Summary

Fifty-one cases of small acute corneal ulcers were examined, and healing time ascertained by instillation of sodium fluorescein under standard arbitrary conditions.

Approximately half the patients received 1.5 g. of ascorbic acid daily; the remainder were given control tablets.

Deep ulcers healed significantly more slowly than superficial ulcers.

The administration of large doses of ascorbic acid had no significant effect upon the healing time of superficial ulcers, but significantly accelerated the healing of deep ulcers.

It is suggested that there may be a localized area around the site of regenerating corneal collagen where the ascorbic acid level falls below the optimum for rapid healing. Raising the general ascorbic acid level with massive doses increases the local rate of replacement.

Pyrorrhoea occurred significantly more frequently in patients with corneal ulcers than in others with non-infective eye complaints.

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Courses of instruction on medical aspects of atomic warfare at the Royal Naval Medical School, originally started for medical officers of the Royal Navy, have been made available to wardmaster officers in the Royal Navy, to medical officers of the R.N.V.R., and to certain civilian members of the nursing profession. These courses were started in 1948. At first they were intended only for Naval medical officers, but soon it was decided that medical officers of the R.A.M.C. and R.A.F. should attend. In January, 1949, the doors were thrown open to civilian medical officers nominated by the Ministry of Health. The medical officers' standard course lasts five and a half days, and the subjects dealt with include atomic physics, effects of radiation in the human body, monitoring and defence organization, and treatment of casualties. The lectures are supplemented by films. Early this year shorter courses lasting three days for nursing officers of the three fighting Services were started, and these were also opened to members of the civilian nursing profession nominated by the Ministry of Health. In August the Admiralty decided that it was desirable that medical officers of the R.N.V.R. should be given an opportunity of attending similar courses of instruction, and these started in September. About the same time it was decided that dental officers of the R.N. and R.N.V.R., who, especially in wartime, play an important part in all medical defence organizations, should attend these short courses. There is a permanent staff of lecturers at the Royal Naval Medical School, and in addition lectures are given on special subjects by outside lecturers.

INTRAPERITONEAL INTESTINAL ANASTOMOSIS IN COLECTOMY

BY

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Below is presented a short series of 15 cases of strictures and ulcers of the colon (mostly carcinomas) treated by excision with intraperitoneal end-to-end anastomosis, both with and without colostomy.

A good deal has been written about these methods in the American literature from 1942 onwards, representative papers being those of Stone and McLanahan (1942), Wangenstein (1945), Waugh and Custer (1945), and Lahey (1946). In the British literature, however, there is a singular dearth of information on this subject in the last eight years—that is, since the new chemotherapeutic agents have altered the principles of colon surgery.

It is probable, therefore, that the extraperitoneal methods of Paul and Mikulicz are still in vogue up and down the country in cases that would be eminently suitable for an intraperitoneal method. I would at once agree that the latter method requires a certain standard of surgical skill in making an anastomosis, especially in accurate mucosal apposition, but where this exists I suggest that the end-to-end anastomosis is a much better procedure mechanically. Risk does not seem to be great in reasonably selected cases. It can, of course, be a good deal more radical than an extraperitoneal excision.

In contrast it might be said that a good deal of trouble can be associated with the extraperitoneal methods, not always reflected in textbooks and writings on the subject. Every practical surgeon will know how difficult it can be to get satisfactory crushing of a spur because of the interposition of painful mesenteric structures or the repeated slipping of the enterotome. An extraperitoneal closure in the presence of a partially crushed spur is always difficult and unsatisfactory, and may leave some degree of stricture. At all events, a colon firmly fixed to the abdominal wall can hardly function as well as a mobile colon in its correct anatomical position and with a properly constructed end-to-end anastomosis. So long as the risks of the two procedures were so different these facts were of no account; but now I believe that the difference in risk is slight in selected cases, and these facts should be given full weight in any decision on the correct line of treatment in a particular case.

The period in hospital for a primary colectomy need be no longer than for any other "clean stitch" case—approximately 14 days. If a colostomy has been done this will add another two weeks; the stay should therefore seldom exceed a month. Many a patient subjected to an extraperitoneal method will have been in hospital a good deal longer than this, and probably has had to undergo multiple attempts at spur-crushing and colostomy closure. This inevitably leads to a serious loss in his earnings as the weeks go by.

Selection of Suitable Cases

I wish to exclude rectosigmoid lesions from this discussion, as I have had no experience in these primary anastomoses, but there seems to be no good reason why any lesion of the colon should not be resectable by this method at one operation or be made resectable after the establishment of a simple colostomy to overcome the acute

Presentation of Cases in Tabular Form

Case	Date First Seen	Sex	Age	Type and Site of Lesion	Brief Clinical Findings	Operative Treatment	Type	Abdominal Complications	Histology	Result August, 1950
1	Aug. 1946	M	37	Carcinoma of descending colon. Acute colonic obstruction	Three weeks' gradual increase in abdominal pain terminating in colonic obstruction	Transverse colectomy for obstruction; 20 days later resection of descending colon, with aseptic end-to-end anastomosis	Operable	Faecal fistula L.I.F. Now has Devine defunctioning transverse colectomy and reconstructed left colon	Adenocarcinoma of colon. No involvement of mesenteric nodes	Alive and well. No evidence of recurrence
2	Apr. 1947	M	49	Carcinoma of transverse colon. Adherent small gut with small gut obstruction	24-hour emergency with obvious small-gut obstruction and a mass in the right epigastrium	Resection transverse colon and loop of small gut, with double end-to-end open anastomosis. Added caecostomy	Operable	Nil. First-intention healing; caecostomy healed spontaneously	Columnar-celled carcinoma with simple adenitis of both mesenteries	Alive and well 2 years later. Now untraced
3	Mar. 1948	F	38	Carcinoma of sigmoid colon. Acute colonic obstruction	Colonic obstruction 7 days. Gross distension	Laparotomy—caecostomy; 6 weeks later resection of sigmoid colon with open end-to-end anastomosis	Operable	Organic small-gut obstruction fifth day from adherence to anastomosis. Operative relief	Tubular columnar-celled carcinoma of sigmoid colon. No involvement of lymph nodes	Died Oct., 1949. Carcinoma of ovaries, probably 2nd primary
4	Nov. 1948	F	71	Carcinoma of descending colon. Chronic colonic obstruction	Abdominal colic and increase in constipation—6 to 8 weeks. Barium enema diagnosis	Resection of left colon with open end-to-end anastomosis between left transverse and mid-sigmoid. Added caecostomy	Operable	Nil. First-intention healing; 5 weeks later, extraperitoneal closure of caecostomy	Undifferentiated polygonal and spindle-celled carcinoma of colon. Nodes not involved	Alive and well
5	Dec. 1948	F	67	Carcinoma of descending colon. Non-obstructive	Refractory anaemia whilst under treatment for fractured tibia. Mass L.I.F. Barium enema diagnosis	Resection of left colon with open end-to-end anastomosis between left transverse and mid-sigmoid	Inoperable; liver secondaries	Nil. First-intention healing	Tubular columnar-celled mucous carcinoma of colon	Died June, '50. Multiple secondaries
6	Feb. 1949	F	73	Carcinoma of caecum. Chronic obstruction	R.I.F. pain 7 weeks, with occasional abdominal colic; bloody diarrhoea 7 weeks. Loss of weight 1 stone (6.35 kg)	Right hemicolectomy, with open end-to-end ileo-transverse anastomosis	Operable	Nil. First-intention healing	Ulcerated tubular polygonal-celled carcinoma of colon. Nodes negative	Died of cerebral haemorrhage, early 1950
7	May 1949	F	61	Carcinoma of caecum. Chronic obstruction	Pain right lower abdomen 5 months; 1 month colic with borborygmi; vomiting 2 weeks; diarrhoea 1 month. Mass R.I.F.	Right hemicolectomy, with open end-to-end ileo-transverse anastomosis	Inoperable because of involved nodes to root of mesentery	Nil. First-intention healing	Columnar-celled carcinoma of colon with involvement of lymph nodes	Died July, '50. Jaundice. Lymph spread to liver
8	June 1949	M	78	Carcinoma of transverse colon. Acute and chronic colonic obstruction	Central abdominal colic 8 weeks; vomiting at intervals 6 weeks; increasing constipation 3 months, relieved diarrhoea. Barium enema diagnosis	Caecostomy; 16 days later resection of transverse colon, with open end-to-end anastomosis	Operable	Nil. First-intention healing; extraperitoneal closure; caecostomy 15th day	Tubulo-papillary columnar-celled carcinoma of transverse colon. No node involvement	Alive and well
9	July 1949	F	68	Diverticular stricture, lower end sigmoid	Occasional abdominal colic 3 to 4 days 2 or 3 times a year for 8 to 9 years; constipation for 6 weeks. Barium enema: stricture sigmoid. Carcinoma could not be excluded	Resection of sigmoid, with open end-to-end anastomosis between mid-descending colon and lower sigmoid	—	Stricture at anastomosis, with diarrhoea for 20 to 24 days. First-intention healing	Diverticulitis	Alive and well
10	June 1949	F	44	Carcinoma of mid-sigmoid. Colonic obstruction	Onset 3 months previously with abdominal colic and diarrhoea; since then aching lower abdominal pain; occasional colic P.R.—hard mass high in pelvis	Resection of sigmoid with open end-to-end anastomosis	Inoperable; widespread peritoneal metastases	Nil. First-intention healing	Tubular columnar-celled carcinoma of colon	Died Nov., '49. Carcinoma cachexia
11	Oct. 1949	F	68	Carcinoma of transverse colon. Colonic obstruction	Colic and increasing constipation 6 months; absolute constipation 2 days; angina of effort 2½ years; colonic distension Barium enema diagnosis after caecostomy	"Blind" caecostomy; 8 days later, resection of transverse colon, with open end-to-end anastomosis	Inoperable; liver metastases	Nil. First-intention healing; extraperitoneal closure of caecostomy 16th day	Tubular columnar-celled carcinoma of colon	Died May, '50
12	Nov. 1949	F	60	Carcinoma of caecum. ? Acute appendix	13 hours pain R.I.F.; nausea; vomited once; bowels loose since onset; bowel habit normal; guarding and tenderness R.I.F.	Right colectomy with open end-to-end anastomosis between ileum and mid-ascending colon	Operable	Nil. First-intention healing	Columnar-celled carcinoma of colon. Inflammation of related nodes	Alive and well
13	May 1949	M	72	Carcinoma of iliac colon. Colonic obstruction	Right hemicolectomy 15 years ago, with gross pararectal incisional hernia; colonic obstruction relieved by ileostomy. Barium enema diagnosis	Resection of iliac colon with open end-to-end anastomosis between descending colon and mid-sigmoid	Operable	Nil. First-intention healing; later unilateral exclusion for ileostomy	Tubular and columnar-celled carcinoma of colon. Nodes not involved	Alive and well

Presentation of Cases in Tabular Form (Cont.)

Case	Date First Seen	Sex	Age	Type and Site of Lesion	Brief Clinical Findings	Operative Treatment	Type	Abdominal Complications	Histology	Result August, 1950
14	Oct. 1949	M	45	Carcinoma of caecum presenting as probable appendicular abscess	Tender mass R.I.F.; treated conservatively; partial resolution. Barium meal and enema. Bilateral pulmonary T.B. with upper right thoracoplasty; considered quiescent	Explored for probably appendicectomy; right hemicolectomy for carcinoma of caecum with end-to-end ileo-transverse anastomosis	Operable	Died 2nd day, pulmonary insufficiency. P.M.: abdomen satisfactory; chest active	Tubular columnar-celled carcinoma of colon	Died 2nd day
15	July 1950	F	56	Constricting carcinoma below splenic flexure. Partial colonic obstruction	18 months previously abdominal colic 1 week; 1 month previously recurrence of colic with constipation for 1 week, relieved by aperient. Barium enema diagnosis	Left hemicolectomy with open end-to-end anastomosis between mid-transverse and upper sigmoid colon	Operable	Nil. First-intention healing	Alveolar tubular columnar-celled mucinous carcinoma of colon infiltrating to serosa. Lymph nodes negative	Alive and well

obstructive element. It is obvious that a safe anastomosis cannot be made in an acutely dilated thin-walled proximal gut with highly infective contents. In these conditions no sulphonamide therapy is possible, and, even if it were, in my opinion an anastomosis within the peritoneum would not be permissible. On the other hand, the presence of chronic obstruction is not always an absolute bar, as in Case 7. Here, owing to hypertrophy and dilatation of the distal ileum from a stenosing growth at the ileo-caecal valve, an anastomosis between the ileum and transverse colon was technically easier than usual because of the similarity of the lumina. In general it may be said that those lesions disclosed in the early stages by barium enema will be suitable for primary resection after adequate pre-operative preparation, while those presenting with some clinical degree of colonic obstruction will require proximal colostomy, barium enema to locate the lesion, and resection after preparation.

Influence of Site of Lesions

Again, I consider that no particular site precludes a primary resection or an end-to-end anastomosis. In the main the accepted resections have been performed with ileo-transverse anastomosis for right colon lesions, transverse-transverse anastomosis for transverse colon lesions, and transverse-sigmoid anastomosis for left colon lesions.

These procedures are perhaps the best, as the blood supply to both ends is more assured, and one is joining two pieces of bowel entirely covered by peritoneum. The mobilization for the transverse-sigmoid anastomosis has to be extensive; but this is the whole secret of the operation, or, for that matter, of any operation on the colon. However, on both the right and the left colon I have done less than the classical resection (see Cases 3, 10, 12, and 13), and performed a successful anastomosis with both the ascending and descending parts of the colon. It would seem, then, that even the retroperitoneal parts of the colon can confidently be used for this procedure.

Type of Anastomosis

Excluding Case 1, all these patients have had an open end-to-end anastomosis, in some cases with crushing-clamps and in some without any type of clamp whatever; the technical minutiae of my ideal anastomosis, however, are dealt with in detail below. To my mind the important thing is accurate mucosal apposition, and I have therefore avoided the aseptic methods. An end-to-end anastomosis undoubtedly seems the method of choice, as it leaves no blind ends to leak or later "blow out." It restores continuity in anatomical manner with no mesenteric overlap.

It is applicable to all parts of the colon, be they completely peritonized or not, and marked difference in the two lumina is no contraindication. This can either be dealt with by partially closing the larger piece of gut or, better still, by cutting the smaller so obliquely that they fit. In Case 12 I anastomosed a contracted ileum to the mid-ascending colon (difference of lumina of about three times) by cutting the ileum extremely obliquely. The lines of section must always leave a shorter antemesenteric border to ensure blood supply (Fig. 1). This device also allows of a larger anastomosis and obviates stricture formation.

FIG. 1.—Showing the oblique line of section of the bowel to ensure its antemesenteric blood supply.

Effect of Chemotherapy

Undoubtedly the sulphonamide drugs administered in an insoluble form pre-operatively are an important added safety factor in this operation, and have given one a confidence in the intraperitoneal method which the older generation of surgeons can never have had. If, however, one exposes a colonic lesion by exploratory laparotomy the fact that no insoluble sulphonamide preparation has been given is no contraindication to a successful resection by the intraperitoneal method (see Cases 2 and 12). In these cases parenteral sulphonamide was given in the immediately post-operative days, and later the insoluble sulphonamide when feeding was resumed. With streptomycin now generally available I would add this drug in a dosage of 1 g. thrice daily, intramuscularly, and no doubt it will find a place as a further safeguard in the routine care of these cases.

Routine Management

Pre-operative Care

Diet: Low-residue high-calorie diet, with more than adequate amounts of fluid, and glucose to the limit of tolerance. **Sulphonamide Therapy:** Phthalyl sulphathiazole

1 g. thrice daily for five days. *Vitamins*: One "multi-vite" tablet is given thrice daily. A depot injection of 100 mg. of vitamin K is given intramuscularly, as deficiency in this vitamin can occur, especially with prolonged debacterializing of the gut with sulphonamide therapy. In these circumstances haematoma in the mesentery or suture line may be disastrous and lead to faecal fistula or peritonitis. *Activity*: The patient should be reasonably ambulant during this preparation. Routine breathing and leg exercises are given. *Blood Examination*: This is routine. Any anaemia is corrected by transfusion a few days before operation or, in the presence of a cardiac lesion as in Case 11, by intravenous iron ("ferriovenin," 5 ml. alternate days). *Enemata*: The lower bowels are emptied by a saline enema every second day, one being given the night before operation. *Aperients*: No pre-operative aperient has been given to these cases.

In cases with colostomy the preparation is the same, and sulphonamide by mouth will adequately debacterialize the distal colon by spillage.

Anaesthesia

Premedication: Omnopon 1/3 gr. (22 mg.); scopolamine 1/150 gr. (0.43 mg.), or if over 60 years morphine 1/6 gr. (11 mg.) and atropine 1/100 gr. (0.65 mg.). *Method*: Induction by intravenous thiopentone followed by cyclopropane and oxygen, with intravenous curare added if further relaxation is required.

Operative Procedure

The Approach.—Various incisions have been used during the series. I find a right paramedian rectus-displacing incision best for right hemicolectomy where the anastomosis is near the midline, while for the left colon a left lower oblique muscle-cutting incision is probably better, as the anastomosis is to be in the left iliac fossa region.

Steps of Operation.—(1) General exploration, including local examination of the lesion and lymphatic drainage and examination of the liver and peritoneum. (2) Mobilization of the lesion; and again I wish to stress that the secret of easy colectomy is adequate mobilization, with the lateral aspects of the colon displaced towards the midline. (3) V-shaped mesenteric incision to the root of the mesentery, generously including the lymphatic drainage. (4) Closure of the mesenteric wound up to 1 to 1½ in. (2.5 to 3.75 cm.) of the mesenteric angle (Fig. 2). (5) Application of crushing-clamps on the side of the bowel to be removed, both placed obliquely as in Fig. 1, but one more so than the other to allow the cut lumina to be equalized (Fig. 2). (6) Application of proflavine pads to exclude wound edges, and small pad brought through the defect in the mesentery to protect it. (7) Application of occlusive clamps to the bowel 2–3 in. (5–7.5 cm.) above and below the lines of section. (8) Section of bowel and removal of specimen. (9) A continuous all-coats stitch, starting at the antemesenteric border, is inserted. It runs down the posterior edges and, turning in the mesenteric angles, comes back anterior to finish again at the antemesenteric border (Fig. 3). The stitch is a simple over-and-over one. (10) Mesenteric proflavine pad and the wound pads removed; the hands are thoroughly washed and rinsed in biniodide of mercury; closure of the mesenteric wound is completed; and interrupted seromuscular stitches of medium linen thread or Chinese silk are placed to cover the first layer completely. (11) The anastomosis is now dusted with proflavine-sulphonamide powder, and the wound closed in layers without drainage. If, however,

FIG. 2.—Demonstrating the differing obliquity in the lines of section to equalize lumina for suturing. (The mesentery of the loop for excision has been omitted for clarity.)

there is the slightest doubt about the security of the union a small soft tube placed down to this area for five days does no harm.

Post-operative Care

Diet.—It is necessary to avoid anything by mouth until intestinal activity is audible subsequent to the post-operative paresis, usually after 48 hours. During this time fluid balance will require to be maintained by intravenous or subcutaneous saline. Thereafter clear fluids should be given by mouth—1 oz. (28 ml.) for four hours, 2 oz. (57 ml.) for four hours, then stepping up fairly rapidly. Nourishing fluids will be taken 24 hours after this, and phthalyl sulphathiazole therapy resumed; next day a light diet with little roughage will be started, being continued for approximately ten days, until the bowels are well opened. Thereafter the diet can become more varied.

FIG. 3.—Illustrating the simple mucosal apposing stitch of 00 chromic catgut. This is applied first, as the anastomosis can be rotated for the insertion of the interrupted seromuscular stitches behind.

Activity.—The patient should be lifted from bed for five minutes on the day after operation. This routine is continued each day for gradually increasing periods in the bedside chair. Leg and breathing exercises are continued.

Care of Bowels.—A rectal examination on the fifth to seventh day will often reveal a rectum full of soft faeces, and a glycerin suppository will aid evacuation. This can be repeated every second day until spontaneous evacuation is obtained. I have used a simple aperient in syrupus sennae $\frac{1}{2}$ dram (1.75 ml.) twice daily, on the ninth to tenth day to ensure a spontaneous evacuation. In cases with colostomy the problem is not so urgent, but is dealt with in the same manner.

In my submission penicillin is not needed for these cases unless some definite indication presents.

Illustrative Cases

Case 7: Carcinoma of Caecum: Primary End-to-end Intraperitoneal Anastomosis in Presence of Chronic Obstruction

This patient, a woman aged 61, was first seen in May, 1949, complaining of pain in the right side of the lower abdomen of five months' duration. She vomited on one occasion, and latterly had had a good deal of malaise. For the last four weeks she had colicky lower abdominal pain, which was relieved after audible borborygmi. Vomiting was fairly frequent over the latter period. There had been anorexia for two weeks and diarrhoea for a month, with a loss of weight of 10 lb. (4.5 kg.).

Examination showed her to be a spare old lady. Her tongue was dry, the pulse 100, blood pressure 190/100 mm., and haemoglobin 84%. The abdomen was slightly distended, showing visible peristalsis and a tumour in the right iliac fossa.

Operation.—This was carried out through a right mid-paramedian incision under a general anaesthetic. A posterior carcinoma of the ileo-caecal region was found to be penetrating into the retroperitoneal tissues, closely related to the right bladder fundus. There was some free fluid. Involved nodes to the root of the mesentery; the ascending colon and hepatic flexure, and the growth, were mobilized; the bladder was entered and repaired. Right hemicolectomy with end-to-end ileo-transverse junction was done by the open method. In this case the ileum was grossly hypertrophied and dilated, making the anastomosis easy. The wound was closed in layers, with a soft drain to the anastomosis from a stab incision in the loin, and an indwelling catheter was placed in the bladder.

Histology.—The growth was a columnar-celled carcinoma of the caecum with involvement of lymph nodes.

Post-operative Course.—Smooth. Drain removed fifth day; no leak. Bowels opened sixth day. Indwelling catheter removed seventh day. The patient was fit for discharge on the eighteenth day. She received phthalyl sulphathiazole in the post-operative period only.

Follow-up.—This patient was seen at regular intervals, and for 18 months remained tolerably well, though she occasionally complained of vague pains at the operation site for which no physical signs could be found. At the end of June, 1950, she was readmitted with a two-weeks history of jaundice and increasing drowsiness, and died on July 9, 1950, of liver insufficiency.

Necropsy revealed obstructive jaundice from large lymphatic glands compressing the common bile duct. Lymph nodes were involved with the columnar-celled carcinoma.

Comment

Although this case was inoperable from the start, the patient was given a further 18 months of tolerable comfort before her very short fatal illness.

Case 15: Carcinoma of Descending Colon: Primary Open End-to-end Intraperitoneal Anastomosis

A woman aged 56 was first seen in July, 1950, giving the following history. Eighteen months previously she had had colicky lower abdominal pain lasting a few days. Thereafter

she was symptomless until one month before admission, when she had a recurrence of the colicky abdominal pain with constipation, which refused to respond to purgatives for one week. After this she began to pass loose stools, and the colicky pain gradually subsided. General, abdominal, and rectal examinations were negative. A barium enema revealed a 2½-in. (6.25-cm.) stricture of the colon just below the splenic flexure.

Operation.—General anaesthesia. Long left paramedian incision. Mobilization of transverse colon, splenic flexure, descending and upper sigmoid colons. A large subsplenic growth was found, with soft nodes in the peripheral group spreading as far as 6 in. (15 cm.) from the growth; no spread to the root of the mesentery. Removal of mobilized colon specified, with mesenteric closure. Primary open end-to-end anastomosis between mid-transverse colon and mid-sigmoid. Wound closed in layers without drainage.

Histology.—Alveolar and tubular columnar-celled mucinous carcinoma of the colon, infiltrating to the serosa. Slight chronic inflammation of lymph nodes.

Post-operative Course.—Smooth. Patient required parenteral fluids for the first two days, and during this time was given 1 oz. (28 ml.) water by mouth hourly. On the third post-operative day bowel sounds were heard; fluids by mouth were slowly increased to 4 oz. (114 ml.) hourly. Phthalyl sulphathiazole recommenced by mouth. On the fourth day nourishing fluids were given. On the sixth day a rectal examination revealed soft faeces in the rectum. A glycerin suppository now produced an evacuation. Light diet was started. Thereafter convalescence was uninterrupted, and the patient was ambulant from the second post-operative day.

Discussion

This small series suggests that the procedure described can be accomplished with a good degree of safety. There were no faecal leaks apart from Case 1, not anastomosed by the recommended method, and it would be fair to say that on the whole convalescence has been really smooth and has given little anxiety. When it is remembered that seven of these patients were over 65 years of age and four of them were over 70, it may well be considered that the powers of colonic healing are greater than we have been led to believe in the past.

Two complications are worthy of mention. In Case 3 a small-gut obstruction occurred from adherence of a loop of small gut to the anastomosis. This required a re-exploration on the fifth day and separation of the small-gut loop. In Case 9 a stricture occurred at the recto-colonic junction owing to the technical error of not cutting the end for anastomosis obliquely enough to give an adequate lumen. The patient suffered from chronic colonic stasis with overflow diarrhoea for some ten days before normal bowel function gradually became restored. This condition was no doubt due to the local oedema at the anastomosis subsiding and natural dilatation occurring through the passage of faeces.

One remaining point I wish to note is the beauty of the operation for cases such as 5, 10, and 11, which were obstructing carcinomas and irremovable metastases. These patients had "clean stitch" operations, and were allowed to leave hospital in a reasonable time to enjoy what life was left to them without the added burden of a colostomy.

Summary

A series of 15 cases of intraperitoneal end-to-end anastomosis after colectomy is presented.

Extra- and intraperitoneal methods are compared.

Factors influencing the choice of operation and the type of anastomosis are discussed.

The detailed management of an intraperitoneal colectomy is given.

Results and complications are discussed.

I wish to thank Sir Henry Souttar for permission to treat these cases and for much helpful advice and criticism, and Dr. Joan Martinez for the skilful anaesthesia which contributed so much towards their recovery.

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The illustrations were redrawn by Miss Sylvia Treadgold from sketches supplied by the author.

EXERCISES IN THE BATH

BY

Sir LEONARD HILL, F.R.S.

The function of the heart is to deliver blood to the capillaries: aided by the valves in the veins and the suction and belly-compressing action of the respiratory pump, and in the active animal by the contraction of skeletal muscles and the frequent changes of posture overcoming the influence of gravity, the blood is returned to the heart by the great veins and without effort on its part. All parts of the body secure an adequate circulation and supply of oxygen, and waste substances are removed. In the sedentary man, inactive, with legs dependent, and gravity acting against the return of blood, the conditions are not so good. Parts of the body may be less well oxygenated and waste products not so well removed by the circulating blood. More work is thrown on the heart by less aid being given to the return of venous blood, and this may possibly contribute to heart disease in the elderly. In recumbency, with the turning movements that take place in sleep, there is a more even circulation, with removal of fatigue. Immersed in

water a 10-stone (63.5 kg.) man weighs only 10 lb. (4.5 kg.). The economy of energy needed for muscular movement carried out under water is then immense.

Mr. T. R. Togna has developed a system of exercise and massage in the bath which set him free from minor troubles of health, and has kept him in such good condition that at the age of 77 he can easily run 81 yards (74 metres) in 12 seconds.

The oxygen pulse (that is, the volume of oxygen used per pulse beat) given by several observers for various adults doing exercise in air ranged from 7 to 13 c.cm. of oxygen intake per beat with a pulse frequency ranging from 120 to 174. The marathon runner De Mar, with a pulse of 118, had an oxygen intake per pulse beat of 17 c.cm. This figure is equalled by Mr. Togna, when doing his exercise with autonomous massage in the bath, with a pulse frequency of 66 beats, 6 beats above his basal.

The exercises performed in water are associated with a large absorption of oxygen per pulse beat—a sign of a higher degree of efficiency of circulation throughout the body. Togna tells me that in his youth he followed scientific and literary studies of a general nature and was always especially interested in problems of health. At the age of 52, while in his bath, he noticed that, by performing vigorous contractions which were bringing into play the body skeletal muscles, his pulse rate did not increase according to his experience in air and when swimming. This fact impressed him. He became intrigued with the meaning of it, and started studying textbooks on the physiology of activity. By making a habit of the activity its beneficial effects became obvious to him.

His theory was established in effect by the experiments of Professor G. P. Crowden in September, 1933, which were reported in the proceedings of the Physiological Society (*J. Physiol.*, 1935, **84**, 31P).

TABLE I.—Results of Observations Carried out on Mr. Togna

(a) Conditions When Tests were Taken	(b) Volume of Air Breathed (c.cm./min.)	(c) Oxygen Consumption (c.cm./min.)	(d) Carbon Dioxide Production (c.cm./min.)	(e) Pulse Rate (Beats per min.)	(f) Oxygen Consumption per Beat (c.cm.)	(g) No. of Movements (per min.)	(h) Blood Pressure	(i) Respiration Rate (per min.)
Basal (reclining)	12,800	282	192	60	4.7	—	140/58	15
Standing run	37,000	1,848	1,860	124	14.9	72	170/78	24
Bath exercise:								
Type I—arm and leg bending	21,000	890	736	72	12.3	42	132/58	15
Type II—trunk raising	24,500	970	840	68	14.3	46	132/54	15
Type III—head, face, neck, and back mas- sage, with simultaneous expansion and contraction of chest and abdomen and leg bending	27,800	1,135	1,080	66	17.2	30	132/55	15
One hour after (reclining)	12,600	400	342	66	6.0	—	142/54	16
Two hours after (reclining)	10,100	330	274	64	5.2	—	146/56	18

TABLE II.—Exercise in the Bath Performed by Healthy Subjects for the First Time

(a)	(b) Volume of Air Breathed (c.cm./min.)	(c) Oxygen Consumption (c.cm./min.)	(d) Carbon Dioxide Production (c.cm./min.)	(e) Pulse Rate (Beats per min.)	(f) Oxygen Consumption per Beat (c.cm.)	(g) No. of Movements per min.	(h) Blood Pressure	(i) Rate of Respirations per min.
<i>Basal Metabolism</i>								
Mr. O. G. (46)	7,470	262	209	78	3.36	—	118/78	13
Miss M. M. (28)	12,500	250	200	72	3.5	—	122/74	16
Miss J. C. (21)	8,400	231	168	76	3.0	—	118/70	15
<i>Exercise in Bath</i>								
Mr. O. G.	18,000	684	630	75	9.1	—	112/66	15
Miss M. M.	14,250	527	399	66	8.0	—	110/6	24
Miss J. C.	9,500	466	366	70	6.66	—	106/56	25
<i>1½ Hours After Resting</i>								
Mr. O. G.	9,500	370	314	82	4.5	—	112/70	12
Miss M. M.	9,750	302	214	70	4.3	—	110/64	16
Miss J. C.	9,000	297	225	72	4.1	—	108/56	18