REFERENCES.

- Adami, J. G.: *The Principles of Pathology*, 1910, i, 22.
 Idem: *System of Medicine* (Allbutt), 1896, i, 134.
 Allbutt, T. G.: *British Medical Journal*, 1871, ii, 416; *Lancet*, 1906, ii, 1105.
 Idem: Address to Section I of the Sanitary Institute, XXI Congress at Bradford in 1903.
 Idem: *Times*, November 6th, 1924.
 Andrews, F. W.: *Journ. Path. and Bact.*, Edin., 1922, xxv, 505; 1925, xxviii, 345.
 Arkwright, J. A.: *Ibid.*, 1927, xxx, 345.
 Barnes, W. Emery: *Early Christians at Prayer* (A.D. 1-400), pp. 68-69, London, Methuen and Co., 1925.
 Bland-Sutton, J.: *Evolution and Disease*, 1890, Contemporary Science Series.
 Boycott, A. E.: *Proc. Roy. Soc. Med.*, 1928, xxii (Path. Sec., p. 3), p. 57.
 Broadbent, W. H.: *British Medical Journal*, 1868, ii, 346.
 Bury, J. S.: *Med. Chron.*, Manchester, 1907, xli, 277.
 Cawadiaz, A. P.: *British Medical Journal*, 1927, ii, 1006.
 Clark, R. M.: *Journ. Mental Sci.*, London, 1928, lxxiv, 265.
 Crookshank, F. G.: *Articles in Influenza*, London, 1922.
 Dible, J. H.: *Recent Advances in Bacteriology*, pp. 34-84, London, 1929.
 Galton, F.: *Hereditary Genius: An Enquiry into its Laws and Consequences*, 1869.
 Gaskell, A.: *What is Life?* London, 1928.
 Gill, C. A.: *The Genesis of Epidemics*, p. 483, 1928.
 Hinton, J.: *The Mystery of Pain*, 1856.
 Jacobson, A. C.: *Genius, Some Revelations*, 1926.
 Jones, Handfield: *British Medical Journal*, 1868, ii, 68, 345.
 Keith, A.: *Bull. Johns Hopkins Hosp.*, Baltimore, 1922, xxx, 155. *Journ. Roy. Anthropol. Inst.*, London, 1928, lviii, 305.
 Krause, A. K.: *Amer. Rev. Tuberc.*, Baltimore, 1928, xviii, 208. *Ibid.*, xviii, 271.
 Langdon Down: *London Hosp. Rep.*, 1866, iii, 259.
 Lumière, A.: *La vie, la maladie, et la mort: phénomènes colloïdaux*, Paris, 1928.
 McDonagh, J. E. R.: *The Nature of Disease*, Part I, 1924; Part II, 1927.
 Marks, J.: *Genius and Disaster*, p. 184, 1928.
 Mercer, C. A.: *Science Progress*, London, 1916-17, xi, 228, 410.
 Motz, F. W.: *Charing Cross Hosp. Gaz.*, 1923, xxiii, 11.
 Myers, J. A.: *Fighters of Fate*, 1927.
 Newsholme, H. P.: *Proc. Roy. Soc. Med.*, 1928, xxii (Epidem. Sect.), 1.
 Osler, W.: *New York Med. Journ.*, 1901, lxxiv, 949.
 Paget, S.: *Confession Medica*, 1908.
 Pearl, R.: *The Biology of Death*, p. 43, 1922.
 Treves, F.: *British Medical Journal*, 1905, ii, 1251.
 Welch, W. H.: *Adaptation in Pathological Processes*, *Amer. Journ. Med. Sci.*, Phila., 1897, cxliii, 631.
 White, P. B.: *Medical Research Council, Special Report Series*, No. 103, 1926.
 White, W. A.: *The Meaning of Disease*, p. 107, 1926.
 Wilks, S.: *British Medical Journal*, 1868, ii, 136.

VOLVULUS OF THE INTESTINE.

BY

R. P. ROWLANDS, M.S., F.R.C.S.,

SURGEON, GUY'S HOSPITAL.

VOLVULUS rotation or twist may affect any of the movable viscera, and this accident is especially likely to happen to those organs or parts which are pendulous or more or less pedunculated, such as the pelvic colon, caecum, spleen, retained testis, ovarian cyst, or subperitoneal fibroid. The weight of a tumour, a distended Meckel's diverticulum, or a mesenteric cyst, or the drag of a peritoneal adhesion may start or complete the twist. I have seen several instances of volvulus of the spleen of the omentum, of the gall-bladder causing sloughing, and one instance of rotation of a loose liver causing jaundice by kinking of the bile ducts. Even the stomach is not immune from volvulus; being fixed as it is at the cardia and pylorus, the dilated or distended intervening portion may twist, especially when it is dragged upon by a large spleen or escapes into a diaphragmatic hernia; serious and acute pyloric obstruction has arisen in these ways, and has been relieved by replacement and removing the cause.

In this article I am chiefly concerned with volvulus of the intestine causing intestinal obstruction. Such a volvulus may be acute, chronic, or recurrent; it may be simple, affecting only one loop of bowel, or it may be compound, as when a loop of small intestine twists round a volvulus of the pelvic colon.¹ Any part, or the whole, of the small intestine² except the duodenum, and any part, or even the whole, of the large intestine except the rectum, may twist (Finney recorded a volvulus of the whole of the colon between the ileo-caecal valve and the pelvic colon³), but the common sites of the volvulus are the pelvic (sigmoid) colon and the caecum. Congenital imperfections, especially elongation of the mesentery, such as a long meso-sigmoid with a narrow base, or a pendulous and freely movable caecum and ascending colon, are usually determining factors. Visceroptosis with distension and elongation of the pelvic colon associated with chronic constipation, and repeated prolapse of the rectum, also contribute to the causation of volvulus. Injuries, violent twisting

movements, and operations may displace and twist the bowels—for instance, the pelvic colon was raised and displaced to the right during an operation for ruptured left extrauterine foetation, the loop was not replaced, and fatal volvulus resulted. The consequences of volvulus are often grave, for obstruction of the vessels may lead to swelling, haemorrhage or infarction, inflammation, and necrosis or gangrene of the twisted loop, thus adding to the dangers of intestinal obstruction. Volvulus of the appendix and of Meckel's diverticulum* often causes severe attacks of inflammation, or gangrene of the twisted part, with peritonitis and ileus.

SYMPTOMS OF ACUTE VOLVULUS.

The symptoms and signs of acute volvulus, whether of the large or small intestine, are those of acute intestinal obstruction, such as severe spasmodic abdominal pain, characteristic vomiting, complete constipation and collapse, with slow weak pulse and subnormal temperature. Here it is only necessary to point out the special features of volvulus. The history of previous attacks is very suggestive of volvulus, the more acute the case the more severe the pain, and, above all, the more rapid and extreme the distension of the abdomen the more is volvulus to be suspected. Visible peristalsis, when observed, in very large coils is almost characteristic of volvulus of the large intestine, but it is not by any means constant. Volvulus is commoner in the large than in the small intestine, and is especially common in the pelvic colon. With volvulus of the small intestine the coils are naturally smaller and the distension less phenomenal, but the severity of the symptoms is usually extreme, and the march of events to a fatal issue is more rapid unless relief is brought by early operation.

SYMPTOMS OF CHRONIC AND RECURRENT VOLVULUS.

These are chiefly those of chronic intestinal obstruction—namely, recurrent attacks of colic with distension, indigestion, and chronic constipation perhaps alternating with diarrhoea, but without blood in the stools. Fever is usually absent. Sometimes the bowels do not act without the aid of large doses of violent purgatives or enemata or both. Opaque meals, and especially a barium enema, may reveal great dilatation and stagnation in the affected loop. An opaque meal is more valuable with chronic incomplete volvulus of the caecum, for an opaque enema may not reach or enter the obstructed loop as the obstruction is more complete at the distal than at the proximal end of the loop. An opaque enema is usually more valuable in the diagnosis of volvulus of the pelvic colon.

DIAGNOSIS OF ACUTE VOLVULUS.

From other kinds of intestinal obstruction volvulus is to be distinguished chiefly by the very acute onset, rapid progress of the symptoms, and particularly by the unusual amount of tympanitic distension of the abdomen, which develops in a very short time. As already mentioned, visible peristalsis in very large coils of intestine is suggestive of volvulus of the large intestine; the twisted dilated caecum is often to be seen lying in the left iliac fossa, and the twisted and distended pelvic colon in the right hypochondrium. There is often a history of previous attacks of colic without fever; the absence of fever tends to exclude recurrent appendicitis, cholecystitis, and diverticulitis. Volvulus of the large intestine is naturally most likely to be mistaken for the far commoner cause of obstruction of the colon—namely, carcinoma of the colon, which causes considerable, but less rapid, gaseous distension. With carcinoma there may be a history of chronic constipation alternating with diarrhoea, with blood and mucus in the stools. Often the diagnosis is not certain until the abdomen is opened, as it should be without delay.

DIAGNOSIS OF CHRONIC VOLVULUS.

Here there is more time and opportunity for investigation. Chronic and recurrent volvulus is most commonly mistaken for chronic constipation, but careful and repeated radiographic examinations may reveal the dilated coils so

* An interesting and successful case of volvulus of a greatly distended Meckel's diverticulum is recorded in *The Operations of Surgery*, Rowlands and Turner, seventh edition, ii, p. 344.

characteristic of volvulus. Volvulus of the caecum is apt to be mistaken for recurrent appendicitis or appendical colic, but with it there is no fever during the attacks. The dilatation of the caecum, its free mobility and pendulous appearance, should correct the mistake once the abdomen has been opened. In one of my cases of chronic volvulus of the pelvic colon the dilated loop had pressed the stomach into an hour-glass shape; moreover, the gastric symptoms were so severe that the diagnosis made before the operation was hour-glass contraction with duodenal ulcer.

TREATMENT OF ACUTE VOLVULUS.

1. *Acute Intestinal Obstruction due to Volvulus.*

Here the main objects are (a) to save life by relieving the acute intestinal obstruction, and (b) if possible to prevent recurrence. The mortality of acute volvulus is about 50 per cent., and is so high chiefly from delay and attempting too much at the emergency operation. A long right paramedian incision is made in the lower abdomen to give a good view and plenty of room to deal with the distended bowel. It is often necessary to deliver the affected loop, but this may be impossible without first letting out gas with a needle, or trocar and cannula; sometimes it is better to incise the loop over a sterilized basin, and to make use of this incision in performing a colostomy or caecostomy. The twist is undone and valvular drainage of the loop established with a soft rubber tube of one-third of an inch internal diameter, which passes through a separate stab wound in the parietes, so that the exploratory wound may heal by primary union. The drainage may so reduce the size of the affected loop of bowel and fix it to the parietes that recurrence of rotation may not take place, and the need of a secondary and perhaps severe operation is thus avoided (Cases I and II). In some cases of volvulus of the pelvic colon it is enough to pass up a rectal tube, guided into the distended loop by a hand in the pelvis. The tube is kept in and sewn to the anus. When the bowel is gangrenous it must be resected, and sometimes the channel can be immediately re-established—for instance, the gangrenous caecum is excised and the ileum, about six inches above the ileo-caecal valve, is joined to the transverse colon. As a rule radical operations have to be deferred until the immediate peril has passed.

2. *Chronic Volvulus of the Intestine.*

This condition may be treated by: (1) excision of the twisted loop; (2) short circuit; (3) fixation of the loop, with or without temporary drainage. As a rule excision is the best method because it makes recurrence impossible, and prevents the troublesome accumulation of faeces and gas in the dilated loop; but short circuit is sufficient and less dangerous in selected cases. Examples of these methods are given below (Cases III and IV).

Fixation of the loop of bowel by suture to the parietes is difficult owing to the length and position of the loop. How can the long large loop of pelvic colon with a narrow base or pedicle be fixed without fear of recurrence or the making of pockets, apertures, or bands, for the development of other forms of intestinal obstruction later on? Recurrence took place in two of my cases of volvulus of the pelvic colon.* In both of these the loop had been fixed to the abdominal wall. Shortening the mesentery after the method of Senn has been successfully used in some cases. The mesentery is "folded" upon itself in a direction parallel to the bowel, and the apex of the fold is sewn to the root of the mesentery without interfering with the blood supply of the bowel. It is evident that this method is not always applicable to such parts as the abnormal pelvic colon, where the loop is long and the base is short. For volvulus of the ileo-caecal region I believe that either excision or short-circuiting is better than fixation, which may cause future trouble by adhesions or kinking.

The following cases may serve to illustrate some of the difficulties of the diagnosis and treatment of volvulus.

CASE I.—*Volvulus of the Caecum: Acute Intestinal Obstruction: Caecostomy: Recovery.*

A married woman, aged 45, first came to me in January, 1922. She had suffered from chronic indigestion for years; this had been attributed to visceroptosis, for which she had worn a Curtis belt. She is said also to have suffered from left hydronephrosis. X-ray examination for stone had been negative. She was very anaemic, and was tender over the appendix. In February, 1922, the

abdomen was explored through a right paramedian incision. The appendix was very long, kinked, and chronically inflamed, and was removed. There was an old, but still active, ulcer on the anterior wall of the duodenum, stenosing the latter. There were so many adhesions that a local operation was not considered safe, therefore a posterior gastro-jejunostomy was performed. There were no gall-stones; the caecum was dilated. She was well for over five years.

On May 15th, 1927, at 10 p.m., she was seized with very severe abdominal pain, and spent the night walking about the room in great distress. Dr. W. was called in on May 16th. Enemata failed to act, and no flatus was passed. Visible peristalsis was noticed, and an immediate operation advised. This was carried out the same day at 6 p.m. A right low paramedian incision was made; the rectus being displaced outwards, displaying a very large distended coil of large intestine, which was found in the lower half of the abdomen; this was cautiously delivered, and found to be the caecum in volvulus, which was very large, and had made two complete clockwise rotations to the left; this had completely obstructed the ascending colon, but not the end of the ileum. The volvulus was uncoiled, and the contents of the caecum were, with some difficulty, pushed on into the transverse colon, but to prevent paralytic distension, and especially to avoid recurrence of the volvulus, a valvular caecostomy was performed. A long rubber tube, with an internal diameter of one-third of an inch, was passed through the abdominal wall at a stab wound one inch internal of the right anterior superior spine. The end of the tube was open, and a side hole was made close to its extremity, which was introduced into the caecum through the anterior muscular band, after a large pouch of caecum had been emptied and clamped; it was fastened to the sides of the incision in the caecum by a catgut stitch, then the small incision containing the tube was inverted by three purse-string sutures of fine catgut, thus making an ink-bottle or continent caecostomy. The caecum was next drawn into contact with the parietal peritoneum, and the tube was tied to a stitch in the skin. The paramedian incision was then completely closed in layers.

It is interesting that in this case it required two complete rotations to produce obstruction of the ascending colon and caecum; there was no band extending from the right flank to the front of the ascending colon to facilitate obstruction. The patient did well, and was seen in perfect health in September, 1928.

CASE II.—*Chronic Volvulus of the Caecum and Chronic Intestinal Obstruction: Anastomosis of the Caecum to the Transverse Colon.*

Miss X had suffered since childhood from very severe constipation with attacks of abdominal pain without fever. Radiographic examination suggested adhesions in the right iliac region, and

Volvulus of the caecum. The twist is more often clockwise to the left.

it was thought that she had chronic appendicitis, and required a laparotomy. The operation was done on April 8th, 1928. The appendix was oedematous and white; there were no adhesions about it or the intestines, but the caecum was very greatly dilated and lying low in the pelvis; it was freely movable and pendulous with the lower end of the ileum, and clearly capable of twisting upon the ascending colon, the lower part of which was movable. There was a white mark on the ascending colon indicating the site of the former twistings, just below adhesions to the right flank. The appendix was removed, and an anastomosis was made between the front of the lower end of the caecum and the descending part

of the transverse colon, the anastomosis being about three inches in length. The patient has done very well since the operation, the constipation and pain being apparently cured.

CASE III.—*Recurrence of Acute Volvulus of the Pelvic Colon in Spite of Colostomy.*

A lady, aged 61, a patient of Dr. B., in 1906 was operated upon for acute intestinal obstruction. After making an incision in the left linea semilunaris, the surgeon accidentally opened a greatly distended colon. It made a noise like a bursting tyre, and discharged a large amount of gas and faeces. He tied in a Paul's tube at once, and the patient gradually recovered. Malignant stricture of the sigmoid was diagnosed, and a bad prognosis was given; but after some weeks the bowels began to operate naturally and there was a good deal of difficulty in keeping the colostomy open. After six months the fistula was allowed to close, and to everybody's surprise the patient made a complete recovery, except for some weakness in the abdominal wall at the site of the colostomy. The bowels acted regularly with the aid of an occasional aperient. She had no more colic, and she never passed any blood or mucus. The abdomen, however, has ever since, and for some time previously, been somewhat distended. On February 27th, 1912, it became more distended, and the patient had a good deal of pain in the lower part of the abdomen, especially on the left side. Since then the swelling has rapidly increased. All purgatives have failed to act, and enemata have also been ineffectual. A rectal tube could not be passed more than six inches. No growth could be felt. An enormously distended coil of intestine could be seen extending along the course of the transverse colon, above the umbilicus and down to the left flank.

I saw her on March 1st, at 8 p.m. In view of the past history and the presence of the greatly distended coil a diagnosis of volvulus of the sigmoid was made, and an operation was performed the same evening. A very large coil of bowel was found occupying the pelvis, the left flank, and also the middle part of the abdomen, extending almost to the liver. A hand was passed into the pelvis and a rotation of the sigmoid loop was made out. At the attachment of its mesentery radiating ridges were felt. The incision was enlarged and the loop was gradually delivered. The coil was longer and larger than a coat sleeve. The twist could not be completely reduced owing to the great distension and extensive adhesions at the site of the colostomy. A trocar was thrust into the middle of the distended bowel, and a very large amount of gas at once escaped through the attached rubber tube; a little faeces also came away. The opening was closed with a purse-string suture of thread as the cannula was withdrawn. An attempt was made to sever the attached piece of colon from the sac of the hernia. In doing this, however, a small opening was made into the bowel. It was therefore decided to tie a glass tube into this opening for temporary drainage only. A loop of bowel above this was placed vertically behind the abdominal incision, which was closed with mass salmon-gut sutures not perforating the peritoneum, so that the bowel might get extensively attached to the parietes to prevent further rotation. The tube was removed a few days later and the patient made a good recovery, and was well three years later.

It is certain that the volvulus was not reduced at the first operation, but the drainage and shrinkage of the distended loop served to re-establish the channel after some weeks. Later on distension increased, and history repeated itself.

CASE IV.—*Chronic Recurrent Volvulus of the Pelvic Colon: Resection: Recovery.*

A boy, aged 14, was in 1918 admitted to Guy's Hospital under my care for repeated attacks of pain in the left loin. In 1913 he had a definite and severe attack of appendicitis, with fever, pain, and local tenderness in the right iliac fossa; he was in bed for three weeks, and an operation in the quiet period was advised.

For two and a half years before admission the boy had suffered from severe attacks of pain in the left loin, relieved by rest in bed, hot bottles, and a dose of castor oil; there was neither vomiting nor any abnormality of the urine or urination. Left renal or ureteral calculus was suspected, but radiography and urinalysis were negative. The attacks recurred more frequently and became more severe during the latter part of 1919. In February, 1920, the boy was readmitted for further investigation, but no evidence could be obtained of any disease or obstruction of the left kidney. Radiographic examination of the gastro-intestinal tract showed no abnormality beyond some delay in the transverse colon, which was prolapsed and dilated. The abdomen was explored and a chronically inflamed appendix was removed. All the large intestine was dilated, especially the caecum, and transverse and pelvic colons; the latter was elongated and hypertrophied, but not obstructed, therefore it was not thought wise to resect it without consulting the mother and unless the attack recurred.

The attacks, however, increased in frequency and severity; therefore, at the end of April, 1920, the abdomen was reopened, and the pendulous and now twisted loop of pelvic colon was excised, an end-to-end union being made. The patient made a good recovery and has been able to carry on his work as an engineer ever since, but he still gets pain in the left loin if he allows his bowels to get constipated; this happens when he is rowing and racing upon the Thames.

PROGNOSIS.

The mortality of volvulus is very high. Thus in Corner and Sargent's⁵ collection of 57 cases, 19 recovered and 21 died after operation; the remainder died without opera-

tion. In the records of Guy's Hospital for the five years 1920-24 Mr. B. L. Laver found 11 cases of volvulus, 6 of the small and 5 of the large intestine, with 5 deaths—a mortality of 45 per cent. in 74 cases. Quick and efficient work and drainage of the distended loop and of the intestines above the obstruction, and not attempting too much in the critical acute stage, are very important elements in the success of the operation.

REFERENCES.

- ¹ Moynihan: *Abdominal Operations*, third edition, ii, 135. ² Whiting: *Annals of Surgery*, 1904, xxxix, 1036. ³ *Johns Hopkins Hospital Bulletin*, March, 1893. ⁴ *The Operations of Surgery*, seventh edition, ii, p. 361. ⁵ *Annals of Surgery*, 1905, xli, 63.

THE USE OF ULTRA-VIOLET RAYS IN DISEASES OF THE NOSE AND THROAT.*

BY

ALBERT EIDINOW, M.B., B.S.LOND.,

(From the National Institute for Medical Research, Mount Vernon, Hampstead.)

THE biological action of light is primarily due to photo-chemical reaction. Waves of light are absorbed by living cells and produce photo-biochemical reactions which influence the whole organism. All living cells are sensitive to the ultra-violet rays from 3,100 to 2,500 A.U.; furthermore, the living cells can be made sensitive to the infra-red, visible, and long ultra-violet rays by the addition of certain dyes and chemical substances called "light sensitizers." When a normal tissue, such as the skin, is exposed to a source of light emitting numerous waves of light, each group of waves penetrates through the depths of the tissue to varying degrees and has a different biological action. The near infra-red, visible red, and yellow rays penetrate beyond the blood vessels in the skin and heat the tissues; as a result vaso-dilatation and hyperaemia are produced. The green, blue, violet, and long ultra-violet rays penetrate to a smaller extent, and are absorbed by the haemoglobin pigments of the cutaneous blood. The long ultra-violet rays excite a greenish fluorescence of the skin, and are selective in their behaviour to the light sensitizers. The ultra-violet rays from 3,100 to 2,500 A.U. penetrate to the superficial layers of the living epidermal cells. They excite a green fluorescent light in the horny layers of the skin, and, having a rapid lethal action on the living cells, produce a characteristic erythema of the skin at the site of irradiation.

The erythema dose of light produces a marked local hyperaemia and excites a local white cell infiltration of the epidermal tissues. The endothelial cells are swollen and enlarged, and the transudation of fluids through the walls of the capillaries is altered. The exudation of plasma produces an intradermal oedema of the tissues at the irradiated area. The minimal erythema dose of ultra-violet rays applied to the skin, the peritoneum, abdominal viscera, or subcutaneous tissue increases the bactericidal properties of the shed defibrinated blood tested *in vitro*. The maximum effect is obtained by irradiation of 20 to 30 sq. cm. per kilogram of weight. This bactericidal effect originates locally at the site of irradiation, and is carried by the blood stream into the general circulation. These results support the theory that ultra-violet rays have a photo-biochemical action on the living cells and produce a substance which has bactericidal properties. The local effect of ultra-violet rays increases the immunity of the skin. This may explain the beneficial action of the local irradiation of lupus lesions, and is due to the increased leucocytic infiltration and the production of a bactericidal photo-biochemical substance.

Workers at the Copenhagen Light Institute have developed the use of the short-flame carbon arc, and have successfully treated many cases of lupus vulgaris of the skin and mucous membranes. The ultra-violet rays emitted from this source of light are mostly long rays. In their technique the whole surface of the body is exposed to light for twenty minutes to two hours twice or three times a week. This technique is only suitable for chronic types

* Read in the Section of Laryngology, Royal Society of Medicine.