RENAL SYMPATHETICO-TONUS AND RENAL SYMPATHECTOMY*

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UNTIL recent years little or no attention has been directed in surgical literature to the sympathetic nervous system in its relationship to the urinary tract. That sympathetico-tonus has a definite place as an etiological factor in the pathology and morbidity of the urinary tract has not, we believe, up to the present time, been sufficiently recognized. It has seemed desirable, therefore, to place on record some observations gleaned from our Urological Clinic at the Lewisham Hospital during the past four years, which, it is believed, clearly demonstrate the significance of renal sympathetico-tonus as a definitely recognizable clinical and pathological entity.

Nearly four years ago our attention was directed to the possibility of a neuropathic basis in a considerable number of patients suffering from varying grades of renal pain, in whom a full urological study revealed little or no gross abnormality. In fact, with the exception of a positive pain reproduction test, delay in emptying of the pyelographic medium, and possibly slight clubbing of the renal calices and dilatation of the pelvis, essentially normal renal findings were the rule. Patients of this type were allowed to drift without the institution of any active treatment, though occasionally exploratory operation, or even nephrectomy, was demanded for the relief of pain. We decided to submit one of these patients to a denervation of the kidney, in the hope that this might afford the desired relief. The result of this operation exceeded our most sanguine expectations, and from that time to the present we have performed it on 28 patients with the greatest satisfaction, and, so far as it has been possible to determine, without any recurrence of pain, though in one patient the operation had to be done at a later date on the opposite kidney. The name of "renal sympathectomy" has been applied, more or less accurately, to this operation. It is noteworthy that there was associated in some of these cases generalized sympathetico-tonus, which in three patients was most marked on the side of the lesion, *e.g.*, increased excitability of the knee-jerks and delayed relaxation-time in the lower limb of the same side. When this occurs it is a collateral diagnostic sign of considerable importance.

In addition to the above group of cases for which the operation was essentially devised we have performed renal sympathectomy on one patient with so-called "essential" hæmaturia, and on one patient with parenchymatous nephritis. The former patient was admitted to Lewisham Hospital with a long-standing history of very persistent hæmaturia, which, as repeated investigation showed, came from the right kidney. Operation was undertaken on the hypothesis that there was spasticity of one, or possibly more, of the papillary ring-muscles surrounding the base of the papilla with consequent venous engorgement of the papilla and hæmaturia, and that this condition might be relieved by sympathectomy. At that time we had not adopted pyeloscopy, and no proof of this assumption was forthcoming. However, the operation was completely successful, and there has been no recurrence of bleeding for now more than fourteen months. The patient with parenchymatous nephritis was referred to the Urological Department at Lewisham Hospital as she was rapidly losing ground, despite intensive medical treatment. Both kidneys were operated on, with three months' interval between the operations. The result, in the year that has elapsed since the first operation, has proved most satisfactory to all concerned.

We merely desire here to place these two cases on record with a view to future investigation. Animal experiments are being carried on by one of us which will be recorded at a later date. Meanwhile it is hoped that interest in other quarters will be stimulated.

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From a physiological point of view, so far as the secretory activity of the kidney is concerned, the operation is harmless; and it is probable that in some diseased conditions of the renal parenchyma considerable benefit will accrue from the ensuing vaso-dilatation and improved circulation. Since the introduction of pyeloscopy into our clinic, the reason for the success of renal sympathectomy in our early cases has become evident, and the indications for its use have become more clearly defined.

INDICATIONS FOR RENAL SYMPATHECTOMY

The pyeloscopic and pyelographic indications for renal sympathectomy (and presumptive evidence also of the existence of renal sympathetico-tonus), so far as the present state of our knowledge permits us to determine, fall broadly into three groups:—

Group (a).—*Irregular and incomplete contractions of the calices and renal pelvis, so that the impulse for peristalsis either does not reach or does not pass beyond the uretero-pelvic junction. Delayed emptying time is a natural corollary.**

This group is characterized by intermittent colicky pain, generally, though not necessarily, of a moderate grade of severity. The condition is really one of fibrillation, closely akin to auricular fibrillation in the heart. It arises probably from a neurogenic spasm or obstruction of the necks of the calices or uretero-pelvic junction.

The researches of Max Brödel, quoted by Kelly and Burnam in their work on "Diseases of the Kidneys, Ureters and Bladder", have shown that there is a series of ring-muscles encircling the bases of the papillæ, the necks of the minor calices and the necks of the major calices, and a stronger muscle at the uretero-pelvic junction, in addition to others in the lower ureter (*vide* Fig. 1). As these muscles, like any other sphincter, are normally in a state of tonic contraction, sympathetico-tonus makes their relaxation difficult, *i.e.*, induces a condition of spasm. This leads to increased tone of the muscles of the pelvis and calices and to increased intra-pelvic pressure. As the sympathetic nerves fix posture, both in relaxation and in contraction, the irregularity of the contractions which characterizes this condition is probably due to an impulse for contraction breaking through this inhibition at different points.

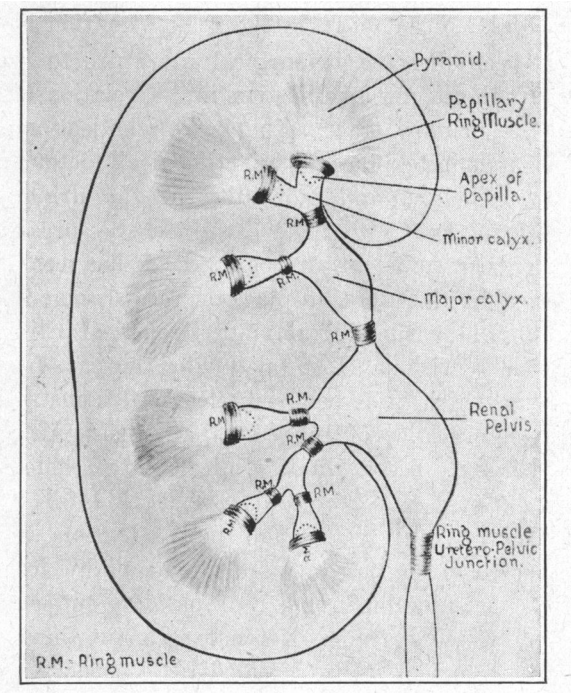

FIG. 1.—Ring-muscle system of the renal pelvis and calices, after Max Brödel ("Diseases of the Kidneys, Ureters and Bladder", Kelly and Burnam).

Just as in the case of voluntary muscle, as the work of Royle has shown, the characteristic that is conferred by sympathetic ramisection is the ability to relax, so relief is afforded by renal sympathectomy because the inhibiting influence is cut out, and there is no factor interfering with movement. In plain language, overaction of the sympathetic nervous system on the musculature of the renal pelvis, calices and ureter impedes their movements and makes them difficult, induces increased intra-pelvic and intra-calical tension, and causes pain. Renal sympathectomy removes this impediment, with resultant lowering of tension and relief of pain. It is essential for the success of renal sympathectomy, however, that any organic obstruction of the ureter should, if present, be removed, otherwise the contractions will still be inefficient, and the condition of fibrillation will still persist.

The association of the two conditions (*i.e.*, neurogenic and organic obstruction) is by no

* The normal sequence is for the calices to contract in regular order from above downwards, followed by contraction of the renal pelvis, which institutes a peristaltic wave in the ureter, which in turn is propagated into the bladder. The normal emptying time with an aqueous pyelographic medium does not exceed ten to twelve minutes.

means uncommon, and two of our patients with well marked ureteral stricture required renal sympathectomy to complete the cure, even after full dilatation of the stricture had been accomplished.

It is *sine qua non* that the presence of organic ureteral obstruction be eliminated before drawing conclusions from the pyeloscopic and pyelographic examinations.

Group (b).—*Marked slowing down with irregularity and increased power of the contractions, associated generally with dilatation of the renal pelvis and clubbing of the calices. Delayed emptying time is a feature here also.*

Clinically, this group is characterized by more persistent dull pain, with liability to acute exacerbations. Relief of the obstruction is followed by disappearance of the clubbing of the calices, at any rate in early cases, for here the papilla is merely forced out of the calyx by the increased intra-pelvic pressure, and returns to its normal position on relief of this pressure. Though definite proof is at present lacking, it is probable that the findings in this group represent a later stage of group (a), though patients may remain in group (a) for many years without showing signs of dilatation of the pelvis or calices.

The above is the presumptive explanation of the origin of many cases of hydronephrosis which occur without evident cause. The condition has a close analogy to Hirschsprung's disease of the large bowel, or megacolon.

This type of obstruction and its attendant pain are sometimes very effectually and immediately relieved, at any rate temporarily, by the hypodermic injection of eserin, the regular exhibition of which for more or less prolonged periods sometimes induces well co-ordinated, firm contractions which are readily demonstrated by pyeloscopy. The recurrence of symptoms after temporary relief by eserin is a very definite indication for renal sympathectomy.

The use of eserin for inducing contractions of the renal pelvis was first suggested to us by Dr. Leon Jona, of Melbourne, and will, we believe, prove of very great value in some of these cases. Our experience, however, is too recent to warrant dogmatism in this regard.

Group (c)—*Dilatation and immobility of a single calyx, and its delayed emptying.*

This condition has been found in two of our recent cases and is included here as a third group, though it is probably merely a variant of group (b).

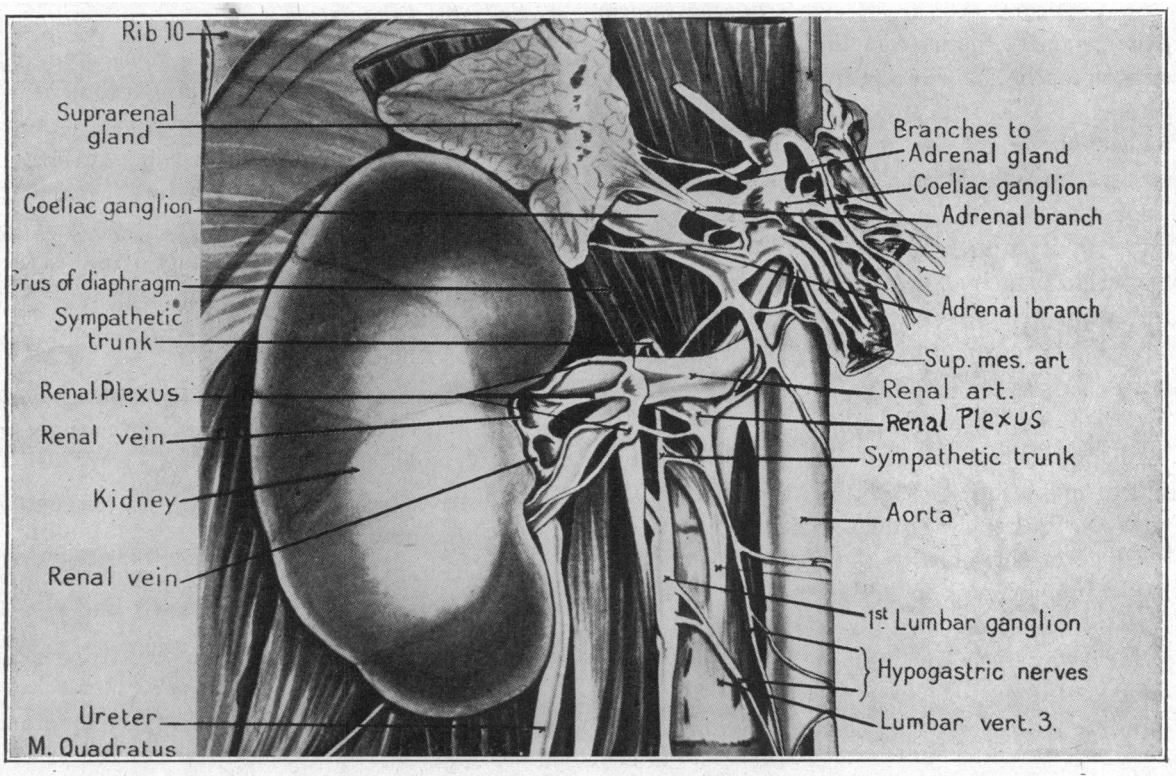

FIG. 2.—Nerve supply of the kidney. Photograph of a dissection in the Department of Anatomy of the Medical School of the University of Sydney.

On pyeloscopy, it was found in these two patients that the renal pelvis and unaffected calices filled in the normal way, *i.e.*, the pelvis first, and the calices progressively and more or less simultaneously from the pelvis outwards. The affected calyx, however, did not begin to fill until the remaining calices were completely outlined, and, on filling, this calyx was definitely clubbed. During the progress of pyeloscopy it remained, to all intents and purposes, completely immobile, and the neck of the calyx remained invisible throughout, probably in a state of spasm. The involved calyx was still distended after a lapse of twenty minutes, long after the remaining calices and pelvis had discharged the medium. Though no operation has yet been undertaken in these two patients, it is a reasonable assumption that the lesion is one of localized sympathetico-tonus.

THE NERVE SUPPLY OF THE KIDNEY

The nerve supply of the kidney (*vide* Fig. 2) is derived from the plexus renalis, which is a branch of the cœliac plexus. The former receives also a direct branch from the nervus splanchnicus minor, which has its origin from the tenth to the twelfth thoracic ganglia, and a branch from the suprarenal plexus. The kidney, therefore, probably has a double innervation, namely, both from the sympathetic and para-sympathetic (*i.e.*, through the vagus) systems.

There is a definite nerve arising from the renal plexus which runs along the posterior inferior aspect of the pelvis and accompanies the ureter in its upper part. This is the so-called "superior principal nerve" of the ureter. The "inferior principal nerve" arises from the hypogastric plexus.

OPERATIVE TECHNIQUE

Adequate exposure and illumination of the field of operation are essential; the operation is otherwise quite impossible. The kidney is exposed extra-peritoneally through a boomerang-shaped lumbar incision, and completely delivered from its fascial and fatty coverings. Beginning as far away from the kidney as is reasonably possible, the pedicle is isolated from the surrounding tissues, *working continuously outwards towards the kidney*. It considerably simplifies the operation when the pedicle can be attacked at some distance from the kidney before the vessels commence to branch. Where the kidney can be completely delivered this is a comparatively easy matter, but in the case of a very short pedicle it may be impossible, and the dissection will have to begin closer to the hilum of the kidney and be carried out in the depths of the operative field.

Cleaning up the pedicle by gauze dissection from the kidney *inwards*, as advised by Papin in his work on "Operations of the Kidney", we have found to be fraught with great danger of tearing the fine branches of the renal artery and vein. The hæmorrhage from this source may be exceedingly difficult to control and necessitate nephrectomy. After the pedicle has been isolated the individual vessels are attacked in turn by careful instrumental dissection, beginning on whichever aspect of the pedicle affords the most ready access, and always working in the direction of the kidney. Each vessel is completely denuded of connective tissue, and all tissue lying between the vessels is removed. The renal pelvis, on both aspects, as far as the hilum, the uretero-pelvic-junction, and the first inch of the ureter are also cleaned up, the superior ureteral nerve being divided in the process. Finally, the kidney is attached solely by its denuded vessels and ureter.

The operation is extremely tedious, and demands painstaking care. A complete operation alone will insure a satisfactory result. Occasional cases will be encountered in which the tissues surrounding the pedicle are extremely fragile and bleed at the slightest touch. This occurred once during the currency of this series and rendered the operation impossible.

SUMMARY

It is believed that the following findings constitute a syndrome definitely indicative of "renal sympathetico-tonus":—

1. Positive pain reproduction test on cystoscopic examination.

2. Positive pyeloscopic and pyelographic findings as described in groups (a), (b) and (c).

3. Delayed emptying time of the renal pelvis and calices, or possibly of a single calyx.

4. Recurrence of pain after its temporary relief by eserin.

5. Evidence of generalized sympathetico-

tonus, which may be most marked on the side of the lesion.

6. Negative urinary findings on microscopic and cultural examinations.

7. Proved absence of organic ureteral stricture.

CONCLUSIONS

The operation of "renal sympathectomy" may be undertaken, in the presence of the above mentioned findings with the confident anticipation of complete and permanent relief of pain.

Whether the operation will find a place in the treatment of so-called "essential" hæmaturia and of some types of nephritis remains yet to be proved.

SLEEP AND ITS DISORDERS IN CHILDHOOD*

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OF the physiology of sleep we know no more than of its pathology. Speculations as to its nature, what part is played by variations in vascularity, in blood pressure, or in osmotic pressure, whether or not there exists a sleep centre acted upon by a hypnotoxin elaborated during the hours of wakefulness, how far the endocrine glands control the process—all such speculations afford us no help in solving the problems of sleep and its disorders in childhood.

In our discussion, therefore, we can only approach the subject with certainty from the purely clinical standpoint. We can only depict disturbances as we find them in practice, and discuss the ways and means whereby they may be combated. Views on etiology must be regarded as wholly speculative. I propose to discuss briefly in turn four examples of such disturbances.

1. Sleeplessness and continuous crying in young infants.
2. Sleeplessness in older children.
3. Night terrors.
4. Enuresis.

SLEEPLESSNESS IN YOUNG INFANTS

Three factors may be concerned in different cases in varying degree in producing this most unhappy state: (*a*) pain or discomfort, (*b*) inherited or constitutional neuropathy, (*c*) faulty management.

Pain or Discomfort.—In a few cases the unrest is caused by persistent pain. Syphilitic periostitis, the subperiosteal hæmorrhages of scurvy, uric acid calculi, otitis media, for example, must not be overlooked. The pains of dyspepsia are a more common cause. In intestinal colic the pain is caused by the increased vigour of the peristaltic contractions of the intestine, and is associated with the passage of a green, watery, or slimy stool, which is expelled violently from the anus with the audible escape of flatus and fluid, and which may be so irritating that it causes excoriation of the skin of the buttocks. Aerophagy, with distension of the stomach, is an even more common cause of abdominal discomfort. But here, as so often happens in infancy, cause and effect are hard to separate, and we are confronted with a vicious circle of symptoms, each productive of the other. The infant, in the first months of life, functions almost solely as a suction apparatus. That apparatus is effective only when the child is at rest, quiet, perhaps even drowsy. The suction act is not a voluntary but a reflex act, and the reflex is inhibited by emotional unrest. Brought to the breast sleepless, crying, and excited, the child, as it were, stammers in its attempt at suction. It substitutes a voluntary, inco-ordinate, ineffective effort for the quiet, sustained, effective suction. Gulping, straining, and choking, it secures from the breast a minimum of milk and a maximum of air. The consequent distension of the stomach is painful. The delayed peristaltic contraction of the fundus—a property of the infant's stomach which expels that

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