

procedure. So far there have been no recurrences among the 50 cases operated upon. Naturally the number of recurrences will depend on the criteria accepted in diagnosing such an event, and a minimal leak may produce marked signs. Hence the figures quoted above may exaggerate the incidence of recanalization following simple ligation. It should be noted that a systolic pulmonary murmur often persists for some time after ligation, presumably as a result of dilatation of the pulmonary artery.

Although on the whole no particular anxiety was felt during most operations, the dramatic and serious events in the following case make it worth recording.

Case 3.—The patient, a girl aged 13, had suffered no symptoms, though she was mentally rather backward. Operation was carried out under thiopentone, followed by nitrous oxide and oxygen and a procaine drip. Immediately the chest had been opened it was noticed that there was practically no bleeding. The heart was inspected. The auricles were seen to be contracting irregularly, while the ventricles were at a standstill. Cardiac massage was begun at once, followed by intracardiac adrenaline. The ventricles resumed beating immediately, and continued to do so strongly and regularly. It was estimated that they had been standing still for two to three minutes. It was decided to proceed with the operation, and this was carried out without further difficulty. After operation the patient was given cytochrome C, 2 pints (1.1 litres) of quadruple-strength plasma, and sodium succinate. She continued unconscious for two days in an attitude resembling decerebrate rigidity. A hopeless prognosis was given to her parents; nevertheless she regained consciousness and entered a period of restlessness lasting about ten days. Henceforth her mentality improved slowly, though it was many weeks before she could feed herself and had regained continence. Six months after operation she returned to school, though she has difficulty in coping. Nevertheless she appears to be improving.

An exactly similar case is described by Wangenstein *et al.* (1949). One must conclude that it is well worth while to persevere in the treatment of such cases, which in the early stages would appear to be utterly hopeless.

Post-operative Course

One boy aged 6 died two days after operation. He was a typical case of persistent ductus arteriosus, and operation was straightforward. On his way to the ward he was allowed to become cyanosed, and this was not discovered for some time. Although he eventually recovered consciousness he died of cerebral anoxaemia after two days. This death is directly attributable to a shortage of trained nursing staff. One patient had a mild wound infection which cleared rapidly. Four patients developed pleural effusions which cleared completely. One patient had a pulmonary infarct; this was one of the infected cases. Two patients required bronchoscopy for post-operative lung collapse, and one patient produced four or five tracheal casts.

Follow-up Period

This has been up to four years, and there have been no recurrences. The woman aged 40 who was in failure recovered completely—this being one of the few types of cardiac failure in which complete recovery is possible. The infected cases all recovered completely, irrespective of the use of antibiotics. In most cases, however, an attempt was made to cure the infection first by the use of large doses of penicillin. The children who were handicapped by the knowledge of heart disease have all returned to a normal life.

Summary and Conclusion

Fifty cases of ligation of persistent ductus arteriosus, with one death, are analysed. Ten physically handicapped patients made a complete recovery, and six who were held back by the knowledge of heart disease were allowed to return to normal life.

No certain knowledge is available to show how many of the asymptomatic cases, had they been left alone, would have gone on to obliteration of the ductus. It is well known that persistent ductus arteriosus is un-

common in the elderly, and this is sometimes taken as proof of the poor prognosis of the condition. On the other hand, it may mean that obliteration does occur more often at a later age than is at present recognized. Nevertheless, operation seems well justified in view of its low mortality as compared with the dangers of a persistent ductus—mainly subacute bacterial endarteritis and cardiac failure. In some cases the accelerated growth and development following operation are striking. For these reasons operation should not be too long delayed, and about 7 years probably represents a good age to operate.

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REDUCTION OF POST-OPERATIVE PAIN

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The object of this communication is to present a simple way of diminishing post-operative pain in abdominal incisions. Briefly, analgesia is obtained by injecting procaine every three hours into the rectus sheath through polythene tubes for a period of three days. The method was first used by Blades and Ford (1950) in chest operations, and they suggested that it might prove successful in abdominal surgery. It was subsequently employed by Gerwig, Thompson, and Blades (1951) in 24 patients undergoing cholecystectomy. These writers came to the conclusion that it guaranteed satisfactory analgesia in upper paramedian incisions.

Pain is the chief factor preventing full respiratory excursions and adequate coughing after abdominal operations. Pain can be diminished by morphine, but morphine has an inhibitory effect on the cough reflex, and this may cause pulmonary complications sufficient to endanger a patient who has had an operation such as partial gastrectomy. Pooler (1949) found that pulmonary complications occurred in 19% of patients after upper abdominal operations. Using a spirometer, he found that there was a great diminution in vital capacity. He came to the conclusion that reflex muscle spasm was the chief cause of this reduction, and something more than the abolition of conscious pain was required. This could be accomplished only by interrupting the reflex arc on the afferent side.

Present Investigation

We were led to try the method of local infiltration with procaine, with a few modifications, after observing the reactions of a healthy young man who developed pulmonary collapse following a simple laparotomy through an upper paramedian incision. He had a great deal of pain in the

wound and needed five injections of morphine and pethidine during the first three post-operative days. He would not cough even with persistent encouragement. His temperature rose to 103° F. (39.4° C.) on the second day and remained at over 100° F. (37.8° C.) for three days. It was felt that this complication could have been avoided by the use of some method which reduced wound pain locally.

In this investigation polythene tubes were used in a consecutive series of 30 upper abdominal operations (see Table). The method adds less than 30 seconds to the operative time.

Summary of Cases

Case	Age	Operation	Post-operative Temperature
1	59	Polya type of gastrectomy	100° F. (37.8° C.) 1st and 2nd days
2	46	" " " "	99° F. (37.2° C.) 1st, 2nd, and 3rd days
3	48	" " " "	100° F. 1st and 2nd days
4	70	" " " "	100° F. 1st day
5	57	Billroth I gastrectomy	Normal
6	64	Polya type of gastrectomy	99° F. 2nd day
7	48	" " " "	99° F. 1st and 2nd days
8	47	Billroth I gastrectomy	101.5° F. (38.6° C.) 2nd day, 100° F. 6th and 7th days
9	51	Polya type of gastrectomy	100° F. 1st day, 99° F. 2nd day
10	44	" " " "	99.5° F. (37.5° C.) 2nd and 4th days
11	42	Billroth I gastrectomy	99.5° F. 1st and 3rd days
12	54	" " " "	99° F. 1st, 2nd, and 3rd days
13	34	Polya type of gastrectomy	100° F. 1st day
14	50	Billroth I gastrectomy	99.5° F. 1st day, 99° F. 2nd day
15	40	" " " "	99° F. 1st and 4th days
16	37	Polya type of gastrectomy	100° F. 1st day, 99° F. 2nd day
17	49	" " " "	Normal
18	42	" " " "	99° F. 1st day, 99.5° F. 2nd day
19	50	Billroth I gastrectomy	100° F. 1st day, 99.5° F. 2nd day
20	51	Polya type of gastrectomy	Normal
21	52	Billroth I gastrectomy	99.5° F. 3rd day, 99° F. 4th day
22	31	Polya type of gastrectomy	Normal
23	54	" " " "	99° F. 1st day, 100° F. 2nd day
24	56	Billroth I gastrectomy	100° F. 1st and 2nd days
25	78	" " " "	100° F. 1st day, 99° F. 2nd and 3rd days
26	55	Gastro-enterostomy	99.5° F. 2nd day
27	44	Billroth I gastrectomy	99° F. 2nd and 3rd days
28	40	" " " "	99.5° F. 3rd day
29	52	Polya type of gastrectomy	99° F. 1st day
30	54	Billroth I gastrectomy	Normal

All the cases had considerable relief from pain a few minutes after the injections were given. This in itself should make it a valuable addition to post-operative treatment, since a sense of well-being improves morale. Patients were able to carry out their breathing exercises unhampered by pain, movement in bed was facilitated, and ambulation was made more comfortable. Another point of interest was that some patients found that the passage of urine and flatus was much easier after the injections of procaine. There was no delay in healing or any evidence of wound infection. It is obvious that great care should be taken not to introduce infection at the time of injection.

It was found, however, that many patients did not sleep during the first night, though pain was relieved. They did not complain of pain, but remained wide awake because cerebration was active. To combat this sleeplessness, an injection of soluble phenobarbitone, 3 gr. (0.2 g.), and pethidine, 100 mg., was given on the first night. In anxious patients this was repeated on the second night. The procaine injections were used only for the first three days after operation, as after this time wound pain was not severe enough to call for continuation of the treatment. A degree of euphoria was noted in some cases, possibly due to a central effect of procaine.

The method was also found to be successful in midline incisions, the tubes being placed between the peritoneum and the linea alba.

Anatomy

The rectus sheath is formed in its upper three-quarters by the aponeurosis of the internal oblique muscle, which splits at the lateral border of the rectus muscle into an anterior and a posterior layer. These layers fuse with each other and with those of the other side at the linea alba. The aponeurosis of the external oblique muscle fuses with this anterior layer and the transversus muscle with the posterior

layer. In the lower quarter all three aponeurotic layers pass in front of the rectus muscle, leaving behind it only the fascia transversalis and the peritoneum.

The nerve supply of the rectus muscle, its sheath, and the subjacent peritoneum is derived segmentally from the lower intercostal nerves. T.7 supplies the upper part, T.10 the level of the umbilicus, and L.1 the lower part above the pubis. The terminal part of a typical lower intercostal nerve enters the posterior aspect of the rectus sheath near its lateral border. It supplies branches to the sheath and to the subjacent peritoneum. It then passes forwards, through the rectus muscle which it supplies, and terminates in the overlying skin.

Technique

After closure of the peritoneum a No. 16 B.W.G. needle is inserted through the skin 4 cm. lateral to the lower third of a paramedian incision, and continued obliquely upwards and inwards, passing through the anterior rectus sheath and the rectus muscle. Along the bore of this needle a size 1 polythene cannula is introduced into the space between the posterior rectus sheath and the rectus muscle. The needle is withdrawn and the polythene tube pulled upwards towards the costal margin. It is most important to be sure that this tube is as high up in the sheath as possible. Failure to ensure this will result in the patient's complaining of pain over the seventh and eighth costal cartilages. The pain is probably due to bruising of the cartilages by retraction at the time of operation.

A second tube is introduced into the upper third of the rectus sheath in the same way and passed downwards towards the lower end of the sheath. This method of placing the tubes lessens the chance of accidental removal before the end of three days. Further fixation of the tubes is obtained with elastic adhesive bandage in the form of a modified watershed dressing after closure of the wound.

Before the patient leaves the theatre 4 ml. of 2% procaine is injected into each tube. A further 3-5 ml. is injected every three hours into each tube for the next three days. The amount injected depends on the thickness of the abdominal wall. If only 2 ml. is injected the period of analgesia is very short. Penicillin, 300,000 units every four hours, is given the night before operation and continued for five days.

Conclusions

Procaine injected through polythene tubes into upper abdominal incisions satisfactorily controls post-operative pain.

The necessity for post-operative narcotics is greatly diminished.

Breathing and coughing are facilitated, with consequent diminution in pulmonary morbidity.

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The staffing of many small homes for old people which are being opened throughout the country is an acute problem, and in an attempt to meet this need the National Old People's Welfare Committee has initiated a training course for matrons and assistant matrons. The fourth of these courses, which are supported by the Ministry of Health, begins in October; it will last for four months and comprise theoretical teaching and practical training in the geriatrics units of London hospitals and in old people's homes. Local education authorities are encouraged to assist students from their areas with grants towards the cost of tuition. Further information about these courses may be obtained from the National Old People's Welfare Committee, 26, Bedford Square, London, W.C.1.