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SURGERY IN THYROTOXICOSIS

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It is difficult at this juncture to elaborate the indications for the surgical treatment of thyrotoxicosis. Any new therapy which promises to abolish the need for operation in a disease is worthy of serious consideration provided it produces as good an effect, is not unduly laborious or tediously upsetting to the patient and carries with it risks to life not greater than the operative ones. Thiourea and thiouracil treatments are now in the testing period to satisfy these requirements in thyrotoxicosis. Preliminary reports are on the whole favourable; time is needed before it can be seen that all the criteria are satisfied. At this early stage it would seem that these drugs, provided they can be given in a thoroughly controlled fashion, should be given a fair trial. But resistant cases are reported, and it also seems inadvisable to give them where pressure symptoms are present, or where the goitre is large, because of their tendency to cause enlargement of the gland. Again, idiosyncrasy to the drugs has caused leucopenia and agranulocytosis which may entail abandoning the therapy, and for psychological and cosmetic reasons operation may still be the more indicated treatment, although in the latter instance, of course, the drug therapy may be made to precede thyroidectomy.

Pre-operative Care

The success of the operation is greatly dependent upon careful, appropriate pre-operative measures. These may be dealt with seriatim:—

Reduction of Metabolism.

General rest is essential for some three weeks in the average patient. She should for that time remain in bed, although the bathroom may be visited. Adequate sleep must be promoted. After a week's rest the administration of Lugol's iodine in milk (or of thiourea or thiouracil) is started. While some favour gradually increasing daily doses of the first-mentioned (5 m. t.d.s., increasing 1 m. t.d.s. up to 15 m. t.d.s.), there does not seem to be any great advantage in this practice over a single daily dose of 10 m. The dosage of thiourea is

1–2 g. daily (3–6 tablets, each tablet of 5 gr.). The dosage of thiouracil is 0.2–1.0 g. daily (2–10 tablets, each tablet of 1½ gr.). Because of the possible effects of these two latter drugs upon the white cells, the blood of patients so medicated must be examined frequently.

The first week of rest, without any of these preparations, will have provided a base line, if the pulse rate be actually charted like the temperature, to which the subsequent amelioration from iodine therapy can be compared. Generally speaking, there is a high pulse rate on admission which sinks within three or four days to a level still well above the normal resting pulse; iodine administration now causes, except in resistant cases, a further and gradual subsidence which in diffuse toxic goitre reaches its lowest in some 10–14 days, in the nodular toxic type in 5–10 days. These are averages and the necessary period may exceed the above limits. Experience alone can teach one recognition of the optimum time for operation. But the great majority fit themselves into the periods given, and the pre-medication can be confidently started to produce its maximum effect on a date suitable to the surgeon.

It may be here interpolated that the disadvantages of preparing the skin in the operation area with tincture of iodine outweigh any theoretical advantages of its absorption. The skin of the neck in women is very easily burned by such applications.

Where there has been previous prolonged iodine therapy, it is better in well-marked cases, unless urgent, to postpone the preparations for operation for a month or more.

Alleviation of Nervousness.

Confidence in the outcome does more than anything else to counteract nervousness and apprehension of operation. This confidence can be instilled in ward patients by their being placed in proximity to one another. The sight of neighbours recovering from the same operation as that which they themselves are to undergo tends more to this confidence than anything else. The practice of segregation and of withholding knowledge of the date of the operation from the patient, so-called "stealing of the thyroid," defeats its own object. With private patients in separate rooms the same confidence may be got by using always the same institution and obtaining the same nursing attendance.

In excitable patients sedatives will be required. Pheno-barbitone in small doses is usually sufficient. Bromides too often cause a rash. For the over-excited patient hyoscine hydrobromide is probably the best.

Improvement in General Physical Condition.

Most patients have lost some weight; many have become relatively dehydrated. The fluid balance should be restored by the liberal administration, except in patients with heart failure, of such drinks as lemonade with added glucose. A jug of this should be perpetually at the patient's side, and encouragement given as to its being taken. Diet should be nutritious without being heavy. In severely wasted patients some weeks may be required in this particular part of the preparation before iodine-therapy is started. Fluids will require to be given by intravenous routes where there is vomiting and diarrhoea.

Patients with cardiac irregularities or failure should have these cared for by a physician. While only the operation is likely to cure fibrillation, digitalis is required to help steady the irregularity and control failure. Mercurial diuretics may also have to be used. Quinidine is best reserved for those patients whose fibrillation does not clear spontaneously in the first ten days after operation.

Anaesthesia

The anaesthetic of choice at the present time is avertin, given rectally in the ward an hour before the time of operation, with the later addition of gas and oxygen inhalation. The dosage of avertin required is usually 0.1 c.c. per kilo of body weight, but it may be lessened where toxicity is slight. Its administration requires care and experience since, given inexpertly, it may be voided into the bed before having produced any effect. The avertin is not supplemented by any pre-medication, but 1/100th of a grain of atropine is given twenty minutes before operation.

After these administrations the patient is made to rest as quietly as possible and, where it can be achieved, in a shaded light. By the time that the attendants come to move her to the theatre she is usually quite sleepy, and careful handling will not upset this desirable state.

When the patient reaches the theatre gas and oxygen is given either by a face mask or through an intratracheal tube. The latter is or is not employed depending on the individual taste of the anaesthetist, but is of course essential in some patients whose goitres are causing distortion or narrowing of the trachea, which may be accentuated in the hyperextended operating position or by the manipulations of the surgeon.

The procedure of infiltration of the neck with local analgesic solutions has in many quarters been given up. But a similar procedure, using normal saline instead of procaine, is widely employed to help separate the platysma from the underlying muscles and to carry in adrenalin hydrochloride

to give haemostasis. Some 100-150 c.c.s of normal saline are injected; the proportion of adrenalin hydrochloride is as 1 minim to 10 c.c.s normal saline.

Essentials of Operative Success

Success in the actual operative part of the treatment depends upon haemostasis, gentle handling, adequate removal, and the use of the non-toxic anaesthetics described. Lack of observance of these will lead to post-operative crises or incomplete amelioration of the disease. In very ill patients the full operation may be regarded as too risky, and it may then be performed in two stages, a subtotal thyroidectomy of each lateral lobe being done with an interval of a week or more between. Ligation of individual main vessels as a preliminary is practically never performed nowadays by the experienced workers in this field.

An important if lesser matter is the getting of a good cosmetic result in the scar in the neck. A hair-line scar is easy to obtain if certain simple practices are followed. The proposed incision is marked out, and cross guide marks made, with such an indicator as Bonney's blue, before any injection is made into the neck. The incision markings are made in, or parallel to, a crease about halfway between the top of the thyroid cartilage and the suprasternal notch. At the end of the operation the skin edges are accurately but lightly joined, using very fine needles and suture material. These, because the strain will be taken by the stitched platysma, can all be removed in forty-eight hours. No needle or cross-stitch marks will then result. Drainage, also for cosmetic reasons, should always be done through the lateral extremities of the incision and not through its centre.

If post-operative crises be regarded as surgical shock in a patient whose illness makes her unduly susceptible, then the importance of haemostasis and gentle handling is apparent. With the use of adrenalin as described it should be possible to get down to the gland with little or no loss of blood, using only two or three ligatures or artery forceps. The necessary ligation and division of both superior lots of vessels makes little difference to the vascularity of the gland; in diffuse cases both inferior arteries can additionally be tied, if readily found, without fear of subsequent myxoedema, but in the nodular type of gland ligation of these vessels has to be more carefully considered from that viewpoint. Naturally such ligatures make haemostasis more easy when the gland is being divided. Whether or not these ligatures are applied, the only satisfactory haemostasis in gland division is got by the repeated application of artery forceps before cuts are made.

Many of the unsuccessful results in respect of a cure or real amelioration are due to a failure to remove enough gland. This is a common mistake on the part of beginners, rightly enough cautious against the risks of myxoedema, tetany and laryngeal palsies. Second operations at a later period, because of initial failure to produce the desired result, are much more difficult technically, and are best avoided by thoroughness. In an averagely toxic case of the diffuse type, leaving a part of the postero-inferior aspect of each lobe of the size of the terminal part of one's thumb, or perhaps rather less, is ample even although both superior and inferior arteries have been ligated. More will be required to be left in the nodular type, especially if toxicity be but slight. But there are far more instances of residual toxicity due to insufficient removal than of myxoedema due to over-removal.

The key to adequate removal lies in the early division between ligatures of the superior thyroid vessels. This allows the upper part of the gland to be pulled forward; the small portion left will then be the postero-inferior part in the region of the parathyroids, the recurrent nerve, and the entering inferior artery.

In secondary toxic goitre (toxic nodular goitre) enucleation of an adenoma is in itself insufficient. There must be a resection of the lobe as well. In this type exploration of both lobes is essential; many a surprise will be found in what appears clinically to be a normal-sized lobe. Again, in some nodular goitres the only normal tissue left is near the superior pole, and it may be advisable then not to divide the superior vessels of one side and leave some gland here in order to prevent subsequent myxoedema.

The Operation of Subtotal Thyroidectomy

The position of the patient is important. The head, kept steady in the midline, is hyperextended over a buttress under the shoulders. Where an adjustable bridge is not fitted to the table, this is achieved best by a big pillow so that when the infrahyoid muscles have been separated in the midline the degree of hyperextension of the head can be lessened, to allow of more room to work under these muscles, by some withdrawal of the pillow toward the anaesthetist.

The incision is made through skin and platysma. Its width will depend upon the size of the gland but should be gauged so that the upper and lower flaps can be reflected with ease up to the top of the thyroid cartilage and down to the suprasternal notch. Provided due care is taken in the coaptation and suturing, as above noted, the cosmetic result of a longish scar is as good as or better than that of a short one. The upper and lower flaps

are reflected while upward tension is put on them; this lifts them away from the subjacent infrahyoid muscles, and, by the aid of the injected saline, it is possible to avoid any nicking of the anterior jugular veins. The two flaps are held retracted, and the infrahyoid muscles are separated by a vertical incision in the midline. Should one lobe be more enlarged than another this line will of course be off the midline of the body.

The gland being now exposed, the hyperextended position of the head is lessened to allow dissection beneath the infrahyoid muscles. Whether or not these will be divided to some extent laterally depends upon the size of the gland and the experience of the surgeon. The beginner will do so frequently at first, only occasionally later. When done or needed, it will be found that only a small cut is required; this is best done at the upper part of the muscles, and will be most helpful if made obliquely, upwards as well as outwards. This allows of easy access later to the superior vessels; once these are doubly ligated and divided between the ligatures, the rest of the operation can usually be performed without straining.

The infrahyoids on the other side to the operator are retracted by the assistant and the surgeon separates the gland carefully from the surrounding tissues until he comes down on the carotid sheath. Middle thyroid veins may need ligature. The superior vessels are divided and the gland displaced forwards. There is often a tongue-like process of the lobe above and behind the entering vessels. Further dissection lower down will show up the inferior artery appearing from behind the carotid. It often runs almost vertically. If it is to be ligated, this is done in continuity well away from the gland. If the artery is not readily found, as happens occasionally, it is better to leave it untied than risk a search which may be damaging to other important structures.

Drawing the gland towards himself, that is towards the midline, the surgeon places a series of artery forceps on it, each grasping a fair amount of tissue and outlining the small piece to be left, and cuts almost vertically on these. Having palpated the trachea below, he is able to direct his forceps so that eventually the successive cuts, after repeated application of the clamps, will bring him down on the lateral aspect of the trachea. The trachea, it is to be noted, will have been rotated by the traction so that the lateral aspect is now almost anterior. The trachea being reached, the gland is stripped from it, leaving it bare. The pyramidal lobe above is removed entirely. The operator now ligatures off the many points seized by the artery forceps, using fine plain catgut. This completed, he changes sides and repeats the procedure on the other lateral lobe.

All bleeding having been stopped, the surgeon pushes a fine artery forceps through the infrahyoid muscles on either side towards the extremities of the skin incision and through the apertures draws pieces of corrugated rubber for drainage.

The infrahyoid muscles are sutured in the mid-line. Similar stitching of the platysma is done. The skin is closed, using the fine needles and material described.

The dressing applied is best retained in position by a figure of eight bandage which passes under the axillae as well as round the neck. This gives a feeling of support to the neck which is comforting in the first few days.

Post-operative Care

The patient is sat up in bed as soon as she is properly recovered from the anaesthesia; till then she is better to have two pillows under her head and shoulders than to lie flat. To control restlessness she should have not more than a sixth of a grain of morphia as a first dose; she may require two or three similar doses of a quarter grain over the first forty-eight hours, after which simpler measures will suffice.

On her return to bed a rectal saline, containing 5 per cent glucose, is given. This is best administered in two lots, of half a pint each. To the first half-pint there may be added forty minims of Lugol's solution. There is, however, some doubt as to whether this, or its oral administration in the next week or two, has any beneficial effect, and some surgeons dispense with it. The saline administration itself, however, is of importance, since fluid is essential, and another pint is given some eight to twelve hours later; in severe cases this may be repeated. Naturally, where an appreciable blood loss has occurred, this will be made good by transfusion.

The chief discomfort of the patient in the first two days is due to tracheitis, which in some degree or other is an inevitable sequel, giving rise to soreness, painful coughing, and occasionally choking sensations. This may be treated by a variety of means. The most efficacious seem to be a compound mixture of aspirin, a hot mixture containing sodium bicarbonate, lemon juice as an astringent, and occasionally a linctus where the cough is very distressing.

The dressing, due to oozing through the drains, soon becomes uncomfortable and can with advantage be changed on the evening of the day of operation if that has taken place in the morning. While all skin stitches will be removed in forty-eight hours, it is quite often advantageous to leave the drains in position for four days.

The general post-operative reaction, with malaise, a moderate fever and raised pulse, is usually

markedly subsiding at the end of forty-eight hours. It is of advantage to the patient's confidence to be told early that her discomforts will have mainly disappeared after that lapse of time.

Post-operative Complications and Sequelae

Haemorrhage.

Post-operative bleeding may be a serious affair, particularly if the blood does not gain egress by the drainage routes and collects as a large constricting neck tumour. Generally speaking, apart from slipping of a ligature on the superior thyroid vessels, it is likely to cease spontaneously. When such a large tumour has collected quickly after operation, the patient collapses, and immediate removal of stitches in the ward is indicated to relieve tension; thereafter the patient is taken to the theatre for evacuation of the clot and ligature of the bleeding vessel.

Acute Post-operative Crisis.

This is characterised by what might be regarded as an excessive post-operative reaction. The pulse is very fast and may be uncountable, the temperature soars, there is delirium and frequently cyanosis. The incidence rate of this complication depends upon the thoroughness of pre-operative care and medication, and upon haemostasis and gentle handling at operation. Its prophylaxis is more easy than its treatment. Good confident nursing will do much. Sedatives will of course be given. It is doubtful if Lugol's iodine, even intravenously, has any effect. Icebags and cold sponging are sometimes efficacious in the more moderate cases. Oxygen therapy, either by the B.L.B. mask or by an oxygen tent, is the most promising line of treatment.

Post-operative Fibrillation.

Fibrillation occasionally occurs in the reaction from operation in patients who have not exhibited irregularity previously. Unless it is concomitant with the symptoms of an acute crisis it need cause no alarm, and requires no special treatment.

Tetanus.

Even with the radical operation advised the risks of parathyroid insufficiency are few. Detection of the parathyroids is not easy while the operation is proceeding, and it is satisfactory to rely on some of them being in their normal situation in the part left. Advice is sometimes given to examine the removed gland and to implant any parathyroids from it into the substance of the sterno-mastoid muscle. Their recognition is not

easy as they are simulated by blobs of fat, minute lymph glands, and little, almost separate, nodules of thyroid tissue projecting from the goitre.

It is not unusual for the pathologist to find one or more parathyroids in the removed gland, and for there to be subsequent manifestations of insufficiency. Occasionally a patient will complain of "pins and needles" feelings, and show circumoral pallor, both features clearing quickly as if a remaining parathyroid or part thereof had taken a little time to compensate for those lost. Only very rarely does this go on to tetanic spasms of the hands and feet. The slight cases, the average ones, get better after taking a few glasses of milk. In more severe instances large doses of calcium lactate, up to 15 grammes a day, are necessary, and rarely one has to give 10 c.c. of a 20 per cent solution of calcium chloride intravenously. In exceedingly rare instances the administration of parathormone is indicated.

Recurrent Laryngeal Nerve Injuries.

These are most commonly due to forcible stretching of the nerves and their occurrence reinforces the plea for gentle handling. But a ligature tied around an inferior artery too near to the gland may include the nerve, or a clamp may inadvertently be put on it, or, occasionally, it may be torn in displacing a posterior nodule. It is suggested by some that the nerve should always be identified and kept clear of; others, and they are more numerous, prefer not to look for it and think there is a risk of injury in the process of identification. The results of injury are hoarseness, due to unilateral incomplete and complete lesions, marked dyspnoea requiring tracheotomy in bilateral incomplete lesions, and loss of voice in bilateral complete lesions. In the first mentioned, the only one to be met with if reasonable care be taken, there is usually, though not invariably, a compensation on the part of the opposite cord which allows of a great deal of recovery of normal voice.

Convalescence

The patient's pronounced well-being a fortnight after an adequate operation should not mislead either her or the surgeon as to the necessity for further convalescence. Too speedy a return to work or to the worries and cares of managing a household, especially if there are young children, is a potent cause of only partial success. Insistence, therefore, should be made upon a further spell of at least three weeks' convalescence, a period which may with advantage be increased where there has been visceral disease, where the toxicity has been pronounced, and where employment or

home conditions do not permit of a gradual return to normal. Fairly frequent attendances at a follow-up department in the first year are necessary. The nervous features of the disease are not always so completely controlled by operation as the metabolic ones, and they can be helped a great deal in a routine check by the surgeon in which increase in, or maintenance of, weight and other general features are pointed out.

THE HEART IN THYROID DYSFUNCTION

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Heart failure caused by the two extremes of thyroid dysfunction, toxic goitre and myxoedema, holds an almost unique position among chronic heart diseases insofar as it may be amenable to complete and lasting cure. Cardiac signs may be predominant in both conditions, yet digitalis is unreliable in toxic goitre and useless in myxoedema. These are the main facts which make the recognition of heart affections due to thyroid dysfunction extremely important.

The Heart in Toxic Goitre

Toxic goitre affects the heart *indirectly* through the enhanced metabolism which causes cardiac fatigue, and *directly* by its toxic effect on the heart muscle.

The great oxygen consumption of the tissues (50-100 per cent above normal) calls for an increased oxygen supply. The haemodynamic adjustments providing for this are an increase in the cardiac output, in the circulating blood volume, and in the velocity of circulation, while the arterio-venous oxygen difference remains normal. The accumulation of metabolites is regarded as the cause of peripheral vasodilatation, which in the thyroid gland may assume the degree of arterio-venous shunt, and is thus responsible for the greatly augmented venous return. The heart deals with the increased venous return by further raising its output (i.e. minute-volume), which in thyrotoxicosis of average severity becomes almost doubled. This is accomplished by tachycardia while the stroke volume remains but slightly affected. Tachycardia in thyrotoxicosis was first thought to be a compensatory mechanism. But it is uneconomical from the point of view of cardiac fatigue and unusual as cardiac adjustment, since