than 50 mL and less than 50 mL, respectively. The exact aetiology of LUTS/BPE is unknown. Among several risk factors, metabolic syndrome, diabetes mellitus, obesity, race, and cardiovascular disease represent the most important.[1]

3. Initial Evaluation

Medical History
A detailed medical history focussing on the urinary tract symptoms, previous surgical procedures, general health issues, and fitness for possible surgical procedures must be taken[4, 5]. Specific areas to discuss when taking the history of a man with BPH symptoms include a history of haematuria, urinary tract infection, previous urinary tract interventions(surgery, catheterisationetc.), urinary retention , diabetes, nervous system disease (e.g., Parkinson's disease or stroke), and aggravation of symptoms by cold or sinus medication. Current prescription and over-the-counter medications should be examined to determine whether the patient is taking drugs that impair bladder contractility (anticholinergic) or that increase outflow resistance (αsympathomimetic).

Symptom Assessment
Urinary symptoms play a key role in the diagnosis of BPH and in the therapeutic management of patients with BPH. It is therefore critical to use a reliable and dully validated instrument for assessment of BPH related urinary symptoms. At the first World Health Organization (WHO) consultation in Paris (1991), it was concluded that there is little correlation between a patient's symptoms, gland size, pathology, anatomy and urodynamic. However, because many patients sought treatment because of severity of their symptoms it was recommended that WHO adopt the questionnaire developed by American Urological Association (AUA) BPH measurement committee, known as

"The AUA-7 Questionnaire". This questionnaire in contrast to other questionnaires is validated to test/re-test reliability, validity and clarity. One additional question was added to global BPH impact on quality of life. This question together with "AUA-7" is known as International Prostate Symptom Score (IPSS). IPSS focuses on 7 items that asked the patient to quantify the severity of their obstructive or irritative complaints on a scale of 0-5. Thus the score can range from 0-35, a symptom score 0-7 consider as mild, 8-19 consider as moderate and 20-35 consider as severe.

The IPSS cannot be used to establish the diagnosis of BPH. Men (and women) with a variety of lower urinary tract disorders (e.g., infection, tumour, neurogenic bladder disease) will have a high IPSS. However, the IPSS is the ideal instrument to grade baseline symptom severity, assess the response to therapy, and detect symptom progression in BPH patients. Such assessment methodologies also allow comparison of the effectiveness of various interventions. Although other symptom score questionnaires are used, the IPSS is now considered as the international standard[6,7.]

Optimal treatment decisions in individual patients will also need to take into account how a given level of symptoms affects each patient's quality of life (bothersomeness).Many patients seeking treatment of BPH do so because bothersome symptoms that affect the quality of their lives.

Uroflowmetry

Uroflowmetry is the electronic recording of the urinary flow rate throughout the course of micturition. It is a common, non-invasive urodynamic test used in the diagnostic evaluation of patients presenting with symptoms of Bladder Outlet Obstruction. It provides a rapid and economic screening tool for the effectiveness of the act of voiding. However since it is influenced by the detrusor pressure, urethral patency, sphincter relaxation uroflowmetry alone cannot be used to establish diagnosis. When combined with measurement of post void residual urine volume (PVR), the usefulness of the test increases.

There are three commonly used methods for flow rate measurement:

a) **The gravimetric method:** operates by measuring the weight of collected fluid or the hydrostatic pressure at the base of the collecting cylinder. The output signal is proportional to the weight of the fluid collected.
b) **Rotating disk method:** In this the urine flow is directed onto a rotating disk. The power needed to keep the disc rotating at a constant speed is measured and it is proportional to the flow rate.
c) **The electronic dipstick method:** uses a capacitance dipstick mounted on the collecting chamber that changes its capacitance as urine accumulates in the cylinder. The output signal is then proportional to the accumulated volume of urine[8].

The patient who presents for an uroflow study should be well hydrated with a reasonably full bladder. The study should be performed in relative privacy, and the patient should be encouraged to void in as normal a fashion as possible. The voided volume, the patient's position, the method of bladder filling (diuresis or catheter; transurethral or suprapubic), and the type of fluid should be recorded.

4. Interpretation of uroflowmetry data

The ICS has recommended the following definitions for the evaluation of uroflowmetry data.[8] The normal uroflow curve is plotted with the flow rate on the x axis (ml/sec) and time in seconds on the y axis (Fig.1). The voided volume is the total volume of urine expelled through the urethra. It has the greatest effect on Qmax and volume less than 150 ml generate inaccurate flow patterns and parameters[8]. Hence, the proceedings of the 3rd international consultation on BPH (1995) recommend that at least two uroflow measurements with at least 150 ml each be obtained when performing uroflowmetry.

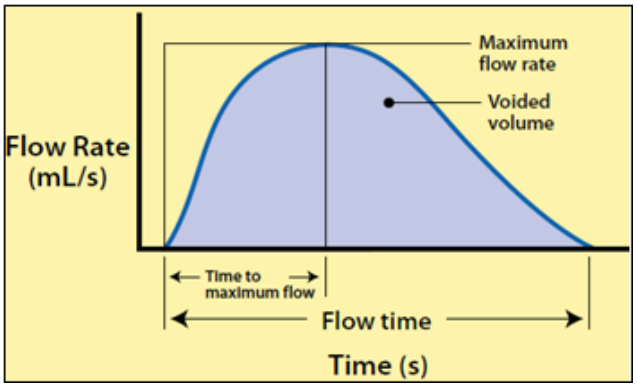

Figure 1: Schematic of a normal flow curve

However the recent ICS-BPH study has found that voided volume of <150 ml can provide useful information particularly in truly obstructed patients and should not be discarded[9]. Due importance should be paid to the pattern of urine flow as depicted on the graph.

The maximal flow rate (Q_{max}) is the maximal measured rate of flow (the peak of the flow curve), and the time to maximal flow is the time elapsed from onset of flow to maximal flow. In patients with a continuous uroflow, the flow time is the time over which flow actually occurs, and the average flow rate (Q_{av}) is determined by dividing the voided volume by the flow time. This is meaningful only if flow is continuous and without terminal dribbling. In patients with intermittent flow patterns, the flow time is measured by disregarding the time intervals between flow episodes.

The flow pattern, that is, the shape of the flow tracing can sometimes be used to make a presumptive diagnosis although it cannot be used to make a definitive diagnosis. The normal flow pattern (Fig. 1) is a continuous, bell-shaped smooth curve with a rapidly increasing flow rate. An intermittent flow pattern is a one that has one or several episodes of flow increasing or decreasing (or ceasing completely) and is commonly secondary to abdominal straining or external sphincter dysfunction.

Peak flow rate is generally the most reliable variable in detecting abnormal voiding. It is influenced by several factors:

1) **Age and sex:** In men, Q_{max} decreases with age, whereas in women it is not influenced by age. Normal women have higher flow rates for a given voided volume than

age-matched men. It is likely related to lower outlet resistance[9].

2) **Chance:** It has been documented that 40% of men have a difference in Q_{max} of at least 2 ml/sec between voids[9]and approximately 20% of men may have a difference of atleast 4 ml/sec[10].

However the ICS-"BPH study found that uroflowmetry alone cannot reliably diagnose bladder outlet obstruction, but it does have some diagnostic power when combined with symptoms. The sensitivity, specificity, and predictive values of threshold levels of Q_{max} of less 15 ml/sec has been calculated as it may be useful in predicting bladder outlet obstruction and outcome following surgery for BPH[10]. Jensen and Associates (1988a) found that patients with Q_{max}less than 15 ml/sec had a better subjective outcome after prostatectomy than those with a Q_{max} greater than 15 ml/sec. They noted that, in patients with a high Q_{max} (>15 ml/sec), there was a lower incidence of preoperative bladder outlet obstruction (as determined by pressure-flow analysis) and a higher incidence of persistent detrusor instability postoperatively.

This is another reason why uroflowmetry alone cannot rule out the presence of bladder outlet obstruction.

Keeping all these points in mind the AHCPR guideline panel has reached the following conclusions regarding uroflowmetry:

- Flow rate measurements are inaccurate if the voided volume is less than 125 to 150 ml.
- Flow rate is the single best non-invasive urodynamic test to detect lower urinary tract obstruction.
- However no cut off values regarding the flow rates to judge appropriateness of therapy can be given.
- Peak flow rate more specifically identifies patients with BPH than does average flow rate.
- Patients with Q_{max} less greater than 15 ml/sec appear to have somewhat poorer treatment outcomes after prostatectomy than do patients with flow rates more than 15 ml/sec[5].

However uroflowmetry is not a fool proof investigation and has its own pitfalls. Apart from drawbacks inherent to various techniques such as susceptibility of disk flow meters to urine flow directionality, it has been seen that flow rates recorded by computerised methods is lower than that recorded visually[10]. Hence it is very important to inspect the graph visually to rule out any artefact before the flow rates are calculated by the computer. Also neither subjective nor objective symptom scores correlate strongly with uroflowmetry measurements.

Postvoid Residual Urine Volume (PVR)

Post void residual urine is volume of urine remaining in the bladder immediately after the completion of micturition. Residual urine normally ranges from 0.09 to 2.24 ml, with the mean being 0.53 ml[10]. Residual urine volume can be measured non-invasively by trans abdominal ultrasonography or by invasive methods such as bladder catheterisation following voiding. The most common method is by trans abdominal ultrasound. Invasive techniques are more precise if performed accurately but carry a small risk of discomfort, urinary tract infection, urethral injury and transient bacteraemia.

There is general agreement between all of the different models in the classification of obstruction; hence, the ICS has proposed a provisional standard nomogram.[11,12.] It is very similar to the AG nomogram except that the boundary between unobstructed and equivocal has been moved to reduce the size of the equivocal region (Figure No. 3). Grading of obstruction is calculated by the bladder outlet obstruction index (BOOI), which is same as the AG number.

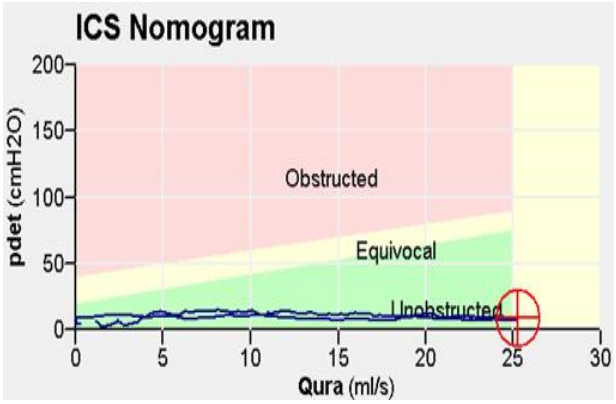

Figure 3: International Continence Society Nomogram

The initial response of the detrusor to obstruction is the development of smooth muscle hypertrophy. It is likely that this increase in muscle mass, although an adaptive response to increased intra-vesical pressure and maintained flow is associated with significant intra- and extracellular changes in the smooth muscle cell that lead to detrusor instability and in some cases impaired contractility. An index of bladder contractility (bladder contractility index [BCI]) is given by the formula P_{det}@Qmax + $5Q_{max}$[12].Using this formula, it is possible to define ranges of bladder contractility: BCI greater than 150 is strong, BCI less than 100 is weak, and BCI of 100 to 150 is normal contractility[12].

Bladder compliance is the relationship between change in volume and change in pressure. It is calculated by dividing the volume change (dV) by the change in detrusor pressure (dP_{det}) and expressed in mL/cmH_2O. It is generally calculated between two points: the P_{det} with the bladder empty at the start of filling and the P_{det}at either the maximal cystometric capacity or the start of a detrusor contraction. Normal bladder compliance should be more than 40 mL/cmH_2O[13] and more than 12.5 mL/cm H_2O[14].

Straining is defined as an increase in *intra-abdominal pressure (P_{abd})* to a value greater than 25 cmH_2O at any time immediately before or during the course of urinary flow[15]. Coughing, identified as an abrupt increase and then decrease in pressure, is not included in this definition.

Pressure-flow studies provide much more specific insight into detrusor function and the aetiology of voiding dysfunction than do flow rate measurements. However, a number of outcome-based investigations demonstrate a modest additional value of pressure-flow studies over symptom and flow rate evaluation.

5. Aims and Objectives

Aim

To correlate the urodynamic profile in patients of BPH with or without inguinal hernia.

Objective

1) To determine the urodynamic parameters in patients of LUTS with BPH in two groups of patients having inguinal Hernia (IH) and those without Inguinal hernia.
2) To determine the IPSS score in patients of LUTS with BPH in two groups of patients having inguinal Hernia (IH) and those without inguinal hernia.
3) To compare the findings of IPSS and urodynamic parameters in two groups of patients having Inguinal Hernia (IH) and those without Inguinal hernia.

6. Material and Methods

Selection of patients

A total of sixty male patients with lower urinary tract symptoms suggestive of benign prostatic hyperplasia (BPH) were included in the study,Group 1 included 30 patients with inguinal hernia and Group 2 included 30 patients without inguinal hernia.

Inclusion Criteria

Sixty male patients of age more than 40 years with lower urinary tract symptom suggestive of BPH.

Exclusion Criteria

1) Patients with urethral stricture.
2) Patients with previous urinary tract surgery.
3) Patients with previous prostate surgery.
4) Patients with Carcinoma.

7. Urodynamic Study

It was done on all patients included in the study.

Following pre requisites were met before the study was undertaken:

1) Absence of any clinical or microbiological evidence of urinary tract infection.
2) Avoidance of any urinary tract instrumentation at least one week prior to the study.

Presence of urinary tract infection or recent urinary tract instrumentation may result in altered bladder dynamics that may not normally exist. A careful note was taken to stop any medication that may affect the detrusor contractility or impair sphincter mechanism. The patient was explained about the procedure and placed comfortably on the urodynamic chair in privacy. A thorough cleaning and proper draping of the parts were done. After performing uroflowmetry, urodynamic study was conducted by inserting a catheter (8 Fr double lumen with a side hole 5cm from the tip) through the urethra under all aseptic precautions using lignocaine 2% jelly. By aspiration through this catheter post void residual urine volume was assessed. The patient was then asked to sit over the uroflowmeter device and the catheter was connected to the pressure transducer. The rectal catheter used for the measurement of intra-abdominal pressure was also connected to an external pressure transducer. The urinary bladder was filled with saline using an infusion pump with filling rate kept at 50ml/min. Patient was asked to cough intermittently to ascertain the position of the catheters during study. These fluid filled catheters transmitted the intra-vesical and intra-abdominal pressures to the transducers. The patient was asked to withhold voiding throughout the storage phase, and to disclose sensations of desire and urgency as and when felt by him. At the point of urgency patient was asked to void (voiding phase). After completion of voiding, the urethral pressure was measured. For this the catheter was constantly perfused at a rate set between 2 – 10ml/min and withdrawn into urethra by a puller at a constant rate of 3mm/sec.

At completion of the urodynamic study, various parameters i.e. maximum flow rate (Q_{max}), post void residual (PVR) volume, detrusor pressures (P_{det}), bladder compliance (BC), Urethral Pressure (UP) were calculated, using the above mentioned software.

From these pressure flow studies, bladder outlet obstruction index and bladder contractility index were also calculated.

The urodynamic parameters studied were:

1) **Q_{max} (Maximum flow rate)**: As it is volume dependent, only voided volumes of at least 150ml were interpreted. It is measured both during uroflowmetry and in voiding phase of urodynamic studies.
   - Normal >15-20 ml/sec
   - Equivocal 10-15 ml/sec
   - Abnormal<10ml/sec
2) **Post Void Residual (PVR) volume**: It is measured*by post void catheterization and residual urine volume > 60 mL was taken as significant.*
3) **Detrusor pressure (P_{det})**: It is the component of intra-vesical pressure (P_{ves}) created by contraction of the detrusor muscle and calculated by subtracting intra-abdominal pressure (P_{abd}) from the intra-vesical pressure [$P_{det} = P_{ves} – P_{abd}$]
4) Normal male voids with a P_{det} of 40 to 60 cmH_2O. The detrusor pressure at maximum flow ($P_{det}@Q_{max}$) has more significance and value more than 60 cmH_2O is taken as abnormal.
5) **Bladder outlet obstruction index (BOOI)**: It is an index calculated from the formula BOOI= $P_{det}@Q_{max} – 2 (Q_{max})$. It is used to grade the degree of obstruction.
   - Normal- <20
   - Equivocal- 20-40
   - Obstruction- >40
6) **Bladder contractility index (BCI)**: It is an index of bladder contractility and calculated from the formula BCI = $P_{det}@Q_{max} + 5(Q_{max})$. It is used to define the range of bladder contractility.
   - Strong- >150
   - Normal- 100-150
   - Weak- <100
7) **Bladder compliance**: It is the relationship between change in intravesical volume and change in intravesical pressure.

Compliance = $\frac{dV(\text{volume change})}{dP_{det}(\text{pressure change})}$

Normal compliance is greater than 40ml/cmH_2O.

8) **Urethral Pressure:** It is defined as the fluid pressure needed to just open a closed urethra. The physiologic pressure drop is 20 to 30 cmH_2O during normal voiding with a Detrusor pressure of 50 to 55 cmH_2O. Normal maximum urethral closing pressure is greater than 20 cmH_2O. The above data was collected and analysed using SPSS version 19 software.

8. Observations and Results

The study was conducted in the Department Of Surgery, Lady Hardinge Medical College And Associated Smt. SuchetaKriplani Hospital, New Delhi From November 2016 To March 2018.

The findings were as follows-

Max Flow Rate (Q_{MAX}):

MEAN Q_{MAX} of the patients of group 1 was 10.50 ml/sec (±4.125). (range 2-19 ml/sec.).

MEAN Q_{MAX} of the patients of group 2 was 11.10 ml/sec (±3.633). (range 6-20 ml/sec.).

PVR (Post Void Residual):

MEAN PVR of the patients in group 1 was 68.17 ml. (range 10-150 ml).

MEAN PVR of the patients in group 2 was 73.60 ml. (range 10-150 ml).

Detrussor Pressure (P_{det}):

Mean P_{det} of the patients in group 1 was 56.90 cmH_2O (Range 9-142 cmH_2O).

Mean p_{det} of the patients in group 2 was 60.50 cmH_2O (Range 20-127 cm H_2O).

BOOI (Bladder Outlet Obstruction Index):

Mean BOOI of the patients in group 1 was 43.23 (Range 3 - 125).

Mean BOOI of the patients in group 2 was 41.93 (Range -10 - 115).

BCI (Bladder Contractility Index):

Mean BCI of the patients in group 1 was 116.17 (Range 56-195).

Mean BCI of the patients in group 2 was 115.13 (Range 56 - 195).

B. .C. (Bladder Compliance):

Mean B.C. of the patients in group 1 was 27.97 ml/cmH_2O. (Range 6 -45 ml/cmH_2O).

Mean B.C. of the patients in group 2 was 27.10 ml/cmH_2O. (Range 4 - 42 ml/cmH_2O).

UP (Urethral Pressure):

Mean UP of the patients in group 1 was 50.90 cmH_2O (Range 35-76 cmH_2O).

Mean up of the patients in group 2 was 51.03 cmH_2O (Range 30-76 cmH_2O).

IPSS (International Prostate Scoring System):

Mean IPSS of the patients in group 1 was 19.80 (Range 10-29)

Mean IPSS of the patients in group 2 was 17.60 (Range 10-25)

9. Conclusion and Recommendations

From the present study we conclude that:

1) Patients of Benign prostatic hyperplasia with inguinal hernia have higher value of mean IPSS score.
2) Mean Qmax was significantly lower in patients with inguinal hernia suggesting LUTS is more severe in patients with inguinal hernia.
3) Urodynamic study gives a more specific diagnosis in patients with Bladder outlet obstruction as compared to other techniques.
4) In combination , Urodynamic studies alongwith IPSS helps to differentiate between obstruction due to Prostate and various other causes of LUTS such as Bladder neck dysfunction,over active bladder, Spastic urethral sphincter, and Poor relaxation of the urethral sphincter, Urethral Stricture or Pseudodysynergia .

We recommend:

1) Every patient with inguinal hernia above 40 years of age should also be asked about LUTS and should be investigated further to rule out cause of LUTS.
2) Urodynamic study should be done routinely in the work up of patients with BPH, as it provides objective documentation of bladder outlet obstruction due to various causes and guides about the degree of obstruction.
   a) That IPSS scoring and Urodynamic Study should be done before starting any intervention such as medical, surgical and life style modification in BPH patients and than at regular intervals to assess long term improvement of symptoms of BPH.
   b) That long term study with large number of patients should be conducted to further consolidate the correlation between the IPSS and Urodynamic Study.

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