TABLE V.—Comparison of the Speech Results Following Fracture of the Pterygoid Hamulus With Those Following Tenotomy of the Tensor Palati

Speech	Fracture	Tenotomy
Class I	16	15
" II	18	9
" III	10	—
	44	24

of 31 patients who achieved class I, 16 had had fracture and 15 tenotomy, although almost twice as many were treated by fracture.

There has been considerable discussion about the optimal age for operation, with little in the way of statistics to substantiate the various views expressed. Wardill (1933) advocated operation early, in the expectation that the provision of an intact mobile palate before speech was attempted would permit this to develop in the normal way. Dorrance (1933) operated regularly at the age of 3 or 4 years, and claimed that speech was as good as with the early operation.

The results analysed in Table VI suggest that children operated on before the age of 9 months have a much better chance of achieving normal speech than those treated later,

TABLE VI.—Age at Which Palate was Closed

Age	No. of Cases	Class I speech in 77%
6 to 9 months ..	16	..
10 " 12 " ..	17	..
13 " 15 " ..	18	..
16 " 18 " ..	12	..
19 " 24 " ..	7	..
2 years ..	5	..
3-4 " ..	3	..
5 to 10 years ..	3	..
11 " 15 " ..	1	..
Over 15 " ..	3	..

and it should also be noted that no case operated on after the age of 3 years had a class I result.

Summary

In 100 cases of cleft-lip and/or cleft-palate both lip and palate were affected in 51, the palate alone in 36, and the lip alone in 13.

All lesions were more common in males.

In 18.8% there was known to be a relative of the child with a cleft.

Six children had associated congenital abnormalities, but in none was operation impossible.

Sixty-one operations were performed for primary lip closure and 85 for palate closure. There was no mortality.

Of the children born with cleft-palate, 47% are speaking without detectable abnormality, and a further 38% have only minor faults. Of the patients operated on under the age of 9 months, 77% speak normally.

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PERSISTENT ADULT BED-WETTING TREATED BY SACRAL NEUROTOMY

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Definition and Aetiology

When the wide and varying group of cases loosely termed enuresis has been analysed and from it excluded all instances of precipitancy, defective control, and unintended bladder evacuation, diurnal or nocturnal, in which organic disease of the urinary tract (infections, developmental abnormalities of bladder and urethra) or of the nervous system has been demonstrated, there remains the clearly defined essential enuresis. This is a continuation of the irregular bladder action of infancy, commoner in the male than in the female, tending in most cases to be outgrown before puberty, though persisting in some cases until much later. It consists in bladder evacuation during sleep without awakening; in a great many cases there is an accompanying diurnal precipitate micturition amounting almost to incontinence and almost a strangury when it is attempted to hold back the urine. When in severe cases the enuresis finally ceases by degrees—as a rule with sporadic recurrences—the patient is left with a "weak" bladder with lifelong diurnal precipitate action.

During the years of active and frequent enuresis the life of the young patient is miserable; to go away from home is a recurring terror and shame, particularly as the most recent attitude appears to be that enuresis is a form of juvenile delinquency to be treated by "pep" talks and putting the young patient "on his honour"—the implications of which he greatly resents if he is at all sensitive and intelligent. Psychiatric thought regards it as an Oedipus matter—the boy, right on to adult life sometimes, wetting his bed to spite his mother and father for sleeping together. It is to the good that the time-honoured hunt for exciting causes (phimosis, worms, enlarged tonsils, etc.) has been abandoned, likewise the consequent operations, even as cures by suggestion. It is true that the patient can be "trained" to endure an uncomfortable bladder during the day for fairly long periods. This, however, is no more curative of the underlying condition than is inducing nocturnal anuria by fluid abstinence during the latter part of the day. The exceptionally good results claimed on hospitalization, when the patient is wakened every hour or so during the night, are open to similar criticism. Treatment by belladonna (as a parasympathetic inhibitor) and by amphetamine (partly a mild sympathetic stimulant, but acting mainly by producing light if any sleep) have equally transient effects.

The unsatisfactory position of treatment is reflected in the enormous literature by the vagueness of views expressed regarding the underlying cause. In the agreed absence of identifiable organic disease, recourse is had to mental and psychiatric defects, reflex factors, and so on; the most positive view was the old expression "pelvic neurosis." It is interesting to note that some fifty years ago Cathelin practised the flooding of pelvic nerves with saline or anaesthetic solutions by epidural injection into the sacral hiatus for the treatment of

"pelvic neuralgias, sexual neuroses, and incontinence." Development of the view that the condition is an inborn defect of nerve control of the bladder has been greatly hindered by the even now highly controversial opinions on the mechanism of the latter.

Innervation of the Bladder

Even here, though the source, deployment, and final distribution of the vesical and other visceral pelvic nerves are well known, the matter is further complicated by a variable and inconstant nomenclature.

The bladder, seminal vesicles, prostate, and lower ends of the ureters, among other organs, are supplied by numerous filaments of the (inferior) hypogastric plexus, which lies in the lateral part of the true pelvis. The part of it

supplying the bladder is sometimes termed the extrinsic vesicle plexus; it is without any sharp demarcation from the rest of the plexus, however. In the submucous and muscular coats fine intrinsic (vesical, urethral, etc.) plexuses are formed before the final distribution of fibres. On both the intrinsic and the extrinsic plexuses the fibres subserving opposing functions are indistinguishably mixed; no satisfactory inferences may be derived from disease in, or stimulation of, either of these situations.

FIG. 1

Sources of Bladder Innervation.— The (inferior) hypogastric plexus

is formed from: (a) *The lumbar sympathetic.* Branches from the lumbar ganglia pass to the presacral or superior hypogastric plexus; the innervation ultimately reaching the bladder is derived probably from the first and second ganglia. From the presacral plexus the fibres pass to the (inferior) hypogastric plexus via the hypogastric nerves, some possibly via branches to the pelvic parasympathetic chain. The site of synapse is open to dispute, but does not affect the question of function. (b) *The sacral nerves.* Filaments pass from the trunks of S2, 3, and 4 immediately on their emergence from the sacral foramina; the major contributor is usually S3, the least S4. Some of the fibres pass direct to the hypogastric plexus, others to the ganglia of the pelvic parasympathetic chain—a continuation of the lumbar chain passing under the common iliac vessels—to lie immediately in front of the sacrum slightly medial to the foramina. The sacral branches—short filaments 4–8 mm. long—pass, therefore, some slightly medially, to join the parasympathetic chain and others laterally to join the plexus. They are best displayed by lifting the cord forwards and outwards. The parasympathetic chain gives numerous branches throughout to the plexus.

Function

(a) *Motor.*—Since the classic researches of Learmonth there has been little or no doubt concerning the main function of the sympathetic component: stimulation causes con-

traction of the bladder neck of the prostatic and seminal vesicular musculature, and of the ureteral orifices, together with relaxation of the detrusor. This part of the innervation is capable of simulation (hypogastric nerves, presacral plexus) without overflow of stimulus into the sacral part; but a brief consideration of the anatomy shows that the effects of pure stimulation of the latter are practically impossible to obtain. That the function of sacral innervation is antagonistic to the sympathetic is inherent in the term parasympathetic: the nomenclature which applies this term to the cord continuing the lumbar sympathetic into the pelvis is unfortunate and misleading. The evidence comes from several sources: compression of sacral nerves by very low spinal disease; operative removal of parasympathetic trunks; and disease or operative damage—for instance, in abdomino-perineal resection of the rectum with a posteriorly adherent growth—all show that damage or removal of the sacral supply leaves a bladder now solely under sympathetic control, without emptying power, and with an obstinately contracted neck. This confirms the quoted effects of sympathetic stimulation and disproves the view that the sacral supply controls both emptying and retention.

(b) *Sensory.*—The question of sensation is more under dispute, and in particular whether the sympathetic supply is sensory in addition to motor. Several observations favour such a view. For instance, patients with a transverse cord lesion above the sacral level "have been aware of filling and emptying of the bladder"—the cautious and honest wording is to be noted. Stimulation of the presacral nerve in the conscious patient has caused an accurately localized pain over the bladder. On the other hand, presacral neurectomy gives very little relief of chronic bladder pain. The vesical sensation in cord lesions may well be peritoneal in origin. I incline to the view that it is vasomotor in origin, adding my experiences with local analgesia of the bladder.

Local Analgesia of the Bladder

During the past 13 years I have performed some 700 prostatic and bladder-base operations under a local analgesic combination. The essential feature is sacral spinal anaesthesia. With the patient sitting, about 0.8 ml. of hyperbaric cinchocaine hydrochloride is injected without barbotage through the lowest interspinal interval, 12–15 minutes being allowed for fixation. The upper level of anaesthesia is S1, shown by paraesthesia of the Turkish slipper area. On the table the hypogastric abdominal wall is anaesthetized by a fan of infiltration with 0.5% procaine*; for vasectomy a further small injection into the cord, supplied from D12 to L1, is required. The method was adopted in order to undertake prostatic operations in even the worst cardiovascular risks: it was developed from the knowledge that transurethral diathermy and resection can be painlessly performed under low spinal analgesia alone, always provided that S1 shows clear signs of anaesthetization. Ordinary sensation—pain of cutting and burning, and, in the enucleation of adenomata, distension of the prostatic bed and the adjacent trigone—therefore travels purely via the sacral nerves.

It was originally intended that the sympathetic element, even in the lumbar region, should be unaffected, in order to avoid the least fall in blood pressure; it was not foreseen that the preservation of the sympathetic supply would result in a most helpful and favourable "fluke"—the removal of sacral inhibition giving virtually a sympathetic stimulation. After enucleation of adenomata the bladder base and prostatic musculature contract down, providing an active haemostasis lasting with cinchocaine some three hours. (This contrasts most favourably with the false haemostasis seen with high spinal analgesia, resulting often in severe reactionary haemorrhage.)

In cystoscopy it is observed that a low spinal analgesic is undesirable when it is necessary to catheterize ureters; the contraction of the bladder base, particularly of the

*Adrenaline should not be employed in elderly patients as there is a great risk of setting up fibrillation.

musculi ureterae, sharply angulates the intramural course of the ureter, making it impossible for the catheter to do more than just enter the orifice. Further, with sacral spinal anaesthesia there is retention as long as the anaesthesia lasts. These various experiences confirm—were it necessary—the retentive sympathetic control described by Learmonth; the effect is clearly not a *purely* vascular one as is sometimes held.

The Bladder-emptying Mechanism

There is evidence to support the view that two distinct types of sensory impulse derive from the bladder base—first, the discomfort and pain when distension begins to stretch the trigone, and, secondly, that of the prostatic urethra which is associated with the sensation of micturition (this is evoked clinically when the examining finger presses into the prostatic groove and in painful disease amounts to strangury). Physiologically, when urine enters and distends the prostatic urethra the sensory impulse via the sacral nerves sets off the detrusor-stimulating, sympathetic-inhibiting reflex of micturition, which then becomes automatic. The trigonal and the prostatic sensations are distinct and different; for long the increased frequency of “middle lobe” prostatic enlargement has been attributed to the carrying up into the bladder of this “trigger” prostatic mucosa and to its being subjected to urinary contact (better, participation in trigonal stretching).

Mechanism of Enuresis

An enticing explanation of the phenomena of enuresis would be an ectopic distribution of the innervation of the prostatic urethra, overlapping the bladder neck and extending on to the trigone: the upward growth of the prostate would engulf the ectopic area progressively, accounting anatomically for the amelioration in most cases, and particularly in some severe ones about puberty. Confirmation by *cystometry* is difficult to obtain, for observations made with a catheter in contact with the urethra clearly present fallacies, as would the use of any form of anaesthesia to remove the effects of stimulation by the instrument. The usual cystometric findings in enuresis are that distension of the bladder up to a considerable volume is tolerated normally, but then extreme intolerance, urgency, and precipitancy develop. There is therefore neither a mental basis nor a general trigonal hypersensitivity, for the volume tolerated implies a considerable degree of trigonal stretching; the specific reaction occurs when the stretching affects the bladder neck, the last place to be affected by the process. In the enuretic this seems to behave as if innervated like the prostatic urethra.

The alternative hypothesis is “parasympatheticotonia”—both motor and sensory; the former implying excessive inhibition of the retentive factor, the latter sensory hypersensitivity (that this does occur is shown by the occasional patient who is completely unable to permit even a soft catheter to remain in his urethra). The converse—sympatheticotonia—has been accepted as a cause of sphincter disturbances in, for instance, achalasia of the cardia and hydronephrosis, and it seems reasonable to extend the type of explanation to enuresis, in which it seems more satisfactory than the idea of an ectopic nerve supply. In either case, however, a surgical reduction of the nerve supply to the bladder base and prostatic urethra clearly offers itself as a radical, or at least a *permanent* symptomatic, treatment of enuresis.

Sacral Neurotomy

There being no information whether the sacral supply has a segmental character—for example, does S 2 supply the trigone and S 3 the prostatic urethra?—as might be expected on developmental grounds, an empirical reduction in the nerve supply should increase sphincter tonus, decrease detrusor tonus and sensitivity, and produce a normal balance. Division of the fibres from S 2 on both sides and crushing of those from S 3 on one side is a likely com-

promise, interfering temporarily only with part of the components of *nervi erigentes*. In the typical case the scales swing strongly to the side of retention for several days, a balance between the two functions being recovered in ten days or so.

Operation

With the patient in a moderate Trendelenburg position, the abdomen is opened in the midline below the umbilicus and the gut packed conveniently away. The pelvic peritoneum is incised posteriorly from the midline at the sacral promontory down to the right of the rectovesical pouch (Fig. 2). The edges of the peritoneum are lifted gently aside along the whole extent and the presacral fascia is similarly divided (Fig. 3). Neither procedure is attended with more than the slightest bleeding. The edges of the fascia, held by forceps, are very gently and gradually raised and peeled outward by gauze dissection on the right side; the parasympathetic chain and the sacral foramina come into view. The former is easily seen; the latter are obscured by loose connective tissue, fat, and small veins. No attempt should be made to demonstrate them by dissection laterally to the parasympathetic chain until the latter has been elevated and drawn outwards; their branches are then seen, some going to the chain and some direct to the hypogastric plexus (Fig. 4). The temptation to define the foramina other than by touch must be resisted, for any dissection is almost certain to result in haemorrhage from fragile veins obscuring and staining the fine filaments and rendering accurate section uncertain. With the chain well raised and drawn outwards, the branches from S 2 and S 3 can be fully defined by gentle open-and-shut forceps-tip movements.

All branches from S 2, both to the chain and outwards to the plexus, are divided, and the foramen is covered with a small disk of wax. The branches from S 3 are crushed. The exposure is repeated on the left side, and branches of S 2 are divided and a disk of wax, in later cases a small sheet of aluminium foil, again is applied over the foramen. The presacral fascia, the peritoneum, and the abdominal wall are closed in the normal appropriate way.

FIG. 2

FIG. 3

FIG. 4

Case Reports

Case 1.—A man aged 23, admitted for interval appendectomy; enuresis since infancy, also diurnal urgency; had to rush to leave class at school. Treated by medicines and tablets (amphetamines recently), fluid restriction in latter part of day, micturition very late at night, etc. Had given up all treatment as a bad job. Enuresis about four to six times a week; even in hospital, with very restricted fluid, enuresis occurred two nights in four when awaiting operation. No organic disease of nervous or urinary system. Cystometry: 4 oz. (113 ml.), pressure 16 cm.; 10 oz. (283 ml.), 18 cm.; 16 oz. (454 ml.), 21 cm.; 17 oz. (480 ml.), precipitate emptying of bladder. Admitted for interval appendectomy, he gladly accepted the chance that a nerve section might at least improve his condition. At operation S 2 divided on both sides; S 3 crushed on the right. Appendectomy. In this first case the procedure, above recommended, of elevating and drawing outwards the chains was not adopted, and the foramina were exposed and defined by blunt dissection. Exceedingly troublesome bleeding made accurate nerve section difficult and problematic. During convalescence he had complete retention for first 24 hours, and passed a great deal at a time; during the next eight days frequency gradually returned to normal. The urgency by day disappeared. He reported at intervals after discharge; enuresis recurred, but to a far less extent than before—twice a month, three times a month, even five or six times a month. This was without precautions about taking of fluid, getting up last thing at night, etc. The daily urgency has completely disappeared. This is the state at 28 months after operation; clearly only a partial success owing to the uncertainty in the operative procedure, and to regeneration.

Case 2.—Male aged 20; enuresis since infancy, treated with numerous drugs and tablets and restricted fluids with temporary and slight improvement, but always relapsing on cessation of treatment to nightly bed-wetting even with restricted fluid and late waking; enuresis in hospital five times a week (admitted for operation on tendo Achillis). No gross organic disease in nervous or urinary system. Cystometry: 4 oz. (113 ml.), pressure 14 cm.; 8 oz. (226 ml.), 16 cm.; 12 oz. (340 ml.), 21 cm.; 16 oz. (454 ml.), 21 cm.; 18 oz. (510 ml.), precipitate emptying of bladder. Sacral parasympathotomy performed; branches S 2 divided both sides; S 3 crushed on right. During three weeks' convalescence in hospital no enuresis, though none of previous precautions taken. During first four days large quantities passed at wide intervals; micturition, initiated only when bladder contained as much as 18 oz. (510 ml.), was easily controlled and quite effortless. Thirteen months later he reported enuresis now thrice a week since operation. No precautions had been observed; the diurnal urgency had completely disappeared; there was no abnormality of bladder or of sex function.

Case 3.—Female aged 23. Enuresis at least three times a week; daily frequency four or five times, always with great precipitancy. Unaffected by dexamphetamine sulphate or fluid intake. Cystometry: pressure 70 cm., volume 700 ml., intense and precipitate micturition (continuous flow); 40 cm. pressure, intense desire to micturate (interrupted flow). No organic disease of urinary or nervous systems. Operative division branches S 2 both sides, crushing S 3 on right. Post-operatively no precautions taken; during 18 days' convalescence she always woke at night when micturition was needed; had never done this in her life before. Reporting nine months later, stated bed wet thrice in each month without any precautions taken.

Case 4.—Male 22. Enuresis since childhood, now five or six times a week, great diurnal precipitancy. Had had treatment by medicines and tablets, restricted fluid, waking by alarm clock in early morning, etc. No organic disease of urinary or nervous systems. Cystometry: 5 oz. (142 ml.), 14 cm. pressure; 10 oz. (284 ml.), 16 cm.; 15 oz. (425 ml.), 20 cm.; 17 oz. (480 ml.), precipitate emptying. Sacral parasympathotomy; S 2 divided both sides, S 3

crushed on right; fine filaments from S 1 on both sides also divided. Normal post-operative course. No enuresis in 16 days; diurnal precipitancy gone. Reported ten months later: no enuresis since discharge, though no precautions taken; still free from diurnal precipitancy.

Case 5.—Male 23. Enuresis six nights in seven. All the usual remedies have been tried. Great daily frequency with precipitancy. Cystometry: 5 oz. (142 ml.), pressure 15 cm.; 10 oz. (284 ml.), 16 cm.; 15 oz. (425 ml.), 20 cm.; 16 oz. (454 ml.), precipitate emptying. This was repeated after administration of a sacral spinal anaesthetic; similar pressures were recorded, but with 20 and 25 oz. (568 and 710 ml.) there were pressures of 24 and 27 cm. still without emptying. Sacral filaments from second divided on the right, from third on both sides; aluminium foil applied over the roots. There was complete retention for 30 hours relieved by catheterization; at the end of a week micturition occurred about every five hours. At the end of five months no recurrence of enuresis; precipitancy of micturition also had not recurred.

Comments

Whether the view taken of the essential nature of enuresis is correct or not, the cases treated by nerve section show one very partial cure over 26 months, no doubt owing to insufficient nerve division and regeneration, two very near cures of 14 and 16 months, and one nine-months cure. In all cases none of the previous restrictions and precautions have been observed; in all, the previous precipitancy had disappeared. The choice of nerve fibres for section is admittedly empirical; it would appear, however, that in the later cases a middle course has been successfully steered between the Charybdis of enuresis (an exaggeration but not entirely inapt!) and the Scylla of retention; the use of crushing only of S 3 was resorted to in case there was, so to speak, over-correction of the enuresis, when nerve recovery would correct this error. On the whole, the amount of nerve division is, if anything, on the timid side. Many more precautions are needed against regeneration. Any mention of an operation on the pelvic sympathetic seems automatically to evoke great concern for the nervi erigentes. There has been no complaint on this score, and, in any case, only a small part of their origin is put temporarily out of action. It might be argued that a temporary damping down of the function concerned in the adolescent male would not be entirely a bad thing.

The cases operated on have been of the severest type; it remains to be seen if the parents of a lad of 10 years or so, with nightly enuresis and the probability of years more of the humiliating condition before a problematic recovery ensues, will not seriously consider the prospect of cure afforded by an operation of little more than interval appendectomy risk and inconvenience.

The application and extension of the procedure to other conditions is no part of the present communication; it is clearly a necessary adjunct to complete interruption of the sympathetic supply to the pelvis in order to obtain complete denervation for painful conditions, and is simpler than the wide and not entirely satisfactory excisions of hypogastric plexuses that have been used. It should afford at least symptomatic relief in cases of stress incontinence, and even in some cases of inexplicable habitual abortion.

The work of the speech therapist, an occupation open to both men and women but so far followed mainly by women, is described in a booklet recently issued by the Central Youth Employment Executive (*The Speech Therapist*. Choice of Careers Series, No. 51, H.M.S.O., 6d.). Details are given of the work in school clinics, which deal solely with children, and in hospitals, where both children and adults are treated. Information is given on the educational qualifications required, arrangements for training, employment prospects, and salaries. This booklet is one of a series intended primarily for boys and girls who are about to decide the kind of work to take up on leaving school.