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Research Article

Urodynamic Evaluation of Chronic Urinary Retention with special reference to Detrusor Underactivity and Compliance

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Abstract

Background: Chronic Urinary Retention poses a diagnostic dilemma in the practice of modern Urology. This is mainly because of the incidence of Detrusor Underactivity (DU), which may interfere with the precise diagnosis of Bladder outlet, Obstruction. The presence of detrusor underactivity also precludes the prediction of surgical outcome in these cases. Besides, large residual urine volumes can occur due to a combination of bladder outlet obstruction and detrusor underactivity, which may be present in variable elements. In the era of evidence base, it becomes even more important that the precise diagnosis is established in all these cases before an invasive treatment is planned.

Aims and Objectives: The main objective of this study was to identify the real incidence of Bladder Outlet Obstruction (BOO) as an etiological factor in the patients of chronic urinary retention. Using conventional multichannel Urodynamics, an effort was also made to diagnose of bladder outlet obstruction in the presence of a significant underactivity of the detrusor muscle. We also tried to look at correlation between detrusor compliance and the severity of outlet obstruction. The incidence of upper tract dilatation was estimated against resting (end filling) bladder pressures. Correlation of residual urine volume with detrusor function and severity of outlet resistance was also sought in this study. We felt that a detailed evaluation in this way should also directly influence the choice of treatment and the outcome measures.

Patients and Methods: We recruited 114 consecutive patients who presented for Urodynamic evaluation for Chronic Urinary retention to our Centre between April 2004 and September 2009. They all had indwelling catheters for varying lengths of time. Forty of these patients were excluded because they had proven relevant neuropathy. These included Diabetic Cystopathy, CVA, Lumbar Disc Lesions and inflammatory and traumatic lesions of the Spinal Cord. Thus, we had 74 cases without an overt neuropathy for evaluation. Urodynamic evaluation included Free Flow Rate estimation (wherever feasible), Filling Cystometry, Voiding Cystometry and Pelvic Floor EMG. Synchronous Videourodynamics was performed only where this was specifically requested.

Results: Thirty eight out of 74 patients of chronic urinary retention had unequivocal outlet obstruction with normal detrusor contractility suggesting that Bladder outlet obstruction is still the commonest etiological factor. Only seven out the 74 patients of chronic retention had significant underactivity of the detrusor without demonstrable obstruction. However, among the remaining 29 cases, 26 patients had a pressure flow relation suggestive of bladder outlet obstruction combined with detrusor underactivity. 28 patients who had detrusor compliance of less than 10 mls/cm. H2O had mean Bladder Outlet Obstruction Index (BOOI) of 83.3, whereas the 24 patients who had detrusor compliance of more than 20 mls/cm. H2O had mean BOOI of 34.75 The quantity of residual urine volume did not correlate either with detrusor underactivity or with bladder outflow obstruction with certainty.

Conclusion: Bladder outlet obstruction (with normal detrusor contractility) still appears to be the commonest aetiological factor in the genesis of Chronic Urinary Retention (51.3%). Detrusor underactivity without evidence of outlet obstruction was seen in only 7 cases. However, there is a definite group in whom Bladder outflow obstruction is seen in the presence of detrusor underactivity (35.13 %), thus taking the patients with Bladder outflow, Obstruction to 84.43% of the total. In these cases, Detrusor Underactivity could have developed secondary to the outlet obstruction. Loss of detrusor compliance correlates well with the presence and degree of Outlet Obstruction in these cases. Residual Urine Volume does not seem to hold any relationship either to the degree of obstruction or to the presence of detrusor underactivity.

Keywords: Chronic Urinary Retention; Diagnosis of Bladder Outlet Obstruction; Underactive Detrusor; Urodynamics in Chronic Retention

Introduction

Chronic urinary retention is still an intriguing proposition in the current Urology practice. It is generally assumed that chronic retention is a result of long-standing Bladder outflow obstruction culminating into partial loss of bladder sensations as well as contractility resulting in high bladder volumes. Current knowledge of Urodynamics suggests that there could be an element of primary detrusor underactivity in the genesis of chronic retention [1]. It is widely recognized that the bladder dysfunction plays an important role in at least some of these patients [2]. Ghalayini, et al. [3] had suggested clean intermittent self-catheterisation as an alternative to transurethral prostatic resection as the initial management of this condition, assuming that underactive detrusor plays an important role in chronic urinary retention. It is also possible that the detrusor underactivity occurs as a result of long standing outlet obstruction. In such cases Bladder outflow obstruction and detrusor underactivity may coexist. This generally produces a complex clinical picture and makes the precise evaluation difficult. Precise diagnosis of bladder outlet obstruction thus becomes an important factor when an invasive treatment is planned [4].

Besides, bladder compliance is often affected in long-standing urinary retention leading to high resting bladder pressures. Although the exact mechanism of loss of bladder compliance is not clear, bladder hypocompliance appears to be related to the chronicity (and severity) of the condition. These cases may have a progressive influence on structure and function of upper urinary tract leading to Chronic Kidney Disease. Abrams, in a review of results of surgery in chronic retention, concluded that high pressure filling in preoperative cystometry had a better response to outflow tract surgery [5]. This brings up the issue of relationship between detrusor hypocompliance and the severity of bladder outlet obstruction.

The main objective of performing Urodynamic evaluation on the patients of chronic urinary retention was to identify the incidence of detrusor underactivity as an aetiological factor. An effort was also made to diagnose bladder outlet obstruction in the presence of a significant underactivity of the detrusor muscle. This would enable us to identify the cases where the surgical treatment can be offered with a predictable outcome. Another aim was to find the correlation between detrusor hypocompliance and the magnitude of Bladder outflow obstruction in these cases. A further attempt is made to determine the correlation of detrusor underactivity to the residual urine volumes. The terminology used in this article conforms with the standardization principles recommended by International Continence Society [6]. It is expected that this study should answer some of the questions raised above.

Materials and Methods

One hundred and fourteen consecutive patients referred to our centre for Urodynamic evaluation for chronic urinary retention were included in our study. All patients presenting with chronic urinary retention and having an indwelling catheter for a minimum period of three days were considered for analysis. They were consecutive cases recruited retrospectively from September 2009 back to April 2004 (Total period of 65 months) without any exclusion. Every patient had signed an informed consent that explained the nature of the investigation, possible complications of the investigation as well as the possible prospect of the results being used for analysis and research purposes. Ethical clearance was obtained from the local review board of Maharashtra Medical Research Society (MMRS). Forty of these 114 cases had overt neurological abnormalities and were therefore excluded from analysis, leaving 74 cases of urinary retention without a known or suspected neurological disease. Neurological diseases were Diabetic Cystopathy, Cerebrovascular Accident, Lumbar Disc Lesion and trauma to the Spinal Cord. Remaining 74 patients had age ranging from 29 to 90 years with average age of 64.3 years (Median age was 65 years) [7]. All patients presented with indwelling catheters. Urethral catheter was present in 56 cases, leaving 18 cases with a Suprapubic Catheter. The duration of catheterization varied from 3 days 2 years (Median duration of catheter 16 days) (Figure 1).

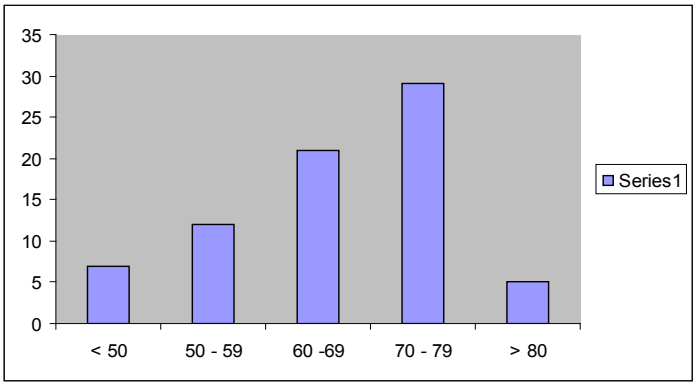

Figure 1: Bar Diagram to show the age range of 74 Patients with Chronic Urinary Retention. Y axis shows the number of patients presenting as Chronic Urinary retention in the age group as shown on the X axis

All these cases were referred to Urodynamic evaluation with specific queries.

- Is there an outlet obstruction?
- Is detrusor function normal or underactive?
- Is there a neurogenic component in chronic retention?

All patients underwent complete clinical evaluation with history of urinary symptoms. Presence of other relevant illnesses

such as diabetes, Ischaemic Heart Disease, Cerebrovascular Accident and Asthma was noted. Complete drug history was obtained. None of these patients had received any alpha-adrenergic blocking agents or antimuscarinics. Physical examination included complete general examination, examination of the genital region and focused neurological examination for the Sacral Reflex Arc. Biochemical parameters and state of the upper tracts (by Ultrasound) were noted in all cases. None of the patients had urinary infection or had the infection treated completely prior to investigation. All patients underwent complete Urodynamic evaluation. Free Flow Rate was obtained wherever possible. Filling Cystometry was performed in standing position using an 8F filling catheter and a 4.5 F pressure line. In patients with a Suprapubic Catheter, this catheter was used as the filling line. Bladder sensations, Compliance, Detrusor Overactivity as well as Bladder Capacity were noted. Note was also made of end filling pressure. Detrusor Leak Point Pressure was measured in all cases where leakage of fluid was seen. This was estimated with 4.5 F filling line in the urethra. Voiding Cystometry was performed without the change of posture and with only the 4.5 F pressure line into the urethra. Videourodynamics was performed only where specifically requested by the referring Clinician. The parameters measured during voiding Cystometry were

1. Opening pressure (Pdet open)
2. Maximum voiding Pressure (Pdet max)
3. Detrusor Pressure at Maximum Flow (PdetQmax)
4. Maximum Urinary Flow (Qmax)F
5. Minimum Pressure at which flow occurs (Pdetmin)

Pressure flow relationship was subjected to ICS as well as Schafer Nomogram to arrive at the diagnosis of Bladder outflow obstruction [8]. The Diagnosis of bladder outlet obstruction in the presence of detrusor underactivity was made using pressure flow relation based on Bladder Outlet Obstruction Index (BOOI = pdetQmax + 5Qmax) Residual volume was computed electronically as well as by hand held Ultrasound equipment (BladderScan). All patients had estimation of the pelvic floor bioelectrical activity using surface electrodes. Statistical Analysis: Three different statistical tests were used in analysis of the data. They are Pearson's Correlation and Coefficient Test, Two Independent Sample t- Test and Anova (Analysis of Variance) Tests. (Individual tests have been mentioned in appropriate sections)

Results

Out of 74 patients available for complete Urodynamic evaluation, 38 patients (51.3 %) showed unequivocal obstruction at the bladder outlet with normal detrusor contractility (PdetQmax > 50 cm. of saline). Seven patients (9.6 %) showed a significant degree of impaired detrusor contractility (Underactive detrusor) with enough voiding inefficiency to account for the urinary retention. The pressure flow analysis in these patients revealed unobstructed voiding. Out of the remaining, twenty-six patients (35.13 %) with chronic retention had pressure flow analysis that suggested underactive detrusor along with a definite element of bladder outlet obstruction (Derived from the Hill equation of the pressure flow analysis). However out of these 26, eight patients developed strong detrusor contractions, but the contraction did not last long enough to sustain the flow. In the remaining eighteen patients, the voluntary voiding detrusor pressure was lower than 50 cms. But the pressure flow relation indicated obstructed bladder outlet. Three patients, although presented with chronic urinary retention, had completely normal voiding sequence at the time of Urodynamic evaluation.

Reduced detrusor compliance was a common finding in this group of patients. Only 18 patients (24.3%) out of 74 had detrusor compliance of greater than 30 mls/cm. However, out of 46 patients who had detrusor compliance lower than 10 mls/cm., all patients (100%) showed obstruction at the bladder outlet. There were 19 patients with detrusor compliance greater than 10 mls/cm but less than 20 mls/cm. nineteen (82.6%) of these patients had unequivocal obstruction at the bladder outlet. Amoung the remaining 18 patients, in whom detrusor compliance was only marginally reduced (21 to 30 mls/cm), only 11 patients (61.1%) showed bladder outlet obstruction. Besides, Detrusor compliance had a direct relationship with the severity of bladder outlet obstruction. Average bladder outlet obstruction index (calculated as Pdet Qmax + 5 Qmax) was 83.3 in the 28 patients who had detrusor compliance of less than 10 mls/cm (Table 1).

Compliance	Number of patients	Average BOOI
0-10	28	83.3
11-20	19	57.84
> 20	24	34.75

Table 1: Comparison of detrusor compliance and BOOI.

Average BOOI was 57.84 in 19 cases who had detrusor compliance between 11 and 20 mls/sec. Average BOOI was 34.75 in 24 cases, who had detrusor compliance of greater than 20 mls/cm. By using ANOVA p value < 0.05, these figures were statistically significant and indicate that as the severity of bladder outlet obstruction increases, the detrusor progressively loses its compliance. Detrusor compliance has also been connected to the alteration in the anatomy of the upper urinary tracts. Diminished detrusor compliance is a common feature in these patients. However high end-filling pressure has an indirect influence over the dilatation of the upper urinary tracts. (Table 2) shows that the incidence of upper tract dilatation increases significantly as the end filling pressure goes above 30 cms. of saline (Two Independent Sample t-test).

End filling pressure	No of patients	Patients with upper tract dilatation	Patients with normal upper tracts
20 or less	32	4 (12.5%)	28
21 to 30	19	2 (10.5%)	17
Above 30	23	13 (56.5%)	10

Table 2: Comparison of End filling pressure and dilated upper tracts.

Residual urine volume was measured in all patients by two methods. There was no correlation of residual volume with either bladder outlet obstruction or underactive detrusor (p value = 0.697 by using correlation test) (Table 3,4)

Number of patients	State of patients	Average Residue
17	Obstructed and underactive (in Amplitude)	345.37
7	Obstructed and underactive (in sustenance)	318.75
37	Obstructed	244
6	Underactive	289

Table 3: Comparison of residue and obstruction.

Compliance	No. of patients	Obstruction with normal contractility	Obstruction with Underactive Detrusor	o/u-sustenance	Underactive Detrusor without Obstruction	Normal
0-10	29	17	7	4	1	-
11-20	20	12	2	3	2	1
21-30	16	5	5	1	3	2
>30	9	4	4	-	1	-

Table 4: Comparison of detrusor compliance and detrusor contractility.

Discussion

One of the objectives of this exercise was to determine the exact etiology of Chronic Urinary Retention. Almost two thirds of the patients we studied fulfilled the Urodynamic criteria of unequivocal bladder outlet obstruction [9]. Abrams [5] in his initial study of 55 patients found that all patients of chronic retention had bladder outlet obstruction. Recent interest in chronic urinary retention stems from the fact that a certain proportion of these patients may have underactive detrusor as the primary pathology. Indeed, in our series of 74 cases, at least 7 patients were found to have detrusor underactivity enough to cause voiding inefficiency and urinary retention but had unobstructed micturition on pressure flow study [10]. They had no demonstrable aetiology to explain detrusor underactivity [11]. These cases are therefore categorized as having idiopathic underactive detrusor [12]. Eighteen cases (24.3%) had very poor flow rates but did not have sufficiently high voiding detrusor pressures to qualify as obstructed by conventional methods, although outlet obstruction could not be excluded with certainty in them.

We then made use of the Hill equation of Hydrodynamics, which defines urethral resistance as Pressure divided by flow square. In a conventional pressure flow sequence, the point of Qmax generally implies the moment of “Minimal Urethral Resistance”, since the urethra is believed to be at its widest at that point of time. Our calculations of Urethral Resistance are based on this relation during the pressure flow cycle for bladders of normal contractility [13,14]. If, by any chance, the detrusor contraction is weak, then the entire PQ equation (at Q max) should simply scale down, keeping the value of Urethral Resistance constant. This is the basis of Diagnosis of BOO in the presence of Detrusor underactivity, as long as the detrusor contraction is strong enough to produce a flow for that magnitude of obstruction [15-17]. Theoretically, pressure and flow relations by this formula form exponential curves. We therefore plotted the exponential curves of pressure and flow in the range of what conventionally can be called obstruction [18]. We then plotted the points of pressure and flow at Qmax of these patients and noted the position of these points on these charts. This is how these 18 patients were categorized as having underactive detrusor yet had urodynamically obstructed bladder outlet [19].

It is possible that the detrusor underactivity is a consequence of long standing obstruction in these patients [20]. Pressure flow study delineated detrusor underactivity in two distinct forms in our study. In one group, detrusor pressure was of low amplitude but

was well sustained. In the other group, detrusor pressure was of normal magnitude but the contraction did not sustain long enough, producing ineffective voiding and high residue. These cases were categorized as "underactive detrusor in terms of sustenance" but had bladder outlet obstruction all the same. (See Table 4) Underactive detrusor has another scale of significance. Failure to raise the detrusor pressure during voiding precludes the diagnosis of bladder outlet obstruction using conventional pressure flow Nomograms. However, we believe that an underactive detrusor should simply scale down the pressure flow relation provided the detrusor contraction is strong enough to produce a flow. This concept has enabled us to prepare a Nomogram by which bladder outlet resistance can be estimated even if the detrusor contraction is not strong enough to give us the unequivocal evidence of obstruction by conventional means [21,22].

Thus, our data estimates that 26 out of the total 74 patients had underactive detrusor as well as bladder outlet obstruction, shown by the pressure flow study. This underactivity may have been secondary to long standing outlet obstruction, but this is difficult to prove and is clearly outside the scope of the current discussion. Thus 64 out of 74 patients in our study had demonstrable bladder outlet obstruction. The purpose of quantifying the outlet resistance in these patients is simply to see that the patients who have proven bladder outlet obstruction and underactive detrusor should be considered for surgical treatment, since the reduction in outlet resistance may trip the micturition balance and restore normal voiding in these patients [23,24].

Compliance: Detrusor compliance is often reduced in patients with chronic urinary retention. However, the aetiology of the loss of compliance is not completely clear, although it is thought to be related to the chronicity of the obstruction. It is generally not possible to assess the duration of obstruction, since the patients with chronic urinary retention have very few symptoms. Mitchell [25] in his comprehensive review of Chronic Retentions described two basic groups in these patients viz. high pressure Chronic Retention and low pressure Chronic Retention, depending on clinical information of soft or tense palpable bladder. He was the first to describe influence of high pressure Chronic Retention on the upper urinary tracts. Abrams further evaluated the patients of Chronic Retention urodynamically before and after surgery for the outflow tract [5]. He divided these patients on the basis of end filling pressures of less than 25 and more than 25 cms of saline. He showed that the upper urinary tract dilatation was more commonly associated with the high-pressure group and that these patients had more satisfactory results of the outflow tract surgery. We too categorized these patients depending on the end filling pressures, but feel that the end filling pressure may have a greater relevance to the state of upper urinary tracts, as shown in the results.

We looked at the correlation between the severity of reduction in compliance and the degree of outlet obstruction in cases of outlet obstruction. We found that there is a positive correlation between the two. i.e. loss of detrusor compliance is directly related to the severity of obstruction at the bladder outlet. Detrusor compliance had a curious relation to the presence and degree of the outlet obstruction. Abrams [5] in his study of chronic retention has concluded that "high Pressure" chronic retention had a better surgical outcome. Our study did not compare the surgical outcome with the Urodynamic parameters, but it asserts that the lowered detrusor compliance is associated with greater incidence and degree of obstruction and therefore should logically have a better surgical outcome. McGuire [26] in his original article on Detrusor Leak point pressures in neurogenic bladder dysfunction proposed that the resting detrusor pressure of 40 cms or more posed a definite risk to the upper urinary tracts. Although we did not try and classify bladders in high pressure and low-pressure groups, our data shows that the end filling detrusor pressure of 30 cms. was associated with upper urinary tract changes in 50 % of patients. Although the data is small, there is a distinct possibility of racial variation in these assumptions. High residual volumes often complicate the evaluation of obstruction in patients with chronic retention. Our data clearly rules out the distinction between outlet obstruction and underactive detrusor function as an aetiological factor of high residual volumes (See Table 4). High residues could thus have a variable contribution of increased outlet resistance and weak detrusor contraction. Residual urine volumes therefore cannot be used to diagnose outlet obstruction with any degree of certainty in these cases [27].

Conclusion

- Bladder outlet obstruction is the commonest etiological factor in the genesis of chronic urinary retention. Normal detrusor contractility in this group was seen in 38 of 74 cases with Bladder outlet obstruction.
- At least 26 of the cases had Bladder outlet obstruction and detrusor underactivity combined. Detrusor underactivity in these cases is either in amplitude or sustenance of detrusor contraction. These features may have been secondary to Bladder outlet obstruction but this group may be offered the benefit of surgery with a favourable outcome.
- Only 10 % of cases showed detrusor underactivity as a sole cause of urinary retention without the evidence of obstruction. None of these patients had any clinical signs to suggest a neuropathy. No other etiology was found in these cases.
- Diminished detrusor compliance is a common finding in chronic retention but the severity of hypocompliance seems to correlate well with severity of Bladder outflow obstruction.
- Although high resting pressure is associated with upper tract changes, resting pressure of 30 cms. is associated with at least 50% of upper tract dilatation.

- Residual volumes alone do not predict detrusor underactivity or outlet obstruction as the etiological factor of chronic retention.

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