means of moist cotton-wool swabs. A Took's corneal-splitting knife should then be taken, and with it a groove cut in between the layers of the scleral substance itself at a distance of 2 to 2.5 mm. from the limbus. It is neither necessary nor advisable to cut deeply with this splitter, but merely enough to make a small furrow running parallel with the limbus (corresponding to that between finger and a closely pared nail). Into this furrow a keratome is inserted and pushed downwards into the anterior chamber in much the same way as Heine does in his operation of cyclo-dialysis, except that the incision should be about 3 or even 4 mm. from end to end. The keratome should then be withdrawn as rapidly as possible. If this is done with sufficient speed very little aqueous is lost. The anterior lip of the scleral wound can now easily be gripped with Elliot's disc forceps and a small piece excised (like the paring of a finger-nail) by means of de Wecker's scissors. By this time very probably a small portion of the iris, close to its root, has prolapsed into the wound, and this is excised, a strictly peripheral iridectomy being aimed at. If the operator has been successful in his efforts thus far he will have lost little aqueous and still have an uncollapsed anterior chamber. He should then gently stroke the conjunctival flap upwards, and by gently pressing on the corneal surface of the limbus in the region of the iridectomy with a spatula he can cause the whole iris to resume its normal relationships, excepting only for the peripheral iridectomy. The conjunctival flap is then secured with one stitch. Should the iris not have prolapsed of its own accord, then its periphery should be gently withdrawn with iris forceps and a pinhole iridectomy performed. In this case more aqueous will undoubtedly be lost, but it should still be possible to complete the operation without causing complete collapse of the anterior chamber. If the iridectomy is a purely peripheral one there should be no necessity to poke an iris retractor into the wound, with consequent increase in the loss of aqueous, as the iris can practically always be caused to resume its proper position in the way indicated above—namely, by stroking the surface of the limbus and adjoining cornea with a spatula in the region of the iridectomy.

I am not so foolish as to claim that this operation is unattended by drawbacks. Chief amongst these is that, seeing the episcleral tissues are cut right down to the substance of the sclera itself and then stripped off this membrane, episcleral vessels, sometimes of relatively considerable size, are almost certain to be severed, and may cause troublesome bleeding. They can, however, be picked up with fine (toothed) conjunctival forceps and the haemorrhage stopped by torsion of the proximal end of the vessel.

In other respects, I have found this operation no more difficult and not more frequently attended by complications in the performance than is Elliot's, and it is less "tricky" and demands less skill in its execution than does Lagrange's. The advantages I claim for it are, roughly, as follows.

1. It is possible to do this operation with the minimum disturbance of the intraocular structures and the minimum risk of intraocular haemorrhage. Cases of acute or congestive glaucoma with shallow anterior chamber should be treated beforehand with myotics and Duke-Elder's method of administering hypertonic saline intravenously. The operation can then, say a week later, be performed as on an uninfamed eye.

2. In a large proportion of cases it is possible to do the operation without causing the anterior chamber to collapse completely. The valve-like nature of the fistula (as opposed to the rigid circular foramen obtained by trephining) is of great assistance in this respect. The advantages of maintaining a sufficient depth of aqueous fluid between the cornea on the one side and the iris and lens on the other need not be stressed here, because they are sufficiently obvious to any operator of experience. But I may say that restoration of the anterior chamber to its normal depth follows, on the average, in from forty-eight to seventy-two hours.

3. The thickness of the membranous covering of the fistula is a more efficient safeguard against late infection than it is possible to secure in cases of corneo-scleral trephining, because in the latter operation little more than conjunctiva *per se* covers the fistula, whereas, in the operation I have described, the fistulous track is covered by conjunctiva, subconjunctival tissue, and Tenon's capsule. The fistulous orifice, moreover, is situated not at the corneo-scleral margin, but at a distance of 2 mm. or even more from it. That the protection from late infection is efficient, I have, in my own mind, little doubt. One of my cases, with very free filtration, had the misfortune

to develop an attack of acute diplo-bacillary conjunctivitis about six months after operation. This attack passed off without being followed by any sign of iris irritation whatsoever (as observed with the slit-lamp, etc.).

4. Should, for any reason, a fibrosis ensue on this operation (as indeed may follow on any form of sclerectomy), a repetition of the operation may be performed without detriment. I have performed the operation successfully, and without difficulty, in a case in which a wide iridectomy had already been done for glaucoma, with insufficient results in the long run. A larger piece of sclera will, of course, have to be excised, but the previous history of the case will guide one in this respect.

In conclusion, I may perhaps be permitted to refer to a case in which this operation, in conjunction with other methods, was followed by truly gratifying results.

A married woman, aged 56, was seen by me in consultation with her medical attendant on the afternoon of March 14th, 1929. The presence of acute glaucoma in both eyes had already been diagnosed by her doctor, and the vision in the better eye (the left one) was no better than perception of hand movements, whilst that in the other eye was bare perception of light. She was admitted to the Eye and Ear Hospital, Bradford, a few hours later, and drops containing eserine 1 per cent., pilocarpine 2 per cent., and dionine 5 per cent. were instilled half-hourly, and, some five hours after I first saw her, 30 c.cm. of 30 per cent. aqueous solution of sodium chloride were administered intravenously according to the method of Duke-Elder. Next day the pupils were pin-point, and the patient was able to distinguish people at her bedside with her better eye, although the vision of the worse one (the right) was barely improved. Three days later the fields were, with a 5 mm. test object, as charted, and the vision of the right eye had improved to 6/60, and that of the left eye to 6/9. On March 21st the operation I have described was performed on the left eye, and on March 29th the patient was discharged from hospital, as she wanted to get home before her right eye was operated on. On April 17th she was readmitted to hospital, and the next day the right eye was operated on in the manner I have described. On May 11th the fields were, with a 5 mm. test object, as charted, and

V.R. with -4c -0.5 ↓90° equalled 6/18;

V.L. with -0.5 ↓90° equalled 6/6.

ACUTE INTESTINAL OBSTRUCTION.

BY

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In presenting for publication a review of 130 cases of intestinal obstruction which have been operated on by me, it is fitting that I should acknowledge the courteously given permission to make use of cases which I operated on whilst acting as surgical registrar to Sir Hugh Rigby, Mr. James Sherren, Mr. Russell Howard, Mr. Hugh Lett, Mr. A. J. Walton, Mr. Robert Milne, Mr. H. S. Souttar, Mr. E. C. Lindsay, Mr. W. S. Perrin, and Mr. G. E. Neligan, all of the surgical staff of the London Hospital.

Surgical lectures and papers on the subject frequently end on a wailing note, as though the summit of knowledge and of technique had been achieved. It is suggested that the existing high mortality is all due to late diagnosis, and that the technique of treatment had reached finality. With this generalized conclusion we venture to disagree. As surgeons it is absurd for us to ask that all our work should be easy child's play. When we are still ignorant of so important a subject as the nature of toxæmia in obstruction it is presumption to assume that the technique of treatment is final. No one who has seen much of intestinal obstruction can fail to be impressed with the fact that some of the most desperate cases survive whilst some apparently trivial cases die. In the former it would seem that by a happy chance appropriate measures were taken, and in the latter that over-confidence led to the omission of some such measure as intestinal drainage, which may be called for as an afterthought in less timely circumstances than at the primary intervention. The cases reviewed are consecutive, and it has not been the practice to refuse operation to any patient who was not actually moribund. No patient who was refused operation lived more than two hours.

It is apparent that the comparatively low mortality in external hernia may be justly attributed to the ease with

which diagnosis is made. It is also probable that the propinquity of low intestinal coils to the usual hernial orifices, more particularly when the right side is involved, makes low obstruction likely, and means a later onset of the

	Cases.	Died.	Mortality per cent.
Strangulated external hernia	57	6	10.4
Obstruction to small intestine by adhesions, bands, foreign bodies, internal hernia, etc.	30	8	27.0
Intussusception	20	6	30.0
Carcinoma of large bowel	20	6	30.0
Volvulus of large bowel	3	2	66.6
Total	130	23	21.5

toxaemia.¹ Twenty-three were cases of inguinal hernia, of which 3 died; 25 were femoral, with 2 deaths; and 9 were umbilical, with 1 death.

Of this group of cases, 8 demanded measures to deal with damaged bowel. In one case infolding of the damaged area was possible. In another, a two-stage resection of small intestine was successfully borne, and in 6 cases immediate resection and anastomosis was done; of these 5 died. This high mortality was, in our opinion, due to over-conservative resections, and to a failure at the outset to appreciate the need for intestinal drainage when resections of obstructed intestine were done. Of the 49 cases in which gut was deemed to be viable, one died.

The 30 cases of small intestine obstruction show 8 deaths. The series of cases shows a very marked improvement in results since two modifications in technique were adopted—spinal anaesthesia with neocain, and the addition of a jejunostomy in all cases where distension was extreme, or in which vomiting was a marked feature. At about the time that these measures were adopted greater emphasis on the need for saline administration was also made, and it is possible that this has played an important part. Before the change 18 cases included 7 deaths; since it, 10 cases included one death, in a patient so ill that a jejunostomy alone was attempted.

Twenty-two cases of large gut carcinoma are included; of these, 10 were situated in the sigmoid region, and 6 of these were operable growths. The practice has been to do a laparotomy under spinal anaesthesia; if the growth is operable caecostomy is done, and an attempt is made to resect the growth some ten days later. The "blind caecostomy" has not been done for the following reasons: (1) because a volvulus or strangulation is not likely to be benefited thereby; (2) because an inoperable growth will demand a more satisfactory permanent operation than a caecostomy can ever prove. The caecostomy is always made with a one-third to a one-half inch rubber tube inserted in just the same way as is a tube in the Senn gastrostomy. It has always closed spontaneously when the tube is removed. Usually there is no leakage at all.

Of these 6 operable cases, 5 have withstood the second stage of the operation successfully. One died of a pulmonary embolus the day before the second stage was to be done. In addition, one patient with carcinoma of the rectum was subsequently resected, and is now alive and well, eighteen months after the operation.

Twenty cases of intussusception have been treated; of these, a sausage-shaped tumour was palpable before the administration of an anaesthetic in 18, and in all 20 it was palpable under the anaesthetic. There have been 6 deaths. The average duration of operation for cases which did not need resection was twelve and a half minutes. Three cases were irreducible, and were resected; all three patients died, aged 4, 6, and 5 months. The remaining 3 deaths were due to (1) shock following a second operation for eventration; (2) shock in a baby of 7 months, in whom reduction had been extremely difficult; (3) an unexplained death, a week after operation, in a baby of 20 months, who had had a lax intussusception, which permitted the passage of some faeces, for 120 hours; reduction was so easy that operation took but seven minutes, and convalescence appeared to be normal until the morning of death.

Three cases of volvulus were treated; two were of the sigmoid about its base, one of the transverse and ascending colon about an axis formed by a long mesentery to the ascending colon, and aided by adhesion of the omentum to an abdominal scar. The latter patient recovered after untwisting and fixation of the colon. The two sigmoid cases died; one survived excision of the gangrenous loop with the insertion of Paul's tubes into the divided ends; three weeks later he developed small gut obstruction from adhesions, from which he died. The other died unexpectedly after the untwisting of a volvulus of a few hours' duration.

In addition to the above cases, two cases of enterospasm are mentioned, though not included in the statistics. Both simulated, and in fact were, cases of acute small gut obstruction. Both were explored under spinal anaesthesia, which, in these cases, did not at once relax the spasm. Both recovered.

DIAGNOSIS OF INTESTINAL OBSTRUCTION.

Intestinal obstruction being a symptom common to many pathological derangements, its diagnosis should rest upon the answer to a simple question. Certain volumes find their way into the intestinal lumen—namely, ingested food, fluids, and gases, *plus* fluids and gases which are poured into the lumen as glandular secretions and from the processes of fermentation. Healthy life demands that these volumes should leave the intestine at as great a rate as they enter. Some leave by being absorbed—for example, water, salts, nutriment. Others, faeces and gases, must be passed from the body.

The common teaching that the signs of obstruction include vomiting and absolute constipation passes over many serious cases of obstruction. The answer to the question, Is the intestine dealing adequately with its fluid content? implies a diagnosis between the absence or presence of obstruction. Failure to appreciate the fact that intestinal obstruction is consistent with the passage of some flatus and faeces leads to dangerous delays. Unless this fact is appreciated, the use of the diagnostic enema becomes a danger.

An illustrative parallel may be found in the diagnosis of retention of urine. It would be as accurate to state that a patient has no urinary obstruction because he has overflow incontinence as to claim that the passage of a small stool or of flatus negated the diagnosis of obstruction. If the value of the trial enema is to benefit the patient its result must be measured by immediate improvement in all the signs and symptoms which have led to the suspicion of organic obstruction, and not, as is so frequently done at present, by an optimistic nurse's "good result."

Difficulties in the diagnosis of intestinal obstruction arise very infrequently when the cause is dramatic, as it is in volvulus, hernial strangulation, carcinoma, etc. They arise most frequently in patients recovering from peritonitis, from operations, and suffering from gall-stone ileus. We have found help in recalling that bands of adhesion firm enough to obstruct the intestine mechanically take some days to form. Distension and vomiting early in convalescence may justly be attributed to peritonitis or to internal hernia. After the fifth day they are probably due to bands of adhesions.

ANAESTHESIA.

General anaesthesia has special dangers in these cases. One mouthful of inspired vomit may readily seal the patient's fate, so that if general anaesthesia is to be employed passage of a stomach tube is an essential feature of the preparation for operation.

Spinal anaesthesia may be regarded as rather more dangerous than ether in ordinary cases. In obstruction the facilities that it grants to both patient and surgeon more than counterbalance its disadvantages. The relaxed abdominal wall, with the ease in exploration and suture which it gives, and the absence of the risk of aspiration of vomit, are advantages which directly benefit the patient. We are firmly convinced that the risk of spinal anaesthesia in intestinal obstruction is far less than that of inhalation anaesthesia of any kind.

The performance of caecostomy and of jejunostomy in obstructed patients is one of the questions in the surgery of intestinal obstruction which are still very much to the

fore. These two simple operations possess the common advantage that they relieve the obstruction. Another advantage which they possess is that they may be done under infiltration anaesthesia painlessly and with facility, and that an already poisoned patient is not submitted to the risks of a larger procedure, a narcotic drug, or the severe fall of blood pressure which is the occasional danger of spinal anaesthesia. In passing, we may remark that drugs such as strychnine, caffeine, and more recently ephedrine, do much to combat this fall. The disadvantage which is again common to both is that conditions endangering the vitality of a loop of gut cannot be benefited. A strangulation, a volvulus, an intussusception, or a Richter's hernia cannot always be diagnosed before operation. Jejunostomy is valuable in small intestine obstruction: first, as a method applicable in desperately ill patients, who will stand nothing more; secondly, and chiefly, as a supplement in all cases with severe distension. It is made with a catheter (No. 12), and, provided that it is infolded in the wall of the gut by the Witzel method, and also that the catheter is passed through a washer of omentum, it will close spontaneously when the catheter is withdrawn.

Help is given by the character of the peritoneal fluid. We have found that in every case of obstruction which we have explored peritoneal fluid is present to excess. In every case in which the vitality of a loop of gut within the abdomen was compromised this fluid has been blood-stained. If, then, in attempting a "blind caecostomy" or a "blind jejunostomy" the peritoneal fluid is bloody, it should act as a warning that exploration on a wider basis is imperative. It is probable that in strangulation of an internal hernia the blood-stained fluid will be found in the sac, and not free in the peritoneal cavity. This type of case will defeat the object of the "blind jejunostomy."

We may state that, so far, we practise spinal anaesthesia and a wide exploration as routine methods, reserving jejunostomy alone for the desperately ill, and as an adjuvant to the primary operation. Caecostomy alone is reserved for the obstruction whose site and nature and operability may be regarded as known. This narrows the field for "blind caecostomy" very considerably.

TOXAEMIA IN OBSTRUCTION.

It is sometimes assumed that all cases of intestinal obstruction exhibit well-marked toxæmia; this is rather far from being the fact. It is rare for a case of a large gut obstruction which is not associated with interference with the blood supply of a portion of intestine to show any evidence of toxæmia.² The majority of cases where there is obstruction in the lower reaches of the small intestine do not exhibit toxæmia until distension has reached the upper coils of intestine; or, in other words, the onset of regurgitant vomiting and of evidence of toxæmia are usually coincident. A clinical exception to this is that nearly all cases of strangulation of intestine exhibit toxæmia in disproportion to the degree to which the upper reaches of intestine are distended. On the clinical side it seems clear that toxæmia as a cause of death from obstruction does not enter into the picture until distension and vomiting have made their appearance; or in cases where there is a closed loop of intestine with interference with its blood supply. Amplifying this fact somewhat, the toxæmia, whatever it may be, depends on (1) high jejunal obstruction and distension, (2) a closed loop plus damage to mucosal blood supply. It is possible to have clinically a closed loop without interference with blood supply, and with no toxæmia, and, in fact, no serious symptoms. Serious symptoms will appear with the damage to the blood supply; but if the coil is low down in the small intestine toxæmia may not make its appearance.

The literature bearing on the cause of death in intestinal obstruction has become formidable in bulk and diverse in theory. It cannot be said that all the factors in obstruction are adequately explained by any of the theories which have hitherto been put forward. The following theories may be regarded as being seriously entertained at the present time:

1. That the phenomena in the toxæmia of intestinal obstruction are due to dehydration or to shock.^{1,2}

2. (a) That toxæmia requires the presence of bacteria (the experimental work of Dragstedt and others). (b) The higher in the gut the more intense the toxæmia (Whipple and McQuarrie, Wilkie, and others). (c) That in addition to the appearance of bacteria some other factor which can be produced by damage to the blood supply is essential (Dragstedt, Moorhead, and others). It must be recalled in this connexion that the simple fact of intestinal distension of itself produces a congested condition of the mucosa which is sufficient to activate or liberate the toxin. Some observers working on different animals have found it difficult to show the appearance of toxæmia at all, and the degree of toxicity of intestinal contents appears to vary very greatly with the methods which are used to free it from bacteria (Wilkie).

3. That death is due to peritoneal infection. This theory has been widely held, and was at one time largely believed in by myself. It appears quite clear, in the light of the work of others, that the facts are against it as a constant factor in death from obstruction.

4. Liver and renal damage (McQuarrie and Whipple). It is undoubtedly proved that liver function and renal function are diminished in intestinal obstruction. The cause of their diminution remains unproved.

5. Anaerobic toxæmia theory.⁷ It cannot be said that this theory explains all the facts. It has been shown that anaerobic bacteria are present in the intestine and are increased in obstruction. It is also a fact that they are present in the intestine of healthy persons. A similarity—not very striking—has been shown between the more extreme cases of intestinal obstruction and cases of gas gangrene; it may well be that death in all its guises wears much the same look.

This theory does not explain the fact that low intestinal obstruction may exhibit no evidence of toxæmia. Since the bacillus of Welch flourishes most in the lower ileum one would expect, if this theory is to be accepted, that the worst cases of toxæmia would be those in which a closed loop of lower ileum existed. The experimental work of Wilkie and of Dragstedt established the fact that lower ileal closed loops are compatible with prolonged good health. A case under my care existed for over a year in good health with a closed distended loop of lower ileum.

It is quite true that enthusiastic clinical reports on the treatment of intestinal obstruction with serum are received. It is unfortunately true that any new treatment is heralded with enthusiastic clinical reports, and it is only after some years that its true value may be assessed.

It has recently been shown⁸ that intestinal obstruction is associated with a drop in the normal amount of chlorides in the blood, and that this drop commences to become steep with the onset of vomiting and the consequent loss of hydrochloric acid. Though the beneficial effect of the administration of saline has been known for years, the reason for its marked effect has not hitherto been so plausibly put forward. With the many theories that have been put forward, and the very large amount of experimental and clinical research into this subject, it is difficult to avoid the conclusion that the whole truth of this matter does not yet lie before us. It seems to be established that high intestinal obstruction is associated with virulent toxæmia. It seems also to be firmly established that chloride starvation exercises a marked effect on the patient's well-being; and it seems quite clear that the prevention of high intestinal distension by means of prompt surgical relief of the obstruction, and the use of high jejunostomy combined with the forced administration of hypertonic chloride solutions, as both pre-operative treatment and post-operative, are the chief measures which may be expected to lower the mortality.

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