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THE CORRELATION BETWEEN URODYNAMIC AND CYSTOSCOPIC FINDINGS IN ELDERLY MEN WITH VOIDING COMPLAINTS

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ABSTRACT

Purpose: We evaluated the urethrocystoscopic findings and results of urodynamic studies in elderly men with voiding complaints.

Materials and Methods: A total of 492 consecutive patients with voiding complaints underwent a standardized screening program, including transrectal ultrasonography of the prostate, urodynamic investigations with pressure-flow study analysis and flexible urethrocystoscopy.

Results: A significant correlation was found between bladder trabeculation and grade of bladder outlet obstruction. Detrusor instability correlated significantly with grade of trabeculation. Grade of obstruction showed a clear correlation with prostatic occlusion of the urethra and the presence of a middle lobe at cystoscopy.

Conclusions: The findings at urethrocystoscopy correlate well with those of urodynamic investigations.

KEY WORDS: urodynamics, cystoscopy, prostate

For many years the diagnosis and management of voiding complaints in elderly men were straightforward. Surgical techniques for removing the obstructive prostatic tissue relieved symptoms in most men and much debate focused on the relative value of open prostatectomy versus transurethral resection. However, with the advent of medical and less invasive modalities for the treatment of bladder outlet obstruction, it has become necessary to know more about the etiology and pathology of the disease.[1] It is well known that evaluation and treatment of voiding complaints in elderly men are primary endeavors of the urologist and lead to the surgical procedures listed in the urological armamentarium.[2] Also, voiding complaints in elderly men are most frequently caused by benign prostatic hyperplasia (BPH), which develops with increasing frequency as men age. The resulting prostatic growth has a critical role in altering voiding, which results in significant (pathological) changes in the urinary tract of some patients and symptoms alone in others. On the other hand, the role of BPH in the voiding dysfunction experienced by elderly men is often unclear.[3] Hyperplasia may be associated with striking lateral lobe enlargement but symptoms may be negligible if the degree of obstruction is not severe. Conversely, BPH may be associated with a relatively small prostate and marked obstructive symptoms if the obstructing tissue originates exclusively within the central zone or periurethral gland area.[4] Although the pathophysiology of BPH and its effect on the bladder wall are not completely understood, we agree that when the bladder passes through the stages of irritability, compensation and decompensation outlet obstruction may occur. In response to outlet resistance, hypertrophy of the detrusor muscle begins and trabeculation may develop.[5]

Urethrocystoscopy provides information on the cause, size and severity of obstruction, patency of the bladder neck, prostatic occlusion of the urethra and estimated prostatic size.[2] The gold standard to measure bladder outlet obstruction is by urodynamic investigations with pressure-flow studies.[6] Although the diagnosis and treatment of BPH are common subjects, only limited information is available regarding the correlation between urethroscopic findings and urodynamic studies.[7] Turner-Warwick et al concluded that the endoscopic appearance of trabeculation in men is usually associated with a thick walled bladder but it is not diagnostic of obstruction, and that the most common correlation is noted with unstable detrusor function, which may or may not be associated with obstruction.[8] Andersen and Nordling concluded that urethrocystoscopy provides good information on the site and severity of obstruction.[9] Recently, Madsen and Bruskewitz concluded that urethrocystoscopy has a limited role in the evaluation of BPH.[10] However, they mentioned that available data suggest that bladder trabeculation in BPH is a predictor of treatment outcome, and that cystoscopy might be performed before invasive therapy to guide the urologist in choosing an operative approach.

We evaluated the findings of urethrocystoscopy compared to those of the preceding urodynamic studies to determine whether trabeculation and prostatic enlargement indicate bladder outlet obstruction, whether an enlarged middle lobe correlates with increased outlet resistance, and whether there is a relationship between bladder trabeculation and instability.

MATERIAL AND METHODS

A total of 492 consecutive patients with voiding complaints underwent a standardized screening program, including history, physical and digital rectal examinations, biochemistry studies (prostate specific antigen), urinalysis and culture, urine cytology, transrectal ultrasonography of the prostate, urodynamic investigations and flexible urethrocystoscopy. Prostatic size was determined using an ultrasound scanner with a 7.5 MHz. transrectal probe. The prostate was imaged from base to apex, documenting the presence of prostatic abnormalities and measuring the prostatic volume using the planimetric method.[11] Urodynamic investigations were performed with an 8F transurethral lumen catheter and an 8F transrectal catheter, both equipped with a microtip pressure sensor. Before cystometry the bladder was emptied through the lumen of the transurethral catheter to quantify residual

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urine after free uroflowmetry. The pressure sensors were set at zero to atmospheric pressure before introduction. The bladder was filled with water at 20C and a filling speed of 50 ml. per minute with the patient supine. Filling was stopped when the patient expressed a strong urge to void, and micturition while standing was allowed in private. The digitally stored data were analyzed with equipment developed at our department.

To obtain useful information from the pressure-flow study curves, it was necessary to relate detrusor pressure to the corresponding flow. To quantify the grade of outlet obstruction, the concept of the linear passive urethral resistance relation, connecting minimal urethral opening pressure with pressure at maximum flow, was used.[6] Classes 0 and 1 of this scale indicate no, classes 2 and 3 moderate, and higher classes severe bladder outlet obstruction on urodynamic study. Another method of grading bladder outlet obstruction is with the urethral resistance factor, which is calculated based on the point of maximum flow and corresponding detrusor pressure.[12] A urethral resistance factor value of more than 29 cm. water indicates obstruction. Finally, the minimal urethral opening pressure and theoretical urethral lumen were calculated on the basis of the passive urethral resistance relation curves, adjusted to the lower pressure area of the pressure flow graph.[13] The investigations were completed by urethrocystoscopy.

The studies were done with the patient under local anesthesia. A flexible urethrocystoscope was used to evaluate the entire bladder surface with special attention to bladder trabeculations, which were classified as 0—none, 1—slight to moderate, 2—severe and 3—severe with formation of (pseudo)diverticula. Moreover, the appearance of the bladder neck was described, and the degree of prostatic occlusion of the urethra as well as the distance from the bladder neck to the verumontanum were reported. Prostatic occlusion was graded as 1—no, 2—moderate and 3—severe obstruction (fig. 1). Also the presence of a high and narrow bladder neck, and a middle lobe was documented. Patients with urethral strictures, prostate cancer or bladder abnormalities, such as bladder stones, were excluded from this study since these diseases were believed to be the predominant cause of the symptoms. For statistical analysis the Kruskal-Wallis and chi-square correlation tests were used.

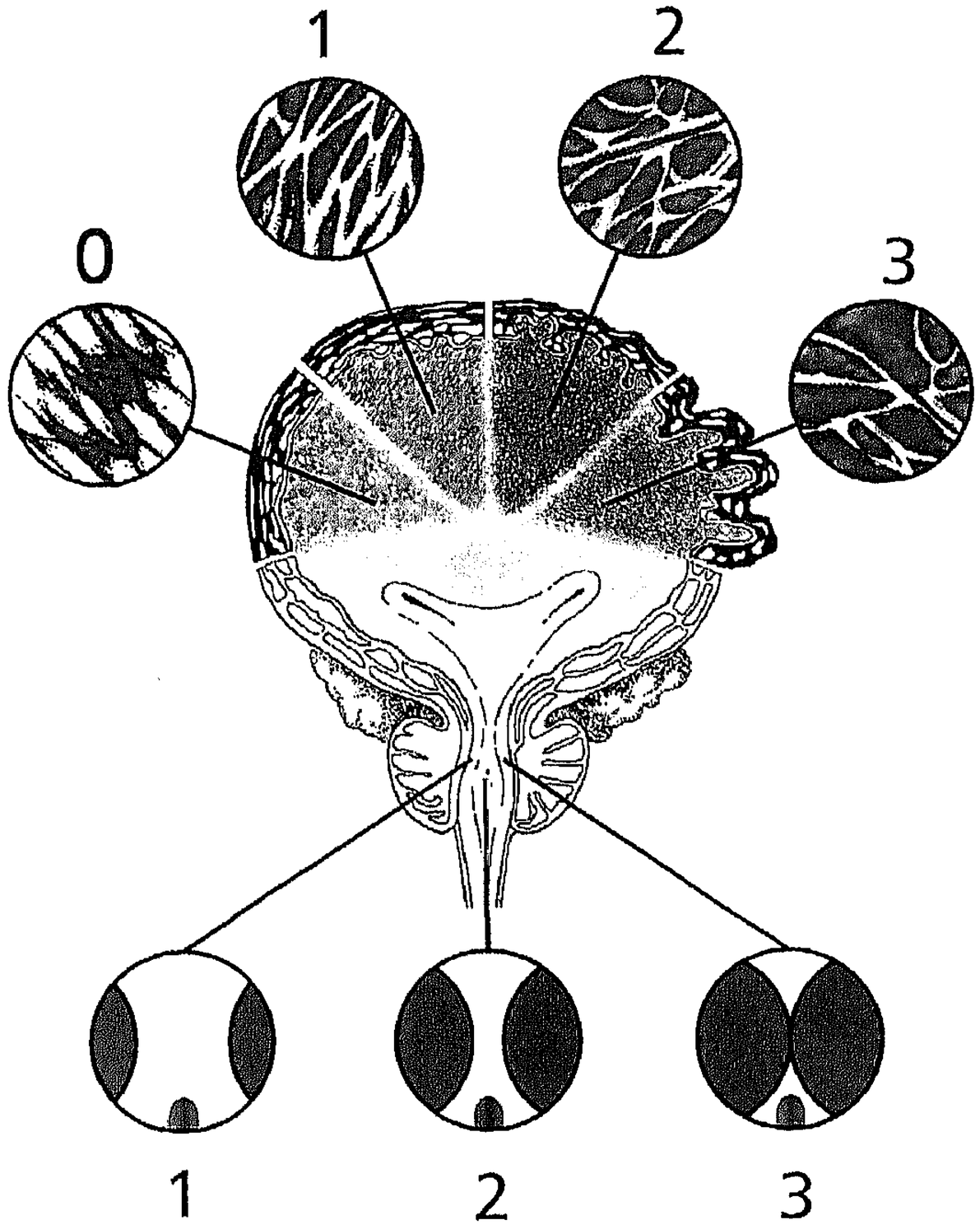

FIG. 1. Cystoscopic appearance of bladder trabeculation (0—none, 1—slight to moderate, 2—severe and 3—severe with formation of diverticula) and prostatic occlusion (1—no, 2—moderate and 3—severe obstruction).

RESULTS

Mean patient age was 64.8 years (range 42 to 89) and the prostate volumes ranged from 13 to 127 cc (mean 44.7 ± 20). The grade of trabeculation was correlated with the clinical parameters (table 1). Of the patients 12% had grade 0, 58% grade 1, 23% grade 2 and 7% grade 3 trabeculation. An increase in trabeculation was noted in patients with larger prostates. The total International Prostatic Symptom Score (I-PSS) also increased slightly with higher grades of trabeculation but without significant statistical correlation. On the other hand, the filling component of I-PSS (the total score of questions 2, 4 and 7) correlated weakly with trabeculation. Also the maximum flow rate and post-void residual volume showed a significant correlation with trabeculation. Uroflowmetry results for the entire group demonstrated an average maximum flow of 10.8 ± 5.8 ml. per second with a post-void residual volume of 70 ± 114 ml. There was a decrease in maximum flow rate and an increase in the post-void residual volume with higher grades of trabeculation.

The pressure-flow study parameters also showed significant correlations with trabeculation. With increasing grade of trabeculation, detrusor pressure at maximum flow rate, linear passive urethral resistance relation, urethral resistance factor and minimal urethral opening pressure increased (table 2). These correlations were statistically significant. Other urodynamic parameters, such as the theoretical urethral lumen, correlated significantly with inverse relation with trabeculation. The cystometric capacity worsened with increasing grade of trabeculation but this was not statistically significant. The relationship between grade of bladder trabeculation and severity of bladder outlet obstruction is shown in figure 2. We conclude that an increase in trabeculation significantly correlates with an increase in bladder outlet obstruction.

Detrusor instability was noted in 74 patients, and there was good correlation between the grade of trabeculation and detrusor instability (table 3). Of the patients 112 had a small middle lobe and 48 had a large middle lobe. With the presence of a middle lobe, there appeared to be a tendency towards increased grade of obstruction according to linear passive urethral resistance relation (fig. 3). The correlation between prostate size, measured by transrectal ultrasound, and trabeculation was less pronounced (fig. 4). However, there appeared to be good correlation between grade of prostatic occlusion, estimated at urethrocystoscopy, and grade of outlet obstruction ($p < 0.0001$, fig. 5).

DISCUSSION

Among the urological community it is generally believed that voiding complaints in elderly men are caused most frequently by BPH. Indeed, for many years the diagnosis and management of this disease aimed at removing the obstructive prostatic tissue. During the last years, however, research has led to the understanding that so-called BPH is not a single disease but one characterized by heterogeneity. The pathophysiology of the disease varies in the nature of the mechanical obstruction, for example lateral, middle or trilobar hyperplasia, the degree of dynamic obstruction and the

TABLE 1. *Correlation between the grade of trabeculation and clinical parameters*

	Trabeculation Grade				p Value
	0	1	2	3	
No. pts.	59	283	113	37	
Mean age (yrs.)	62.7	64.7	66.1	67.1	Not significant
I-PSS:*					
Total	17.2 ± 6.3	17.5 ± 6.5	18.7 ± 6.9	20.4 ± 6.3	Not significant
Filling	6.8 ± 3.7	7.5 ± 3.5	8.5 ± 3.9	8.8 ± 3.6	0.05
Voiding	10.3 ± 3.6	9.9 ± 3.7	10.4 ± 4.8	11.6 ± 3.6	Not significant
Maximum flow rate (ml./sec.)*	11.3 ± 4.5	11.6 ± 6.5	9.8 ± 4.2	6.9 ± 3.9	<0.0001
Prostate vol. (gm.)*	38 ± 15	43 ± 17.5	53 ± 26	45 ± 19	<0.0001
Residual vol. (ml.)*	56 ± 127	59 ± 100	86 ± 113	142 ± 172	<0.0001

Filling symptoms—total score of questions 2, 4 and 7 on I-PSS, voiding symptoms—total score of questions 1, 3, 5 and 6 on I-PSS.
* Mean plus or minus standard deviation.

TABLE 2. *Correlation between the grade of trabeculation and the mean value of urodynamic parameters*

	Trabeculation Grade				p Value
	0	1	2	3	
Detrusor pressure at maximum flow (cm. water)*	41.3 ± 20.7	51.1 ± 23.1	67.7 ± 23.2	87.7 ± 32.6	<0.0001
Urethral resistance factor (cm. water)*	29.6 ± 16.7	32.8 ± 15.2	45.5 ± 16.7	60.7 ± 23.6	<0.0001
Minimal voiding pressure (cm. water)*	18.7 ± 12.1	25.2 ± 15.9	33.8 ± 16.8	40.5 ± 20.3	<0.0001
Theroretical urethral lumen ($mm.^2$)*	4.1 ± 2.7	3.6 ± 2.2	2.5 ± 1.6	2.0 ± 2.6	<0.0001
Capacity (ml.)*	406 ± 121	400 ± 126	386 ± 143	353 ± 149	Not significant
Compliance (ml./water)*	38.1 ± 32.9	30.3 ± 35.9	27.5 ± 33.1	37.1 ± 55.7	<0.05
Linear passive urethral resistance relation (mode)	1	2	4	4	<0.0001

* Mean plus or minus standard deviation.

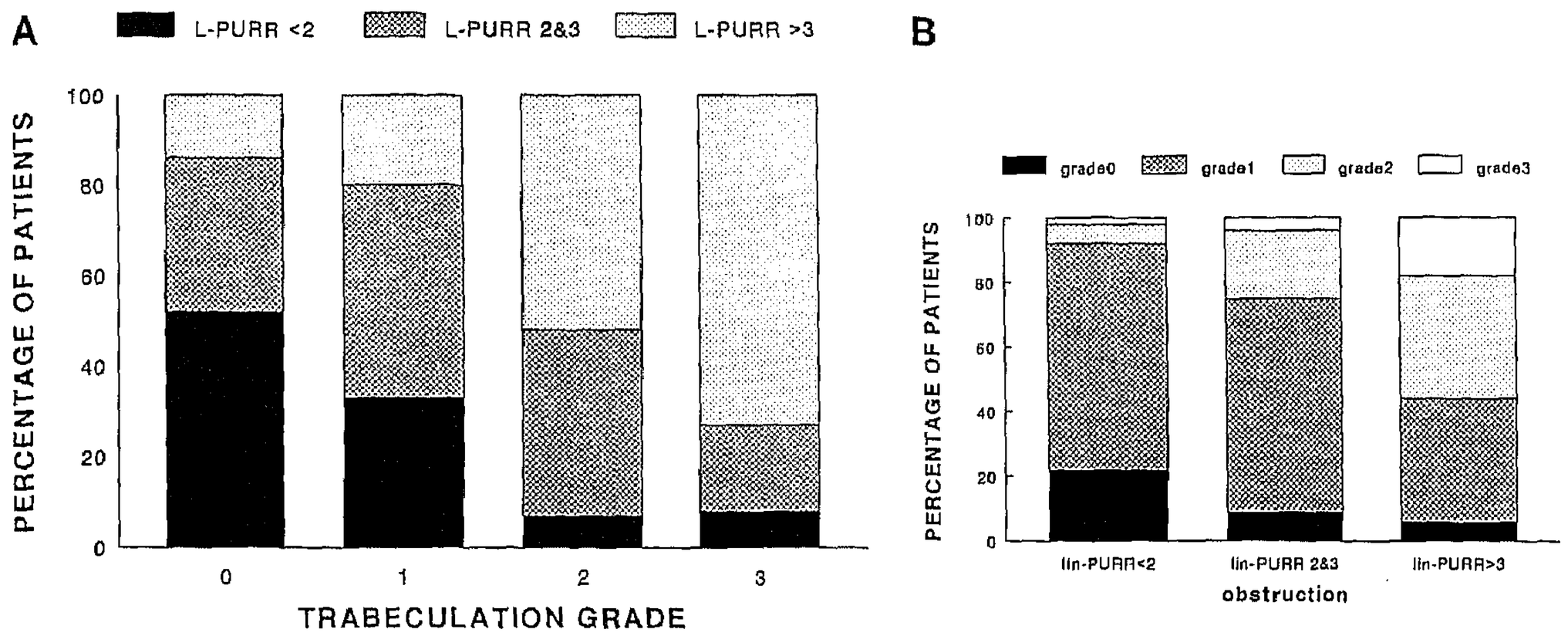

FIG. 2. Correlation between grade of trabeculation (*A*) and grade of bladder outlet obstruction (*B*) according to linear passive urethral resistance relation (*L-PURR*, *lin-PURR*).

TABLE 3. *Correlation between the grade of trabeculation and detrusor instability*

Detrusor	Trabeculation Grade				Totals
	0	1	2	3	
Instability	5 (8.5)	35 (12.4)	18 (15.9)	16 (43.2)	74 (15)
Stable	54 (91.5)	248 (87.6)	95 (84.1)	21 (56.8)	418 (85)

Values are given as number of patients (percent).

response of the detrusor musculature. The rings of Hald provided a sound basis in which the pathophysiology is divided into 3 parts: lower urinary tract symptoms, prostate size and bladder outlet obstruction.[14] Despite the existence of an increasing number of reports on the relationship between prostate size and obstruction, a defined correlation between the pathophysiological components remains unproved.[15–17] Does there really exist a good correlation between the urethrocystoscopic findings and the results of pressure-flow studies? Is the finding of trabeculation correlated with worsening bladder function? Does trabeculation correlate with bladder instability?

We showed unequivocally that a correlation exists between the presence of a middle lobe and the grade of bladder outlet obstruction. Moreover, the obstruction classification of the prostate at cystoscopy seems to correlate even better with grade of bladder outlet obstruction than measurement of prostate volume alone. We agree with Andersen and Nordling that urethrocystoscopy also provides good information on the site as well as the hydrodynamic severity of organic infravesical obstruction.[9] Indeed, the urodynamic parameters of bladder outlet obstruction, judged by the pressure flow parameters, were significantly correlated with the urethrocystoscopic findings of prostatic occlusion of the urethra and the presence of a middle lobe.

At cystoscopy, many urologists attempt to evaluate the degree of obstruction by assessing bladder trabeculation. However, to our knowledge no studies have shown a significant association between bladder trabeculation and severity of obstruction.[9, 18] In the male patient the detrusor muscle

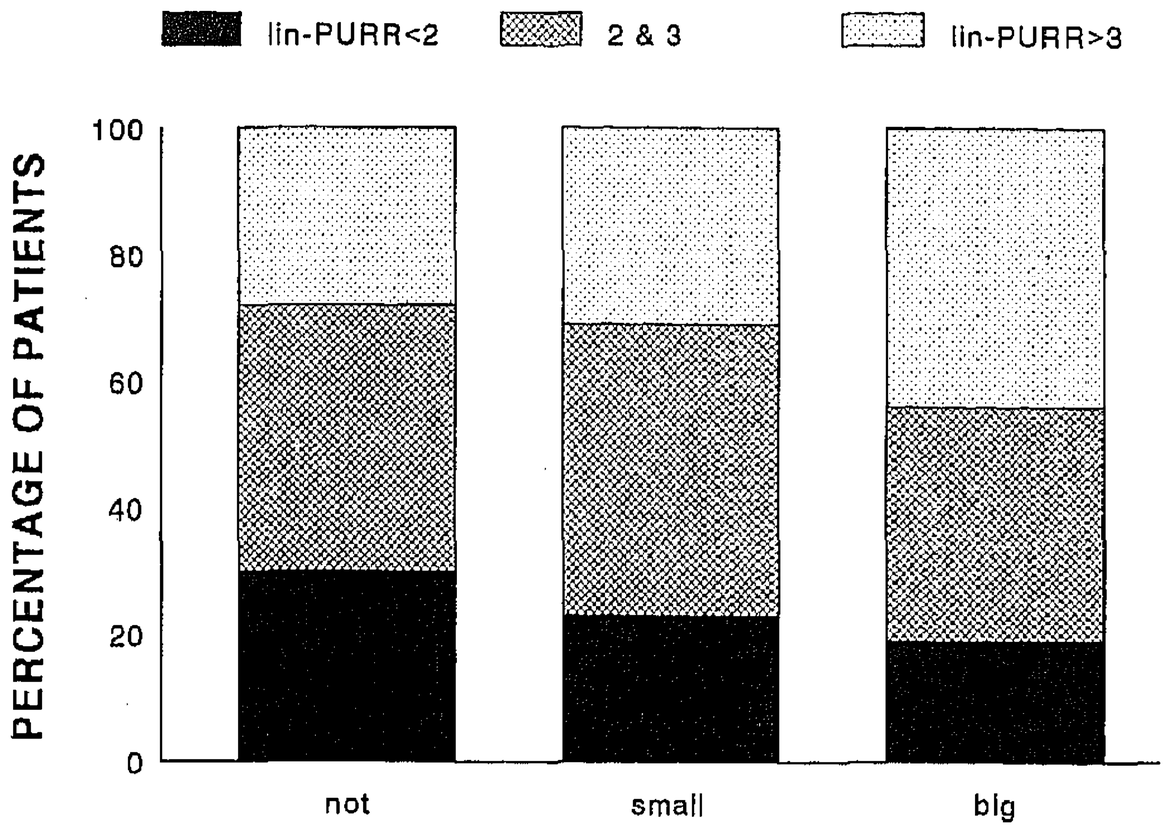

FIG. 3. Correlation between presence of middle lobe and grade of bladder outlet obstruction according to linear passive urethral resistance relation (*lin-PURR*).

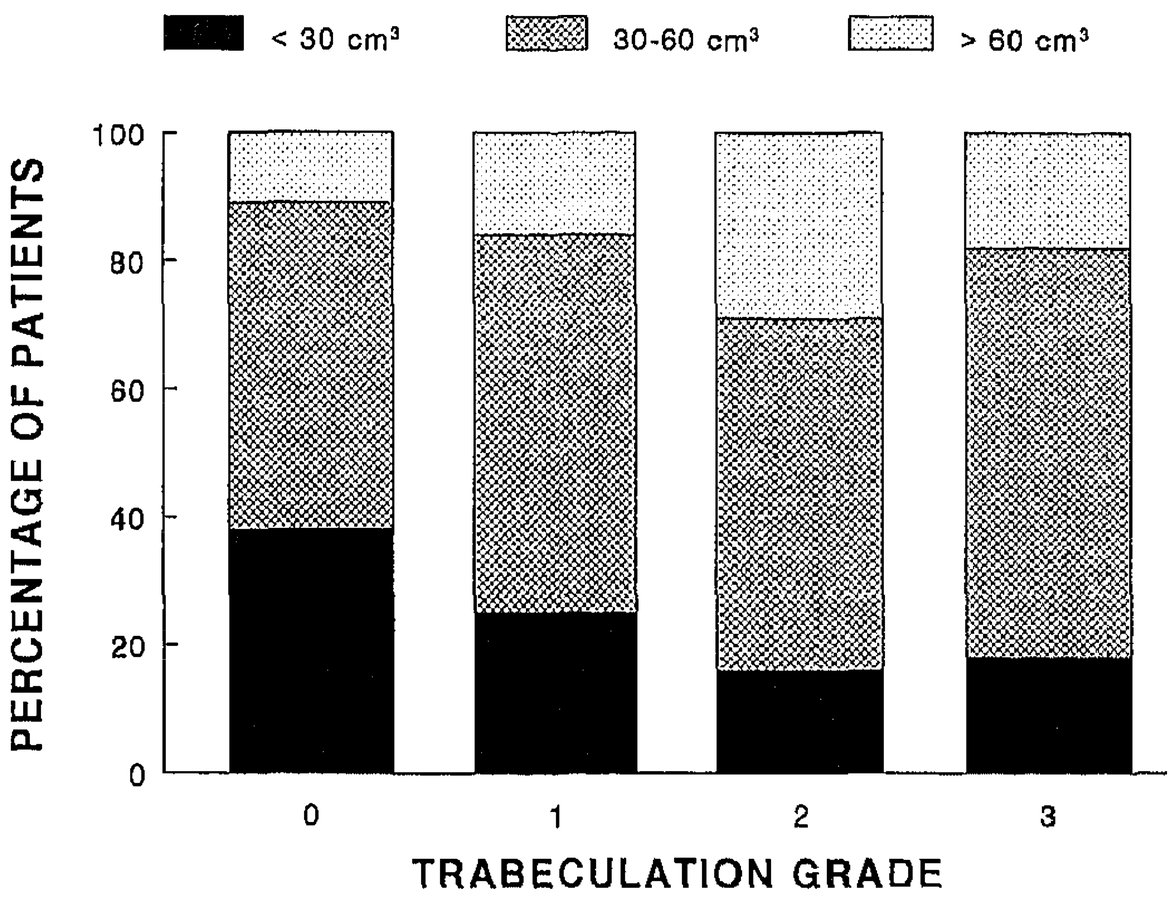

FIG. 4. Correlation between grade of trabeculation and prostate size measured by transrectal ultrasound.

reacts to outlet obstruction in a variety of ways and not all detrusors are equal. The presence of bladder trabeculation and (pseudo)diverticula has traditionally been regarded as a sign of compensatory bladder hypertrophy. Chapple and Turner-Warwick concluded that the endoscopic appearance of trabeculation in the male patient is usually associated with a thick walled bladder but neither is diagnostic of obstruction.[19] Our results show that there is good correlation between grade of trabeculation and grade of bladder outlet obstruction. For the individual patient, however, one cannot make the same conclusion. Moreover, we are aware that grading of trabeculation is physician dependent. Some researchers stated that trabeculation appeared to correlate with collagen deposition, rather than muscular hypertrophy, although both of these processes appear to occur in obstructed bladders.[20,21] However, sequence of hypertrophy and collagen deposition is not clear, and some discrepancies in the findings related to the presence or absence of muscular hypertrophy and collagen deposition may reflect the stage of development of detrusor changes in relation to obstruction. In contrast with the findings of Andersen and Nordling,[9] our study shows a clear correlation of detrusor instability with grade of trabeculation.

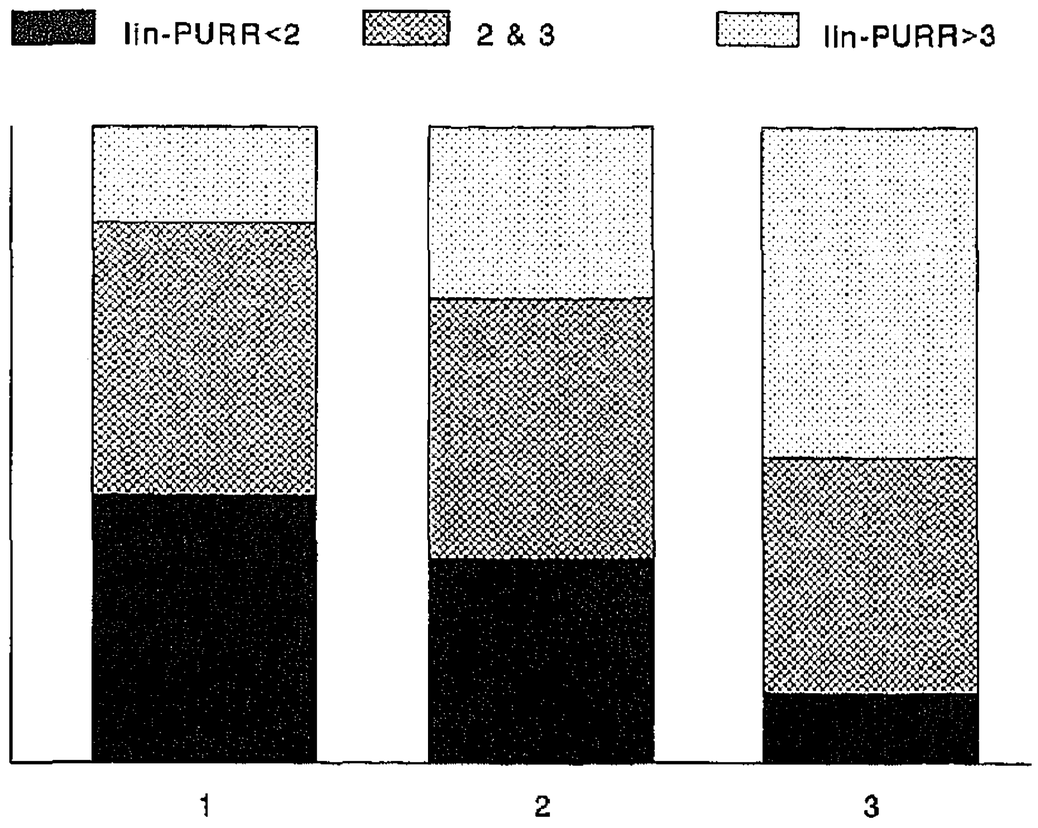

FIG. 5. Correlation between grade of prostatic occlusion (1—none, 2—moderately and 3—severe occlusion) and bladder outlet obstruction according to linear passive urethral resistance relation (*lin-PURR*).

We agree with Elbadawi et al that it remains to be determined whether overactivity and trabeculation represent a cause and effect relationship or are independent manifestations of the same process that initiates structural changes in the aging detrusor in general.[22] They attempted to define a structural and urodynamic grouping of patterns with prognostic, predictive potential in various forms of voiding dysfunction. There seems to be good correlation between the ultrastructural features of the structural patterns and matching urodynamic findings. Widespread degeneration of muscle cells and axons is proposed as the structural correlate of impaired detrusor contractility in the aging detrusor.

The lack of a strong relationship between urological symptoms, and the anatomical and physiological measures of BPH severity has been described by others.[23,24] Our study confirmed this presumption only partially. It appeared that the filling component of the symptom scores correlated significantly with grade of bladder trabeculation. An explanation for this finding may be that with an increase in bladder outlet obstruction an increase in the number of patients with bladder instabilities can be found.

Finally, what is the implementation of our findings in daily clinical practice? A considerable number of urologists still depend on cystoscopic rather than urodynamic findings in the diagnosis of bladder outlet obstruction because they do not have urodynamic equipment at their disposal or are not used to performing urodynamics in patients with BPH. However, bladder outlet obstruction is present in approximately 15% of patients with normal cystoscopic findings (fig. 2, *A*). On the other hand, if severe trabeculation is present, approximately 8% of the patients have no obstruction at all.

CONCLUSIONS

Generally the findings at urethrocystoscopy correlate well with the results of urodynamic investigations. For the individual patient, however, one cannot make the same conclusion. In response to several different etiological factors, the bladder wall undergoes distinct morphological changes that are readily recognized macroscopically as trabeculation. Whether trabeculation is associated with bladder dysfunction with irreversible changes at the cellular level or simply a sign of reversible compensation due to bladder obstruction remains unclear.

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EDITORIAL COMMENT

This significant article contains important data. The study clearly documents a correlation between cystoscopic appearance (grade of trabeculation and grade of prostatic urethral obstruction), and urodynamic indexes of obstruction, detrusor instability and low compliance. The implication of these findings is that cystoscopic appearance can predict obstruction and detrusor instability but the authors have not really shown this to be true. They did not evaluate impaired detrusor contractility. It is possible that the cystoscopic appearance will also correlate with impaired detrusor contractility. If so, then cystoscopy does nothing more than correlate with all of the underlying pathophysiological conditions that account for symptoms in prostatism, that is obstruction, instability, low compliance and impaired contractility. How, then, is this clinically useful? What does it mean for an individual patient if cystoscopy is normal or there is no obstruction? What is the clinical role of these diagnostic procedures? Are they useful or predictive of therapeutic outcomes? We still must learn much more about this most common affliction of men.

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REPLY BY AUTHORS

Currently many studies are being conducted to investigate the pathophysiology of BPH and its effect on the bladder wall. It is generally accepted that the best test to measure bladder function is urodynamic investigation with pressure-flow studies. However, many urologists still rely on clinical experience to diagnose bladder outlet obstruction as "measured" by the results of symptom scores, clinical examination and the findings at urethrocystoscopy. Indeed, in general the urethrocystoscopic findings correlate well with the urodynamic results. For the individual patient, however, one cannot make the same conclusion. Therefore, we believe that the value of urethrocystoscopy is only limited. It should not be used to diagnose bladder outlet obstruction but primarily to exclude bladder pathology and to decide among interventional approaches (transurethral incision or resection of the prostate, suprapubic prostatectomy and so forth).

It remains unclear whether trabeculation is associated with bladder dysfunction with irreversible changes at the cellular level. Recently, Rosier et al analyzed detrusor contraction power in patients with lower urinary tract symptoms and bladder outlet obstruction and concluded that maximum contraction during micturition is affected by the grade of bladder outlet obstruction.[1] Because of this finding and the fact that the correlation between the cystoscopic appearance with bladder outlet obstruction is limited, we believe that the cystoscopic appearance will correlate only poorly with impaired detrusor contractility.

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