RENAL SYMPATHETICO-TONUS.

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Nervous patients suffering with backache, abdominal pain, indigestion, and occasional sharp attacks of colic are a frequent source of difficulty and disappointment. A number are referred to the surgical and medical out-patient clinics, numerous investigations are carried out, and from time to time operations for appendicitis, cholecystitis or movable kidney are advised and performed. Some are improved, others are no better, whilst a few may be re-opened for adhesions. A proportion drift into the massage department. The cause of the persistent pain remains obscure, and after operation for genuine pathological conditions some patients continue unwell, and are absorbed into that large group of patients termed "neurotics".

During the past eleven years, chiefly owing to the work of Papin and Aubard⁽¹⁾, of Harris⁽²⁾ in Sydney, Hess⁽³⁾ in America, of J. B. Oldham and C. A. Wells⁽⁴⁾ in Liverpool, considerable evidence has been collected, carefully analyzed, and conservatively submitted. This indicates that some of these patients are suffering from pain due to irregular functioning of the sympathetic nerve supply to the kidney. Harris⁽²⁾ has coined the term "Renal Sympathetico-Tonus" for the condition; "Renal Asthma" has been suggested, whilst "Nephralgia" is an alternative. These findings are of interest to physicians, surgeons and practitioners, as some cases are permanently relieved by the operation of renal sympathectomy. A more detailed interpretation of pyelograms than usual is required, thus the radiologist's sphere is extended.

Before the diagnosis of renal sympathetico-tonus is made and surgical aid advised certain conditions must be satisfied by each patient. As a rule, one side only is affected; occasionally the lesion is bilateral, and a double operation is necessary. The conditions are:

- (1) A chain of symptoms.
- (2) Certain physical signs.
- (3) Positive uroselectan findings.
- (4) Confirmatory cystoscopic, reno-secretory and pyelographic observations.
- (5) Response to a therapeutic diagnostic test.

This communication presents a resumé of the present position of renal sympathetico-tonus.

The Anatomy.

The renal sympathetic plexus is composed chiefly of post-ganglionic fibres and small ganglia. They are derived from several sources including the coeliac ganglia, the lesser splanchnic nerves (occasionally from the great splanchnics), the aortico-renal ganglia, and also twigs from the first lumbar ganglion. There is a connection with the supra-renal sympathetic plexus. The renal plexus consists of some vaso-dilator fibres but mainly of vaso-constrictor fibres, stimulation of which results in spasm of the sphincter muscle of the kidney pelvis and blood vessels, with diminished urine secretion, whilst its division produces vaso-dilatation and an augmented flow of dilute urine.

The plexus passes from about the aorta to the kidney pedicle in a variable and irregular leash of fine fibres, concentrating chiefly around the middle third (left side) and outer third (right side) of the renal artery. It ramifies along the arteries to the kidney tissue, to the musculature of the pelvis, to the upper ureter, to the supra-renal gland and to the spermatic plexuses. Oldham⁽⁴⁾ points out that the inferior mesenteric nerve supplying the descending and sigmoid colon arises from the aortic renal ganglion, and may be laterally displaced into the renal plexus, and possibly damaged during the left renal denervation.

The Effect of Sympathectomy on the Kidney.

No ill effects have been observed after denervation of the renal pedicle in animals and in man. The kidney is capable of functioning efficiently independent of a nerve supply; this is confirmed by its successful transplantation from one animal to another.

The Pathology of Renal Sympathetico-Tonus.

Harris⁽²⁾ divides renal sympathetico-tonus into three stages, which develop at varying rates over considerable periods.

(1) **The Primary Phase.** At first these subjects suffer from occasional sharp attacks of unilateral renal colic, caused by over-action or irritability of the muscle of the renal pelvis and calices. Harris calls it the stage of *irritability or over-action*.

(2) **The Intermediary Phase.** The period of irregular or over-action of the kidney pelvis is followed by one of gradual exhaustion with atonic dilatation and relaxation. A constant increase in the content of the pelvis occurs and causes a persistent dull ache in the loin. Periodically, infrequent sharp attacks of colic-like pain arise when the tension in the pelvis rises sufficiently to stimulate the tired muscle to contract. The spasms are excited by mental perturbation or by vigorous physical work.

(3) **The Final Phase.** Over a period of years the tired muscle of the pelvis yields further, and an organic hydronephrosis develops as contrasted with the previous passive relaxation. The ache in the loin radiating to the iliac fossa or below the iliac crests continues unremittently with attacks of colic, requiring morphia for their relief. Harris labels it the stage of *dilatation and paralysis*. Occasionally, pyelitis is superimposed, rigors and sharp temperatures are noted, and pus and B. coli are present in the urine, but such an infection is not an essential feature of renal sympathetico-tonus.

Essential Hæmaturia.

When, after exhaustive investigations, no reason is found for bleeding from the urinary tract, the term *essential hæmaturia* is used. An explanation for it may be that it is due to renal sympathetico-tonus, the bleeding arising from the renal papillæ which become deeply congested by spasm or hypertonicity of the sphincter muscle around their base. Harris⁽²⁾ has reported a case of essential hæmaturia relieved by renal sympathectomy. Most surgeons are familiar with the condition; it is not infrequently treated by nephrectomy.

The Symptoms of Renal Sympathetico-Tonus.

These are general and local. The subjects, about two-thirds of whom are women, are in poor general health. Their strength is below normal, and they are readily fatigued; a few are completely incapacitated. They usually have a pessimistic outlook, and the neurotic element is prominent, a factor which discourages the search for an organic lesion.

The ailment is essentially chronic, and extends over a term of years with occasional remissions. When the pathological process is appreciated and has been traced in several patients, it is possible to recognize the condition in what at first sight appears to be a confused, uninteresting, functional malady. There is a strong temptation to dismiss these nervous patients as neurasthenic or neurotic.

(1) A continual dull ache in the loin is the constant complaint. Usually worse on one side, aggravated by continued exercise, and relieved by rest, it does not keep patients awake, although as a rule sleep is indifferent.

(2) The attacks of renal colic are short at first, moderately severe, and may be fairly frequent. They are associated with nausea and vomiting. Gradually the attacks become less frequent because the pelvic muscle is tiring and getting weaker. In some patients colic is experienced only once, twice or thrice. In the advanced stage the colic is infrequent but equally severe, and is complicated by organic changes, and possibly infection, in the pelvis.

(3) Abdominal Pain and Indigestion. Patients suffer abdominal discomfort grading to pain, in the lower abdomen, more especially in the left iliac fossa. An explanation for it may be that the sympathetic nerve supply to the colon is from the same source as that of the kidneys, and that the nervous excitation radiates. Flatulent indigestion is occasional, and suggests chronic cholecystitis.

(4) Dysuria, Frequency, Urgency, Polyuria and Stranguary. These are found in a few cases, especially in the later stages.

(5) Hæmaturia. This is the symptom which causes a few patients to seek medical aid (see note on Essential Hæmaturia).

The Signs.

(1) The affected kidney is palpable, mobile, and tender, especially in thin subjects, and enlarged in 40 per cent. of cases. In a small proportion the sensitive 'lump' in the loin is the primary complaint.

(2) During an attack of colic, the costo-vertebral angle is painful and tender on pressure on the affected side.

(3) On the painful side, the knee jerk is frequently more lively, but is more readily fatigued than on the opposite side (Harris).

(4) In a few patients, when the eyes are at rest, the pupil is larger on the side concerned.

Signs (3) and (4) indicate a unilateral disturbance of sympathetic tone.

The Urine.

It is exceptional for abnormal contents to be detected in the urine, although I note that the pathologist frequently reports oxalates in an otherwise negative specimen. Rarely a trace of albumin or blood is found, and if pyelitis be present, pus and organisms.

The Investigation and Diagnosis.

(1) **X-ray Examination of the Urinary Area.** The painful kidney may show a low-placed, perhaps enlarged shadow. The pioneer workers have carefully excluded patients with renal calculi in order not to complicate the picture of renal sympathetico-tonus. Calculi are unlikely in the early and intermediate stages, but are a possibility in the advanced condition.

(2) **Excretion Urography.** The findings vary according to the development.

(a) *In the early period.* When consecutive films are taken, irritability or quick contractions in the pelvis on the affected side are present. Harris⁽²⁾ has described these from pyeloscopic observations, a technique akin to screening of the stomach during a barium meal. He speaks highly of its value, but as yet it is not generally practised in Great Britain. Due to the irritable contracted muscle, the pelvis may appear actually smaller on the affected than on the healthy side.

(b) *The intermediate stage.* This reveals a moderate dilatation of the pelvis, and the calices may show slight reduction of the cupping of the papillæ. The concentration of and the rate of excretion of the dye by the affected kidney are delayed. Stasis is the characteristic of this stage, so that there is evidence of the dye in the pelvis some time after the other side is clear.

(c) *In the later stages* varying degrees of hydronephrosis are found, with flattening or even clubbing of the calices.

(d) The ureter may be dilated or kinked at the pelvi-rectal junction.

(3) **The Cystoscopic Findings.** (a) The bladder is as a rule normal; there may be redness around the ureteric orifice of the impaired kidney.

(b) *The indigo carmine excretion test.* In most cases the appearance of the dye at the ureteric orifices is delayed on the affected side, and the concentration may be impaired. In the advanced condition the size, frequency and colour of the spurt is diminished. In health, the dye after the intra-venous injection appears at the bladder in four to six minutes; in renal sympathetico-tonus eight to ten minutes is the average time.

(c) **Retrograde Pyelography.** Four points are carefully noted after the ureters are catheterized.

(1) *The pain-distension test.* The volume of sodium iodide injected into the pelvis before pain in the back is experienced is measured on each side. The insertion is made into the apparently normal organ first. In the early pathological kidney the volume may be the same, or even slightly less than its fellow, but considerable increases are usual in the developed case.

In a recent personal case, 40 ccs. were required to provoke the pain. The average capacity of the healthy pelvis is 5 to 7 ccs. To ensure the accuracy of this test during the injection the ureteric orifice is observed through the cystoscope, for occasionally the fluid regurgitates into the bladder.

The distention is performed by the surgeon or by his trained assistant. In thin patients a satisfactory pyelogram can be obtained

with a portable X-ray apparatus in the operating theatre. When the radiological department is some distance from the theatre, then the writer elicits the pain distention test by saline injections in the theatre, and the sodium iodide is introduced in the X-ray department, slightly less than the amount of saline being injected to avoid a repetition of the pain.

- (2) *The character of pain produced* by distension of the renal pelvis is carefully noted. Patients are not warned to expect discomfort; their face is watched during the injection. Frequently the pain is described unhesitatingly as the same as that of which the patient habitually complains; this is a good confirmatory sign. Vomiting is sometimes provoked. The discomfort varies with the speed and temperature of the filling, with the sedative given before the cystoscopy, and according to the mental state of the patient. It is usually located on the side being filled, but is occasionally diffuse backache and lower abdominal pain.
- (3) *The pyelogram.* The picture depends on the stage of development. In an early case a good film will even show constriction points corresponding to the bands of muscle in the renal pelvis. In a fair percentage of cases a moderate degree of dilatation of the pelvis is apparent, and early diminution of cupping of the calices. In advanced cases a frank organic hydronephrosis is revealed.
- (4) *The "emptying rate."* The pyelogram having been taken, another film is made as many minutes later as cubic centimetres were inserted; thus if the pelvis received 10 ccs. then the "emptying rate" film is taken ten minutes afterwards. The normal pelvis easily empties at the rate of 1 cc. per minute, but in renal sympathetico-tonus, even in the early irritable stage, some "hold-up" is always present; this constitutes a significant observation.
- (5) *A diagnostic injection.* Eserine, grains 1/100 to 1/80 hypodermically, causes an orderly contraction of the pelvis, checks irregular movements, and reduces the intra-pelvic tension. If it is given during an attack of pain, relief follows in stages 1 and 2 of renal sympathetico-tonus. In stage 3, when there is an organic change, and perhaps obstruction at the pelvi-ureteral junction, the symptoms are unaffected or even aggravated. This test, whilst being confirmatory, is not absolute.

During the periods of continual ache eserine, grains 1/100 to 1/50, or physostigmine three times a day orally will, for a time, afford relief.

Oldham⁽⁴⁾ gives other indications for renal sympathectomy. The writer has not extended the operation to these conditions, but the claims appear reasonable, especially as existing treatment is unsatisfactory.

(a) **Nephroptosis.** Oldham advises renal sympathectomy as a successful and more effective treatment of nephroptosis than nephropexy, subject of course to pyelographic evidence of stasis being obtained.

(b) **Oliguria or Anuria.** This condition is considered to be due to intense vaso-constriction of the renal vessels, and renal sympathectomy is submitted as rational and effective treatment.

(c) **Renal calculi.** Renal sympathectomy as part of the operation for renal calculi to retard the re-formation of stones is suggested. It is based on the premise that the increased flow of dilute urine following it is unlikely to deposit crystals.

(d) **Nephritis.** Decapsulation which has been advocated and tried over a period of years has proved to be of temporary value. Harris has reported a case of nephritis on which renal sympathectomy has been performed with good effect. Page and Heuer⁽⁵⁾ also record temporary improvement.

(e) **Arterial hypertension and renal tuberculosis** have also been treated by renal sympathectomy. The results have still to be assessed.

The Differential Diagnosis.

Other lesions, such as gall stones, chronic appendicitis and gynæcological affections may exist with renal sympathetico-tonus. Some patients have already had operations for these conditions. Kidney lesions such as stone, tuberculosis and growth must be excluded. A complete clinical examination and exhaustive investigation of all cases is necessary before diagnosing renal sympathectico-tonus, and advising treatment by renal sympathectomy. All authorities are emphatic on this point. The detailed and repeated investigations before proceeding to operation are a characteristic of the writings on the subject.

Severe constipation is often complained of by patients, and its treatment by extending the operation on the kidney into a lumbar sympathectomy has been suggested. Such an added procedure is inadvisable as it may confuse and impair the results.

Whenever the diagnosis is in doubt, further observation is required, and the re-examination is carried out in three to six months' time.

The Operation.

Before proceeding to surgical intervention the kidney efficiency is established, especially the adequate function of the healthy side. This is necessary because very occasionally nephrectomy of the affected kidney may be required for the rare complication of uncontrollable hæmorrhage.

Through a large loin incision the kidney is exposed, mobilized, and lifted out of the wound. In a third of the cases the organ is more mobile than usual, and is often enlarged. Variable degrees of dilatation of the pelvis are found, occasionally an aberrant renal artery, or a varicose condition of the veins about the pelvi-ureteral junction may be present.

The renal artery, vein, pelvis, and upper three inches of the ureter are defined and gently cleaned. Both sides of the pedicle are treated. The dissection is done as if an anatomical specimen were being prepared, and, when completed, it resembles a text book illustration.

The stripping of the fine sympathetic fibres begins a quarter of an inch from the inferior vena cava on the right, and just removed from the aorta on the left, and proceeds to the kidney hilum. By working from the middle line to the kidney, gross hæmorrhage is avoided; this may be so persistent as to necessitate nephrectomy (Harris and Oldham). Cushing's silver clips are admirable for controlling bleeding from the small friable veins about the pedicle deep in the wound. The nerve fibrils are readily seen as fine, white, glistening threads. Finally, the pedicle is painted with 10 per cent. carbolic acid; this paralyzes unremoved sympathetic fibres, and it also shows them up white, thus ensuring that the operation is completely performed.

Oldham states that nephropexy on mobile kidneys, plastic operation on the lesser degrees of hydronephrosis, or the removal of aberrant renal arteries is unnecessary. Marked hydronephrosis requires excision of the redundant lesions and plastic repair. It is important to establish the patency of the pelvi-ureteral junction. Successful reconstructions of hydro-nephrotic sacs are freely reported; the writer's experience is in accord with this. The procedure is a dainty one requiring good exposure and accurate suturing. Aberrant renal arteries are not divided but are denervated, for their removal is followed by necrosis of the area of kidney they supply.

At the end of the operation before returning the kidney to its bed, eserine, gr. 1/100 is injected. This causes a wave of contraction to pass along the pelvis and down the ureter, but obstruction at the pelvi-uretic junction will prevent this, and investigation of this point is then indicated.

A tube is always inserted into the kidney bed.

Complications of the Operation.

Hæmorrhage. Bleeding occurs from small torn vessels (usually veins). If it proves uncontrollable, nephrectomy is necessary. It is avoided by careful work and by dissection from the middle line towards the kidney rather than by stripping from the kidney to the midline (Harris). The bleeding often subsides when the kidney is returned to its bed, assisted by pressure of a hot pack.

Acute Dilatation of the Stomach. When the kidney is approached through the abdomen, acute dilatation of the stomach may follow (Oldham). I have not experienced it in five cases so treated.

Other complications are those usual with kidney exposure. They are infection of and abscess in the peri-nephric space, abdominal distension, paralytic ileus. Later the scar may become painful, and occasionally an incisional hernia develops.

The operative mortality is less than 5 per cent.

Post-Operative Progress.

The Ache in the Loin. After considerable initial post-operative pain the ache in the loin disappears. Within a few days patients state that the "old pain" has gone and that they have only the soreness "where the operation was." In rare instances the ache may recur to a small degree a few months later.

Other Symptoms. Pyelitis may persist, and rarely a trace of albumin is detectable in the urine. Treatment on the usual lines is indicated. Dysuria has continued in a small number of patients.

Subsequent Investigation. Three weeks after operation the patient is cystoscoped, and the following observations are consistently recorded.

(1) *The indigo-carmin excretion test.* The dye is excreted quicker than formerly by the denervated kidney, whilst on the other side the time of its appearance is unchanged.

(2) *Retrograde pyelography.* The distensibility of the pelvis is much increased, with the advantage that no pain or discomfort is now caused. The average pre-operative pain-distension capacity of the pelvis is six to fifteen cc.; after renal sympathectomy it is twenty to forty cc. Oldham describes how he injected one hundred cc. without causing the patient pain.

The other side is unchanged. The emptying time is improved, but this is not so marked once organic changes have occurred.

The Late Results.

(1) In most instances these are entirely satisfactory, patients remaining free from the chronic lumbar backache and attacks of colic.

(2) A few patients return at varying periods with similar symptoms on the other side. I have not experienced this, but equally satisfactory results are reported by Oldham and Wells from the second operation.

(3) The neurotic element is unchanged, although Oldham states that several bedridden patients have returned to normal life. The patient's outlook is brightened, the general health is better, and the strength is increased. Relief from aches and pains in the head occasionally follows, but this is an incident rather than an effect of the operation.

(4) Dyspeptic subjects continue so, and the chronic appendix, the gall bladder, achlorhydria and enteroptosis remain to be diagnosed and treated.

(5) The sympathetic nerves to the kidney regenerate to some extent. Oldham performed pyelography a year after operation and found that whilst the volume of the pelvis was still considerably greater than before operation, an ache in the loin was experienced when over 15 cc. were injected. Nevertheless, the patients were symptom-free and enjoying good health. No organic change has been noted in the ureter or kidney pelvis.

Conclusion.

The present position of the comparatively newly recognized condition of renal sympathetico-tonus is considered. Renal sympathectomy promises relief to a small group of previously undiagnosed sufferers, to whom only temporary alleviation by symptomatic remedies is available.

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