may form if a mydriatic is not used. After the subsidence of the primary oedema of the cornea in three to five weeks, a secondary oedema makes its appearance accompanied by ingrowth of vessels into the cornea from the undamaged region of the limbus contiguous to the triangular white patches of conjunctival destruction. These vessels assume characteristic and fantastic shapes; they show pointed ends, right-angled branches, intracorneal haemorrhages, sudden alterations of calibre, and constrictions cutting off the tips of the vessels, which may form blood islands just under the epithelium, also often of bizarre shapes. These vessels extend into the cornea, the secondary oedema spreading ahead of them. This process may continue for eight weeks or more and may then begin to subside, the vessels narrowing and often in course of time disappearing. A faint nebula is left in the substantia propria, the texture of which appears to be altered, but no further change occurs.

(c) In more severe cases, after the initial vascularization has cleared up, there is a relapse within a few weeks; the secondary oedema reappears, more vessels enter the cornea, and the same process of intracorneal haemorrhage, constriction of vessels, and regression occurs. These repeated relapses may continue for a year or more and then cease. Such an eye is left with a fair amount of sight but is in an unstable condition. As the intracorneal haemorrhages subside and the vessels retrogress they leave behind them a scarred area containing intracorneal deposits of fat and cholesterol. This stage of haemorrhages, retrogression of vessels, and degenerative deposits is symptomless and may continue for years. As the sight is fair (6/9 usually) these patients make no complaint, and numbers of them escaped notice between 1920 and 1935. After about ten years, however, such eyes are liable to a degenerative ulceration (delayed mustard gas keratitis). The ulcers are superficial and occur in the deposits of cholesterol where these reach the surface layers. The cholesterol is cast off and the individual ulcer heals with loss of substance after treatment. Hyoscine would appear to give greater relief than atropine in these cases. A number of faceted scars remain which seriously interfere with visual acuity, but as there are no very dense opacities this can be strikingly improved with contact lenses.

This delayed keratitis, which is now seen as a degenerative ulceration, can continue at intervals for twenty-four years or longer after the original exposure. Such relapsing eyes present the characteristic and now well-recognized picture of a transverse band of scarring with cholesterol and fatty deposits, facets, and abnormally shaped blood vessels and blood islands, together with destruction of limbal capillaries in the horizontal meridian and irregular and varicose conjunctival vessels.

(d) The most severe cases of all may go on to perforation of the cornea. These are extremely rare, and are probably due to an actual splash of liquid mustard. The initial course is the same as in the other types (a, b, and c), but the initial partial recovery is retarded and the sight poor all the time. The actual perforation, however, may not occur for ten years or more after the injury.

Conclusions

In the present state of our knowledge the effects of mustard gas on the eye are seen to depend on the size of the dose and the structures involved. Prognosis can be based on this. The series of changes set up by the gas tends towards self-limitation and spontaneous recovery, the results being better than the initial condition would suggest, even in severe cases incapacitated for months. It would appear that treatment at present should be symptomatic, since the condition is a chemical injury with possible secondary degenerative changes. The patient should be reassured as to the ultimate outcome.

REFERENCES

- Mann, Ida, and Pullinger, B. D. (1942). *Proc. roy. Soc. Med.*, **35**, 229.
Phillips, T. J. (1940). *Ibid.*, **33**, 229.

Recent gifts by the late Harvey Cushing and Dr. John F. Fulton have increased the medical library of Yale University to 85,000 volumes, making it one of the largest in the United States.

STRANGULATED HERNIA

A CONSIDERATION OF SOME FACTORS AFFECTING THE MORTALITY

BY

D. M. DOUGLAS, M.S., Ch.M., F.R.C.S.

*First Assistant in Surgery, British Postgraduate Medical School;
Major, R.A.M.C.*

In many surgical fields it is a difficult matter to assess results. It is only too often necessary to apply arbitrary standards of success such as "Good," "Fair," or "Unsatisfactory," and it is evident that results classified in this way are governed to an appreciable extent by subjective factors. It may be for this reason that analytical studies of case series have been criticized as at best inaccurate and at worst misleading.

Whatever the justification for this view, it is difficult to see how such a criticism can be made in a field whose sole aim is to save life and whose standard is nothing more complicated than survival. It will not be disputed that most cases of strangulated hernia will eventually have a fatal outcome if not treated surgically. By the same token, the primary aim in submitting them to operation is to save life. Hence it must be conceded that it is reasonable to use the fact of survival as the criterion of success in this sphere, a criterion which even the most sceptical can hardly criticize as subjective.

The object of this study was to analyse all cases of strangulated external abdominal hernia treated by operation in the surgical unit of the British Postgraduate Medical School in the five-year period 1936-40, with special reference to the fatalities. By so doing, it was hoped to find where the surgical treatment had failed and how such failures could be avoided in the future. The hernias were divided into three types—inguinal, femoral, and ventral—the last comprising para-umbilical and incisional hernias.

Material

During the period referred to, 551 cases of external abdominal hernia were treated surgically. Of these, 448 were simple and 103 strangulated. The types found in the two groups differed considerably in numerical distribution (Fig. 1). Thus in the simple group 77% were inguinal,

FIG. 1.—Types of hernia met with in a series of 551 consecutive cases (expressed in percentages). It will be noted that the femoral type forms no less than 49.5% of the strangulated group and only 10% of the simple group.

10% femoral, and 13% ventral, while in the strangulated group 33% were inguinal, 49.5% femoral, and 17.5% ventral. This leads to the interesting observation that whereas only 10% of inguinal hernias treated were strangulated, no less than 54% of femoral hernias—more than half—developed this serious complication.

It is true that an uncomplicated femoral hernia in a fat patient may easily escape detection, and that many patients, knowing they have a lump in the groin, seek advice only

when distressing symptoms of strangulation occur. But, even taking these factors into consideration and remembering that the second certainly applies to inguinal hernia as well, the figures strongly suggest that the patient with the untreated femoral hernia is running a considerable risk of strangulation—such a risk, indeed, that should not be lightly dismissed by the doctor called on to give advice.

Age and Sex Distribution.—By far the majority of cases occurred from the fourth to the eighth decade of life, and no less than 57% of the patients were over the age of 60 (Fig. 2). Since simple hernia is not especially a disease of

FIG. 2.—Age and sex distribution in strangulated hernia. Ordinates show number of cases; abscissae show age in ten-year intervals. Note that most of the patients were over the age of 50.

late life, the reason for this is by no means clear. It may, however, be suggested that, apart from a natural reluctance on the part of both patient and surgeon to resort to operative cure in the later age groups, the factors likely to cause strangulation are more commonly at work in the elderly than in the young. Thus the incidence of the various causes of straining, such as coughing, difficulty in micturition, and chronic constipation, is higher in the second half of life. The abdominal musculature, too, tends to lose tone as life progresses. These two factors may well combine to cause the passage of viscera into a hernial sac which, though capable of accommodating its normal content with ease, nevertheless reacts by causing venous obstruction and finally strangulation when a sudden addition is made. Prof. Grey Turner has constantly emphasized that age should not be a deterrent to operative intervention, pointing out that it is often the advanced pathological condition and not the age of the patient which determines a fatal outcome in these cases. So far as sex distribution is concerned the variations in the three types are striking (Fig. 2). Thus no fewer than 31 of the 34 inguinal strangulations occurred in males, whereas the reverse was true in the femoral and ventral groups, 43 of the 51 femoral cases and 16 of the 18 ventral cases being female.

Mortality and Cause of Death

Of the 103 patients, 17 (16.5%) died. In two of the deaths, factors divorced from the subject in hand were clearly involved. Thus generalized abdominal carcinomatosis from carcinoma of the head of the pancreas was present in one case, and a sudden cerebro-vascular accident occurred in another case which was progressing favourably. Nevertheless they are included in the mortality figures for the sake of completeness. Three deaths occurred in the inguinal, 9 in the femoral, and 5 in the ventral groups—a mortality rate of 8.8, 17.6, and 27.7% respectively (Fig. 3, B).

The largest single cause of death was some form of pulmonary complication (Fig. 3, A). Seven deaths were classified under this heading, 4 of them being confirmed at necropsy. Five of the 7 deaths were taken to be due to frank bronchopneumonia, the other two being described as post-operative atelectasis. The average age of these patients was 73 years. Peritonitis accounted for 3 deaths, all confirmed at necropsy. The cause of the peritonitis in one case was a pre-operative perforation of the bowel immediately above the constriction ring. In the other 2 leakage occurred from bowel which at operation was deemed viable

FIG. 3.—A. Causes of death in 17 fatal cases. Note that pulmonary complications were responsible for most of the deaths. In this group the average age was 73 years. B. Individual percentage mortality rate. The relatively benign character of the strangulated inguinal hernia is to be noted.

but which subsequently became gangrenous after having been returned to the abdomen. Myocardial failure, a cause of death always to be regarded with suspicion, was held to be responsible in 2 cases. One of these was confirmed at necropsy, the heart muscle showing fatty changes and the lungs showing patchy atelectasis. The cause of death in the remaining 5 cases was described as due to the effects of intestinal obstruction in 2, renal failure in 1, and the 2 cases already referred to—carcinoma of the pancreas and cerebral thrombosis. The cause of death was confirmed at necropsy in 10 of the 17 fatalities.

Factors Involved in the Mortality

Age.—When the age of the patient is correlated with the mortality it will be seen to be a very important factor in

FIG. 4.—Factors concerned in the mortality. The ordinates in all figures are percentages. In the femoral and ventral types the mortality rises rapidly with age, whereas this tendency is not seen in the inguinal type. Mortality rises with the increase of duration of strangulation, and anaesthesia does not appear to be significant.

the prognosis (Fig. 4). In the whole five-year period not one death from strangulated hernia occurred in a patient under 50 years of age. The average age of the 17 fatal

cases was no less than 68.9 years, with the comparatively restricted range of from 53 to 91 years. In both the femoral and the ventral types the mortality rose progressively with each decade. Thus in the femoral group the mortality up to the age of 60—25 cases in all—was *nil*, while in the seventh, eighth, ninth, and tenth decades it was 18, 30, 75, and 100% respectively. A comparable rise was seen in the ventral group. This tendency was not, however, observed in the inguinal group, the three deaths occurring in the sixth decade, while none of the 17 patients over 60 years died, although no fewer than 8 of them were over 70. It would be foolish to make generalizations from such a small series as this, but this figure does suggest, what is often held, that old men stand operative procedures better than old women. This is further borne out by the fact that of the 41 males in the whole series only 4 died, whereas of the 62 females 13 died. This gives a male and a female mortality rate of 9.7 and 20.9% respectively, figures which may well be significant.

Duration of Strangulation.—Although all the cases in the series were confirmed at operation to be in fact strangulated—that is, that interference with the blood supply of the viscus in the sac was evident—it is difficult to be certain how long pre-operatively the strangulation had existed. The criterion taken was the time interval between the first symptom of the recent attack and the operation. This obviously falls far short of scientific requirements; but it is the one in general use, and to accept a statement from a patient as to when the hernia became tense would be even less reliable, since many of the women in the femoral group are unaware that hernia is present. In this connexion the case of a male patient with a strangulated inguinal hernia may be briefly cited.

This man was admitted with abdominal pain, vomiting, and constipation. No external cause for the obvious intestinal obstruction was evident, and he did not throw any light on the condition, except that he had an inguinal hernia, which he had replaced shortly after the onset of the attack. Laparotomy revealed a reduction en masse, intraperitoneally, of an inguinal hernia which contained coils of the strangulated small bowel. In spite of the fact that the patient knew he had an inguinal hernia he was totally unaware that it was causing his symptoms.

The cases, then, were classified into five groups, according to the duration of symptoms. The first group included those up to twenty-four hours, the second up to forty-eight hours, and so on by twenty-four-hour periods to the fifth group, which comprised those whose symptoms had lasted for over four days (Fig. 4). Irrespective of any other factor, the mortality rose progressively as the duration of symptoms increased. Thus in the first twenty-four hours of the disease the mortality was only 5.7%, while in the group of over four days' duration 8 of the 16 patients died—a mortality of 50%. The intervening groups showed comparable rises in mortality.

Anaesthesia.—Three types of anaesthetic were used in the series: general—usually gas, oxygen, and ether—spinal, and local. The case mortality for these types was 12, 14.6, and 21.6% respectively. This would at first glance suggest that general anaesthesia was safest, a conclusion which is of course wholly erroneous. The figures simply mean that general anaesthesia was used in the good operative risks and that local anaesthesia was the method of choice in the desperately ill patient. In fact, I feel confident that if 37 of the cases had not been operated on under local anaesthesia the mortality in the whole series would have been considerably higher.

Viability of Intestine.—Of the 103 cases, resection of gut was considered to be necessary in 7. In 2 others, already referred to, gut which was deemed viable at operation was

subsequently found at necropsy to be gangrenous. Thus a total of 9 cases showed non-viable intestine—a percentage of 8.7. The resection rate rose in step with the duration of symptoms (Fig. 5). Thus in none of the 35 cases in the

FIG. 5.—Ordinates denote percentages; abscissae, days. Note the steady rise in the number of cases requiring resection of intestine as the duration of strangulation increases.

first-day group was resection necessary. In the subsequent twenty-four-hour groups the resection rate rose to 4, 10.5, 12.8, and 18.7% respectively. Hence a patient with a strangulation of over four days faced a 1 in 5 risk of requiring enterectomy. It is of interest to note that the two cases in which non-viability of intestine that had been returned to the abdomen at operation was found at necropsy were both in early groups—second-day and third-day respectively. It was no doubt for this reason that the surgeon was persuaded to return the bowel to the abdomen. As for the individual types, non-viability was commonest in the ventral group (16.6%), next in the femoral group (10%), and least common in the inguinal group (2.9%). This is a very striking difference indeed, and no reasonable explanation can be offered beyond the fact that the inguinal group were operated upon at a slightly earlier stage than the other two groups. It is further confirmation of the fact, borne out in the other sections, that a strangulated inguinal hernia is a more benign type of lesion than any of the others. As for the mortality of resection, 2 (28%) of the 7 patients died. If the 2 cases of bowel gangrene found at necropsy are included, 4 of the 9 patients showing non-viability died, a mortality of 44%. Hence this series indicates that the presence of gangrenous bowel in a hernial sac reduces the patient's chances of survival to about one-half.

Commentary

There is only one point of view from which to examine operative data if they are not to become a meaningless and wearying collection of figures. It is to regard all deaths as failures of surgical practice and attempt to lay one's finger on the spot where the treatment was ineffective.

With this in mind, what factors could reasonably be held to blame for the seventeen deaths in this series? Two stand out clearly enough to be significant—the age of the patient and the duration of the strangulation. It is evident that as doctors we have little control over the second factor, save in so far as we can teach the public that a hernia, and particularly a femoral or para-umbilical hernia, is not only an uncomfortable companion but may be a treacherous one as well. In the matter of the age of the patient, however, more could be done to save those in the later age groups, who are faced with a mortality of from 30 to 70%. As was shown earlier in this paper, the overwhelming cause of death in these groups is not connected directly with the hernia at all; it is some form of pulmonary complication. It is of the utmost importance, then, that we recognize at the moment of admission of such a case to hospital that, provided the patient is not moribund, what is about to determine the outcome of the case is not the brief sojourn on the operating table. On the contrary, it is the relatively prolonged sojourn in bed afterwards. The restriction of bodily activity involved, added to the already almost basal level at which these patients live, is followed inevitably by a chain of events which will reduce their chances of survival to a minimum. Of these events two are particularly

dangerous. The first is the diminished pulmonary ventilation which follows the reduced respiratory requirements. Areas of atelectasis result which are invaded by pathogenic organisms, leading to a frank bronchopneumonia. The second is the venous stasis, particularly in the lower limbs, which is the result of the loss of two of the physiological factors which normally aid venous return to the right heart—namely, the negative pressure in the thorax which develops in deep respiration, and the propulsive action of contracting muscles in the limbs. As the venous flow slows down, so intravascular thrombosis is facilitated and thrombi are shed, to become enmeshed in the pulmonary circulation and cause scattered pulmonary infarcts, which in their turn are likely to become infected.

Recognizing, then, that it is bodily inactivity and not the comparatively trivial operation involved that will determine a fatal outcome, what can be done to improve matters? Of the measures in use in younger age groups to prevent the foregoing chain of events most are not satisfactory in the aged. Thus the employment of regular breathing and muscular exercises, measures normally as valuable to the abdominal surgeon as are active exercises to the orthopaedic surgeon, is not as a rule successful in the later age groups because of lack of co-operation. An old lady of 75 who has suffered the outrage of being admitted to hospital for an emergency operation is usually too bewildered and frightened to take such an apparently trivial admonition seriously and too absent-minded to co-operate even if she did. The same might be said for the use of any form of mask or tent for the administration of oxygen or carbon dioxide, though not perhaps to the same extent.

The only certain preventive measure for these patients is to regard the operation as a mere incident in the treatment and so plan it that the period of restriction in bed is kept down to the absolute minimum of one day. Nature herself aids us in accomplishing this in that the pain felt from the wound often seems to be much less in elderly patients than in the young. The involuntary exercise involved in getting out of bed into a chair increases the respiratory requirements, the pulmonary ventilation, and the rate of venous return.

Some such regime as follows is suggested in a patient over the age of 70 with a strangulated hernia. After a preliminary gastric lavage, operation is performed under local anaesthesia, with little or no pre-operative sedation. Omnopon or morphine occasionally seems to precipitate mental confusion, which is never completely recovered from, and the latter is to be avoided in an already inoperative patient. After the minimum operative procedure necessary to save life, with no attempt at reconstruction, a pad of wool is placed over the dressing and over all a firm hip spica bandage is applied. If a post-operative sedative is used, paraldehyde or potassium bromide and chloral are to be preferred to opium derivatives. During the first twenty-four-hour period, if there has been much vomiting, the fluid balance may be restored by the intramuscular route much more safely than intravenously.

On the day following operation the patient is got up in a chair for two or three hours, and this time is increased daily till on about the fifth or sixth day he is spending most of his waking hours moving about in it. He is permitted to walk as soon as he feels like it, and is encouraged to do so as early as possible.

This regime must of course be modified if an exteriorization operation has been performed, and is not so easily carried out in strangulated incisional or para-umbilical hernia. But it is applicable to both the inguinal and femoral groups, which make up the bulk of the cases.

Summary

An analysis is presented of 103 consecutive cases of strangulated external abdominal hernia treated by surgical operation, with a mortality of 16.9%.

An attempt is made to discover the significant factors concerned in this mortality.

Of these, the age of the patient and the duration of the strangulation are shown to be the most important.

The management of the condition in the aged patient is briefly discussed.

Acknowledgment is made to Prof. Grey Turner for stimulus and advice, to the surgical staff of the British Postgraduate Medical School, and to Dr. Allen Daley, Chief Medical Officer to the L.C.C., for permission to publish these data from Hammersmith Hospital.

ALLERGY, ENURESIS, AND STAMMERING

BY

I. GORDON, M.D., M.R.C.P., D.P.H.

Assistant Medical Officer of Health, Ilford

It was with considerable scepticism that the advent of nocturnal enuresis (Bray, 1937) and stammering (Kennedy and Williams, 1938) as allergic manifestations was noted, because so many conditions of doubtful origin, from epilepsy to dysmenorrhoea, have been so regarded. Enuresis and stammering are among the commonest preoccupations of the school medical officer, and it was accordingly decided to investigate the matter. The necessity for further inquiry into the aetiology of enuresis must be apparent to all who read the abundant and divergent claims to treat the disease successfully. Some authors think the cause is purely psychological, others can find a posterior urethritis. Some get the child up every hour or so or give ephedrine, which may keep it awake; others give bromide or luminal to keep it asleep. One advises ignoring the condition, and another makes the boy wash his bed-linen with great ceremony. One insists on the chamber being as handy as possible; someone else wants it right out of the way. Some state that the child will automatically be cured if he sleeps in hospital or with friends; others point out the large increase in enuresis caused by evacuation.

To find the correct incidence of enuresis it is essential to ask the leading question. For instance, out of 2,416 routine inspections a history of enuresis was spontaneously forthcoming in only 33 (1.3%) cases. Nevertheless, out of 200 children specially interrogated enuresis was reported in 14 (7%). It may be remarked that these figures apply only to school children between the ages of 5 and 14. Figures that include children of ages other than these will naturally be quite different, as the incidence of bed-wetting diminishes progressively as the child grows older. Mothers were always asked if the child had at any time since the age of 5 repeatedly wet his bed.

In order to establish the statistical significance of the figures given, the table of Loewenthal and Wilson (1939) was used. If "s" is found after a number it means that the result is significant at the level $P=0.05$. Further, "v.s." means that a conclusion is very significant at the level $P=0.005$. Some of the work done for this investigation had to be excluded for statistical reasons. For instance, an increase in nail-biting among allergics was found; but, considering the numbers in the series, the result was such that, according to the table of Loewenthal and Wilson, chance could not be excluded.

The Investigation

In each instance 200 unselected routine cases acted as a control. A history of allergy in the child or the family