THE 'ICED CYSTOGRAM'—A NEW TECHNIQUE FOR DISTINGUISHING OBSTRUCTION AT THE LEVEL OF THE EXTERNAL SPHINCTER FROM OBSTRUCTION AT THE BLADDER NECK

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INTRODUCTION

A PROPORTION of patients following spinal cord injury are unable to empty their bladders adequately unless the resistance to urinary outflow is reduced by resection of the bladder neck or division of the external urethral sphincter. Sometimes both procedures are necessary before satisfactory voiding can be achieved. Since these operations may result in incontinence of urine, they are usually performed only on males as a device for collecting urine from incontinent female patients has not yet been perfected.

In patients with lower motor neuron lesions, obstruction to urinary outflow occurs at the bladder neck because reflex detrusor contractions are abolished or weakened and are unable to pull open the vesical neck. Despite the absence of reflex spasm in the striated muscles of the pelvic floor in these patients, obstruction at the membranous urethra can occur, probably due to the constricting action of elastic tissue in the wall of the urethra in this region.

In patients with upper motor neuron lesions, the absence of sustaining and integrating impulses from the involuntary centres in the brain concerned with micturition may result in ineffective and inefficient detrusor contractions (Tang & Ruch, 1955). These are not strong enough to pull open the bladder neck and obstruction occurs in this area. Spasm of the striated external urethral sphincter raises the urethral resistance and reflexly inhibits detrusor contraction via the second, third and fourth segments of the spinal cord (Bors, 1957). The afferent impulses of this reflex inhibition travel in the pudendal nerves.

In those cases where the vesical neck appears wide open on the cystogram, the operation of choice to relieve the resistance to urinary outflow is division of the external sphincter. In cases where the cystogram has shown little or no opening of the bladder neck it has been the practice in many Spinal Units to attempt to relieve the resistance to urinary flow in two stages (Gibbon *et al.*, 1965; Bunce, 1967; Walsh, 1971; Pearman & England, 1972). First, a transurethral resection of the bladder neck is done. If satisfactory bladder emptying does not result from this procedure, external urethral sphincterotomy is performed.

The authors had believed for some time that in some upper motor neuron lesions, despite apparent failure of the bladder neck to open adequately on cystography, the actual obstruction was at the external sphincter rather than at the bladder neck. Indeed, some of these patients were treated by external urethral sphincterotomy alone, but the decision to do this operation was made on empirical grounds. Division of the external sphincter by itself was effective in some cases but not in others and we did not have a reliable method of selecting those cases

in which it would be successful. Walsh (1971) reported similar experience. As many of these patients showed a positive ice-water test, it was decided to perform cystography using *iced* contrast medium to demonstrate radiologically whether the reflexly stimulated detrusor contraction was capable of pulling open the bladder neck. This might equally well have been done using 'urethral profile' pressure studies, but the necessary equipment was not available and it was found that the 'iced cystogram' was easy to perform and gave reliable results. This technique has been successfully employed in a number of cases and it has been our experience that external sphincterotomy is all that is required in patients with outflow obstruction in whom adequate bladder neck opening has been demonstrated by a cystogram using iced contrast medium.

TECHNIQUE

The patient is catheterised by a non-touch technique in the X-ray department and the bladder is emptied. The catheter is left in position. The patient is positioned A.P. in the 45° oblique position with the urethra overlying the soft tissues of the thigh. *Iced* contrast medium is drawn up into three 100-ml. syringes. We have found a sterile 17.5 per cent aqueous solution of diodone at less than 4°C. (*i.e.* immediately after thawing) to be a satisfactory contrast medium.

200 to 300 ml. of contrast medium is rapidly instilled into the bladder and its passage is viewed on the Image Intensifier (and recorded on the video tape for later evaluation). The catheter is removed at once and films which show the bladder, bladder neck and urethra are taken in rapid sequence as the contrast medium is being expelled.

It should be emphasised that sophisticated X-ray machines are not essential and we have obtained good results with basic equipment (see figures 1-3).

CLINICAL APPLICATION

We have found the 'iced cystogram' to be useful in the radiological investigation of bladder function in patients with upper motor neuron bladders which do not empty satisfactorily after 10 to 12 weeks of intermittent catheterisation.

First, a cystogram is done and an attempt is made to obtain voiding films. If the bladder neck appears wide open, a retrograde urethrogram is performed the following day to confirm obstruction at the level of the external sphincter. However, if little or no opening of the bladder neck is seen on the first cystogram, an 'iced cystogram' is done the second day.

If obstruction at the membranous urethra is confirmed by the retrograde urethrogram or demonstrated by the 'iced cystogram' (when it was not obvious on the first cystogram) the external urethral sphincter is divided. On the other hand, if both the normal and 'iced cystograms' show obstruction at the bladder neck a transurethral resection of the vesical neck and prostate is performed.

ILLUSTRATIVE CASES

R. Y., a male aged 44 years, fell 10 feet and sustained a fracture-dislocation of the twelfth thoracic vertebra on the first lumbar, resulting in complete loss of sensation and motor power below T12. His fluid intake was controlled (125 ml. every two hours)

FIG. 1

FIG. 2

FIG. 3

Fig. 1.—Cystogram of R. Y. The bladder neck has opened only slightly.

Fig. 2.—Cystogram of R. Y. during manual compression.

Fig. 3—Cystogram of R. Y. using iced contrast medium. The bladder neck and prostatic urethra have opened widely but the membranous urethra has remained narrowed and only a small amount of contrast has passed this level.

and his bladder was managed by six-hourly intermittent catheterisation (Pearman & England, 1972). Return of reflex activity in the sacral segments of the spinal cord was observed three weeks after injury when the bulbocavernosus reflex became positive. The ice-water test became positive five weeks later. However, reflex voiding had still not commenced 12 weeks after injury. A specimen of urine was obtained for culture at every catheterisation. During the 12-week period of intermittent catheterisation (345 catheterisations) he had three episodes of significant bacteriuria due to *Strep. faecalis* (two occasions) and *Providencia B* which were eliminated by two-week courses of nitrofurantoin and sulphamethoxazole plus trimethoprim respectively. The intravenous pyelogram was normal. The cystogram revealed slight opening of the bladder neck (fig. 1). No evidence of vesico-ureteric reflux was seen at cystography. Some contrast was forced into the prostatic urethra by manual compression but no contrast passed the external sphincter (fig. 2). A second cystogram using iced contrast medium was done five days later. The bladder neck and prostatic urethra opened widely, but the membranous urethra remained narrowed and only a small amount of contrast passed this level (fig. 3). The diagnosis of obstruction at the level of the external sphincter was made and this muscle was divided endoscopically. Following removal of the catheter on the third day after the operation, reflex voiding in response to 'tapping' of the skin of the suprapubic region occurred. The residual urine was 35 ml. and a positive ice-water test was elicited. He has had two further urinary tract infections due to *E. coli* and *Bacterium anitratum*, but at the time of writing, four months after the external urethral sphincterotomy, his urinary tract is not infected and the residual is 5 ml.

J. E., a male aged 20 years, became completely paraplegic below T11 as the result of a gunshot wound. His bladder was managed by six-hourly intermittent catheterisation. The bulbocavernosus reflex became positive three weeks after injury and a positive ice-water test was elicited during the seventh and eighth week after injury, but positive responses to the ice-water test were not obtained after the eighth week. Ten weeks after injury he was still unable to void and was requiring intermittent catheterisation every six hours. At each of these 293 catheterizations a specimen of urine had been obtained and cultured and there were no episodes of significant bacteriuria. A cystogram showed slight opening of the bladder neck during manual compression but no filling of the urethra occurred. No evidence of vesico-ureteric reflux was seen. An 'iced cystogram' was performed on the following day. The bladder neck opened widely and some bladder emptying occurred but the membranous urethra appeared to be narrowed. When the urinary flow ceased the external sphincter closed before the bladder neck. An external urethral sphincterotomy was performed, after which he voided reflexly and had a residual urine of 15 ml. He has remained free of urinary tract infection since the operation.

SUMMARY

A new technique of cystography is described which demonstrates radiologically the ability of the detrusor contraction to pull open the bladder neck in some patients with upper motor neuron bladders following spinal cord injury in whom this has not been shown by the normal methods of cystography. Resection of the bladder neck as a first-stage procedure can be avoided in patients with outflow obstruction in whom bladder neck opening has been observed on the 'iced cystogram', since division of the external urethral sphincter is usually all that is necessary in these cases.

RÉSUMÉ

Une nouvelle technique de cystographie est étudiée pour démontrer radiologiquement la possibilité de la contraction du détrusor pour ouvrir le col de la vessie, chez certains

malades avec des vessies neurogènes automatiques, à la suite d'un traumatisme médullaire, chez qui l'ouverture du col n'a pas été démontrée, par les méthodes cystographiques normales.

La résection du col, comme première intervention, peut être évitée chez des malades dont le 'cystogramme glacé' est positif, La résection du sphincter strié n'étant uniquement nécessaire dans ces cas.

ZUSAMMENFASSUNG

Eine neue Technik der Zystographie wird beschrieben, welche in Patienten mit spastischer Bladder nach Querschnittlähmung die radiologische Darstellung der Öffnung des Blasenausgangs als Folge der Detrusorkontraktion ermöglicht. Die Resektion des Blasenausgangsgewebes kann bei dem Ergebnis des 'Eis-Zystogramms' vermieden werden und die Resektion des externen urethralen Sphinter allein genügt zur Beseitigung der Obstruktion.

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