the pain of the piercing of the peritoneum, and after several refillings it is felt but little.

It is more important than with pneumothorax to feel the strata at the progress of the needle, as of course the manometer gives no indication whether the needle has passed the peritoneum. The danger of piercing the bowels seems very remote: the smooth intestines escape the needle if they are not too tympanitic and if the needle is not too pointed. Also, with the finer needle there would be no danger if the bowels were pierced.

Before passing air through the needle it is advisable to test with a syringe whether blood or any liquid is present. The amount of gas introduced averages 500 c.cm.—oxygen or air being used. The reading at the manometer is round about zero, rising slightly after the filling of each fraction and dropping again quickly, eventually remaining at 2 or 3 cm. H₂O. Sometimes slight oscillations corresponding to the respiration are noticeable. If the needle has not yet reached the peritoneal cavity the manometric pressure of course rises rapidly, even after introducing the smallest amount of gas. The manometer serves in this sense as a control.

Another control is the reduction and the disappearance of the dull liver sound on percussion. During or soon after the filling, the patient usually complains about the sudden appearance of pain in one or both shoulders; this is of so regular occurrence that it is advisable to tell the patient beforehand about it and to reassure him. The appearance of this phenomenon and the projection of pain to the shoulder region are obviously due to the phrenic nerve, and can also be used as a control; the effectiveness of the filling can further be checked by means of radiographs.

Refilling can be done once or twice weekly; when pure oxygen is used the intervals are 3 or 4 days because of more rapid absorption. When air is used the intervals are from 6 to 8 days. Because of its calming effect oxygen is preferable for the first fillings for cases with major abdominal discomfort and frequent colics, and for cases with a higher grade of secondary anaemia and dyspnoea. The number of fillings required varies greatly, and it may be necessary to continue treatment for three months or more.

Results

Of the 7 cases in the series only one was treated for more than 3 months.

Case 1.—A woman aged 28 had been suffering for 3 years from severe diarrhoea. She had from 15 to 25 bowel motions daily—in better periods and under the influence of opium 10 to 12 motions—always with an admixture of mucus and blood, occasionally pus. Loss of weight was 46 lb. in 3 years. During three months' treatment with pneumoperitoneum the number of bowel motions was steadily reduced and she regained 17 lb. Her general condition improved, and finally the stool was free from mucus and blood. The diagnosis of ulcerative colitis had been confirmed by sigmoidoscopy. Investigation after one year showed that she was free from complaints and had further gained in weight.

In one case only two fillings were required. Particulars of this case are as follows:

Case 2.—A man, part Polynesian, aged 42, had been suffering from symptoms of chronic colitis for several years. His loss of weight was over 30 lb. and there was incapacity for work and general debility. After pneumoperitoneum and one refilling he felt well. No sigmoidoscopy had been carried out; the presence of a tumour in the colon suggested by severe secondary anaemia had been excluded by radiological examination. Re-examination after 7 months showed that the patient had gained 14 lb. He was still feeling well and was able to work.

In some cases a moderate amount of peritoneal effusion developed; this liquid was sooner or later reabsorbed spontaneously. In such cases it is advisable to give 10 c.cm. of calcium chloride intravenously 3 times weekly. It appeared also that patients who developed temporary ascites responded more quickly to treatment.

Summary

The therapeutic action of pneumoperitoneum is probably due partly to activating the visceral peritoneum and "tuning it to a higher pitch" by the setting up of a permanent bland

irritation to the vast peritoneal surface, and partly to mechanical action and indirect influence on the autonomic nervous system.

Pneumoperitoneum may be described as a simple and effective therapeutic procedure in apparently intractable cases of chronic ulcerative colitis. It is easily performed, and is free enough from danger for it to be introduced, and for refillings to be made, by any practitioner, even without the facilities of a clinic or a hospital.

SOME OBSERVATIONS ON BILIARY PAIN

BY

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The recent article by Mr. F. R. Brown (1942) in the *Journal* has prompted me to record some clinical observations on biliary pain. The classical "pain" of what is loosely termed biliary colic is really, of course, a pain complex, which has been split into components and explained by Morley (1931). My hope is only to add a very little to what he and others have already said.

Components of the Biliary Pain Complex

I think that in a fully developed case five components of the complex can be recognized, though more commonly only two or three are met with.

1. In most cases of biliary colic the pain is first felt by the patient as a violent if dull ache in the central epigastrium, coming in waves. Like other visceral pains it is absorbing, so that the sufferer for the time being is as if paralysed, and almost identified with his own pain. If he can divert his attention from it for long enough he will pass his hand from side to side across his epigastrium, from one costal margin to the other, to indicate its position, which he still cannot describe with any accuracy. I should be inclined in the case of biliary colic to convert the vertical oval in Fig. 5 of Brown's article to a horizontal one (Fig. 1). In some cases, more

Fig 1

Fig 2

Fig 3

Fig 4

Fig 5

particularly when the attack is short and infection slight or absent (as evidenced by freedom from pyrexia and leucocytosis), this component is the only one felt, and there may be no tenderness over the gall-bladder. I have also been able to observe one of the cases in which an idiosyncrasy to morphine has developed after cholecystectomy, and which Smyth (1941) quotes Walters (1938) as ascribing to spasm of the sphincter of Oddi. In this case the pain provoked by morphine was

of the nature described above—a severe but not definitely localized transverse pain in the epigastrium.

2. The second component is certainly inconstant, but I am surprised that I cannot find any direct reference to it in the works I have consulted. Moynihan (1905) mentions that pain (during the acute colicky phase) may be felt in the chest, and Cope (1925) recorded pain in the back of the neck in a patient found to have a stone in the common bile duct. He also quotes Reynolds's *System of Medicine* as mentioning pain radiating to the clavicles; but I cannot find a suggestion that there is a second type of visceral pain occurring in biliary disorders. I feel satisfied that there is. It is a severe dull ache, said by the patient to be in the neck—most severe in the back of the neck, but also radiating in front to the clavicular regions. It is symmetrical, and one patient described it as "like a necklace of pain" (Fig. 2). It may be so severe as to overshadow the epigastric pain, which is also present. It occurs early in the attack, accompanying the first component.

3. As is well known, rather later in the attack a third component appears—pain in the right side below the costal margin, and accurately located by the patient. At the same time local tenderness develops, elicited by very light tapping with the tip of a finger (Fig. 3).

4. The fourth component often arises about the same time, is met with in severe attacks, and is said by the patient to "go through to the back"—to the region of the angle of the right scapula. In character it is similar to component 3, and different from the paralyzing waves of pain of components 1 and 2 (Fig. 4).

5. According to Morley (1931) shoulder-tip pain is present in only 5% of cases. In my experience it is not remarked on by the patient during the colic, though it may be present; but the information can at times be elicited from him that it preceded or followed the attack. It resembles components 3 and 4 in nature, and is often thought by the patient to be an intercurrent rheumatic pain (Fig. 5).

Explanation of the Various "Pains"

The explanation is an interesting exercise in the light of current theories. According to Brown's theory of primary position, the first component is related to the derivation of elements of the bile passages from an outgrowth of the foregut caudal to the stomach, and thus innervated by the 8th and 9th thoracic nerves, which is the segmental distribution of the pain. I submit that there are also good embryological grounds for an explanation of the situation of the second component, which to my mind is also a visceral pain. Mesodermal elements of the bile passages derive from the septum transversum, like the central part of the diaphragm, and, also like it, are innervated from the primary positional nerves C3, 4, and 5. The visceral pain connected with these elements would, according to Brown's hypothesis, be felt in the region of the neck supplied by these nerves, and this accords exactly with my observations.

It seems hardly necessary to repeat Morley's explanation of the third component. The inflamed or congested peritoneal coat of the gall-bladder irritates an area of the parietal peritoneum and sets up "peritono-cutaneous radiation" from the nerves of the anterior parietal peritoneum to the more superficial branches. I would add two observations in support of this view. First, in cases in which the inflammation of the gall-bladder has practically subsided pain can be reproduced by the patient's actively protruding and retracting the abdominal wall for a few seconds, or it may be provoked by walking—both of which movements can be taken to increase friction between the gall-bladder wall and the anterior parietal peritoneum. Furthermore, in one case of chronic cholecystitis, later confirmed by operation, the localized pain below the right costal margin came on before the main meal of the day, was aggravated by walking, and was at once relieved by taking the meal. The clinico-pathological interpretation is as follows. When the inflamed gall-bladder was distended with bile it was in contact with the anterior parietal peritoneum, and pain was set up which was relieved by the shrinking of the gall-bladder and its retraction after the meal.

The fourth component is explained in a similar way by cutaneous radiation occurring from the posterior parietal

peritoneum, which later in the attack becomes inflamed. That considerable disturbance does take place in this region is shown by the frequent occurrence of crepitations, and by other evidence of congestion at the base of the right lung.

Morley (1931, p. 28) remarks that while gall-stones do not at all commonly give rise to shoulder-tip pain they are responsible for almost the only reference to it in the surgical textbooks. He adds: "The reason of this is to be found in the confusion that has arisen between the 'shoulder pain' or pain radiating to the angle of the right scapula, which is an almost constant feature of biliary colic, and true shoulder-tip pain due to phrenic stimulation."

I suggest that the pain in the back of the neck and clavicular regions, which I have described as the second component and which has all the features of visceral pain, is an equally likely cause of the confusion. Shoulder-tip pain properly so called does of course arise in biliary disease. Hurst (1934), for example, mentions it as occurring in hepatitis or "bilious attacks." A very interesting light on this problem was shed by a case I observed a few months ago.

The patient, a healthy man aged 36, had a severe attack of epidemic catarrhal jaundice, the source of infection being known, and he also in his turn infected a third person. On the tenth day of his illness, the jaundice being very deep, I casually asked him if he had shoulder-tip pain, and he agreed that he had. On local examination, a striking appearance of the right shoulder presented itself. There was an area of erythema, slightly raised above the surface and dotted with small closely set papules. It was almost circular in outline, and was five inches in diameter, with its centre over the tip of the acromion process (Fig. 5). It corresponded exactly with the area outlined in an illustration in Morley's book (p. 37) showing the area of pain and hyperalgesia in a case of traumatic laceration of the spleen.

It seems justifiable to assume that in the case described a corresponding area of stimulation on the right side was the cause of the pain and its accompanying phenomena—namely, the contact of the inflamed surface of the liver with the central part of the diaphragm. This leads me to the conjecture that shoulder-tip pain in biliary disease is commonly due to concomitant hepatitis. The cutaneous eruption faded in a few days, and I was unable to elicit any marked hyperalgesia over it. Whatever the explanation of the process which had given rise to it, there can be no doubt as to its objectivity, and it seems to me to give support to Morley's views.

It is to be noted that the five components may follow one another in varying order. Thus in one case the first complaint was of pain below the right costal margin of several weeks' duration (third component), and probably attributable to commencing metastatic infection of the gall-bladder. This was followed by slight jaundice and shoulder-tip pain (fifth component), presumably due to hepatitis; and then a few days later by the first and second components, which coincided with attempts by the gall-bladder to expel solid or semi-solid matter which had precipitated by this time.

Summary

The biliary pain complex is split up into five components and explained in the light of current theories. Special reference is made to a variety of visceral pain arising in the bile passages which is not well recognized. Reference is also made to a case of epidemic jaundice in which shoulder-tip pain was associated with a cutaneous eruption.

I am indebted to Mrs. J. M. D. Young for the figures

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The name of the Federal Council of Australian Aerial Medical Services has recently been changed to "Flying Doctor Service." The service has six bases in remote parts of Australia, which keep in touch with about 250 outposts by two-way radio. The cost of upkeep is £21,000, partly financed by the Federal and State Governments and partly by private contributions. The service is at present suffering from shortage of staff because many doctors, pilots, and wireless operators have enlisted.