reported by Bassett *et al.* (1939). On the other hand, the results show that once vitamin D was made available the excess of fat in the faeces did not prevent calcium absorption by soap formation. There may be two reasons for this: first, soap formation possibly does not occur until the calcium and fatty acids come together in the colon (Ingelfinger, 1943); secondly, calcium soaps can be utilized, though poorly (Boyd *et al.*, 1932).

Progress Note.—Ten weeks after the conclusion of the experiment blood calcium and phosphate values had risen to normal with continued parenteral vitamin D therapy, but the phosphatase remained high (see Fig.).

Discussion

The response to the parenteral injection of a dose of vitamin D which was ineffective by mouth indicates failure of absorption of vitamin D in our patient. This failure was not due to the increased steatorrhoea produced by the experimental conditions, since these conditions did not obtain before the experiment was begun, when the patient had been receiving the same dose of the vitamin while on a low-fat diet. Absorption of the vitamin at this time would have affected calcium absorption during the experimental period, since the action of vitamin D even in small doses is a prolonged one (Hannon *et al.*, 1934), so that apparently even without massive steatorrhoea absorption of the vitamin was defective. We were not able, as originally planned, to determine whether absorption of the vitamin occurs in the absence of fat in the bowel.

On the basis of our observations certain recommendations may be made. Ordinary doses of vitamin D may be ineffective in the prevention of osteomalacia in steatorrhoea. In the treatment of this condition parenteral therapy with ordinary doses of the vitamin is effective; oral therapy requires very large doses and is at best uncertain. Large amounts of calcium are necessary to replenish the stores. The patient may absorb 1 g. of calcium daily, equivalent to 7.7 g. of calcium lactate, and may even absorb much more (Starr and Gardner, 1930). It should be remembered, too, that approximately 13.5 g. of fatty acids combine with 1 g. of calcium, and it is possible that some calcium becomes unavailable by forming calcium soaps, so that, though the fat intake need never be severely limited except for diarrhoea, it should be as low as is compatible with a palatable diet when steatorrhoea is complicated by osteomalacia. Possible deficiencies of other fat-soluble vitamins need also to be treated.

Summary

A case of osteomalacia secondary to steatorrhoea is described. The bone disease progressed despite treatment with a low-fat diet and vitamin D and calcium supplements. On a daily intake of 70 g. of fat, 4.6 g. of calcium, and 12,000 i.u. of vitamin D orally the patient retained 1.9 g. of calcium in 16 days. With the same dose of vitamin given intramuscularly she retained 6 g. of calcium in 16 days. Apparently a failure to absorb vitamin D occurs in osteomalacia due to steatorrhoea.

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SUPERIOR MESENTERIC ARTERIAL OCCLUSION

RECOVERY WITHOUT RESECTION

BY

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In the pre-heparin era Whittaker and Pemberton (1938), in a discussion of 60 cases of superior mesenteric arterial occlusion, cited only one case with spontaneous recovery which later, coming to necropsy from an unrelated cause, was proved to have obliteration of the superior mesenteric artery. They also quoted Dye as having had three cases clinically diagnosed as mesenteric thrombosis, in which, on death from unrelated causes, obliteration of that artery was found at necropsy. However, since the introduction of heparin therapy, Jorpes (1946) quotes Ravdin as having two spontaneous recoveries, and Rudberg as having one in which the intestine looked viable and was not resected.

Spontaneous Recovery in Case Management.—The incidence of spontaneous recovery is impossible of assessment from the data available, as a number of cases undiagnosed and untreated will recover; but that a definite percentage do recover is certain, and this should be borne in mind when one is confronted with haemorrhagic infarction of the small gut that is still apparently viable. Especially is this so now, for while in the past the mortality rate of resected cases was 84.2% (Whittaker and Pemberton, 1938) and 83% (Cokkinis, 1926), the rate has no doubt dropped considerably in early cases since the introduction of heparin, —for example, Jorpes (1946) quotes Murray and McKenzie as having six resections with four recoveries.

Aetiology.—Cases of arterial occlusion can be immediately divided into embolic and thrombotic, and most of those in the literature would seem to be due to the latter phenomenon in local arterial disease—a very common condition, whether it be an atheroma, an arteriosclerosis, or a thrombo-angiitis obliterans. Even in cases of degenerative heart disease a thrombosis from associated arterial disease is more likely than an embolism, though in valvular disease of the heart embolism of course does occur. In the following case, with no evidence of embolism and with widespread peripheral arterial degeneration, thrombosis is very probably the correct diagnosis.

Addendum to Accepted Pathology

It is puzzling that a part with so much collateral circulation is so readily subject to infarction, and it has been suggested (Boyd, 1946) that the intense spasm of the gut in response to the local anaemia isolates the segment from the neighbouring circulation, while Cokkinis (1926) avers that infarction takes place when the secondary spreading thrombosis reaches the distal arterial arcade and blocks the vasa

recta. It would seem to be more in line with vascular pathology to suggest that in response to a local thrombosis a state of severe arterial spasm or "stupor" results in the distal arterial tree from a local vasoconstrictor reflex. This would at once place emphasis on treatment by such measures as restoration of the blood pressure by replacement of circulating fluid, moderate heat, and adequate morphine—in themselves powerful methods of overcoming the generalized vasospasm associated with the profound shock found in this condition. Locally, in the viable cases under discussion, an excision of the thrombosed segment of artery should be undertaken, or, if this is impracticable, a periarterial sympathectomy of the main trunk of the superior mesenteric artery. In post-operative care heparin, of course, will always be added to minimize the extent of the secondary thrombosis.

It is perhaps relevant, before leaving this subject of arterial spasm, to refer to the exhaustive account by Cohen (1944), who, studying peripheral vessels, could find no evidence of a sympathetic reflex and little evidence that periarterial sympathectomy has any effect on vascular spasm; nor did he find that arteriectomies had any dramatic effect on the return of distal pulses—in fact, he pointed out that no vasoconstriction occurs in the deeper vessels of an extremity on stimulation of the sympathetic nerve. However, in the case of the splanchnic area, conditions are very different, and the importance of vasoconstrictor fibres is very great; in fact, the splanchnic bed forms the most important part of the peripheral resistance (Wright, 1945).

Case History and Course

The patient, a retired bank clerk, aged 64 years, was admitted at 4 p.m. on Aug. 19, 1947. There was no previous history of illness of note. The patient had always been a healthy man, but had been on a pension for several years on account of "gout." The family history revealed nothing relevant. He was awakened at 5 a.m. on Aug. 19 with abdominal colic which made him roll about the bed. He had breakfast at 8 a.m., when the pains became worse, and he vomited at 10 a.m. and again at midday, since when he had been retching. His bowels had not opened since the onset of the pain, but previously they had been quite regular. General interrogation revealed that he had had palpitations both at rest and on exertion and that for several years he had noticed shortness of breath on stair-climbing. There was no swelling of the ankles. He had had frequent severe frontal headaches and some frequency and difficulty of micturition.

On examination the patient was seen to be a rather pale elderly man with slightly cyanotic lips; he was not in obvious pain. The temperature was 95° F. (35° C.), pulse 120, with very poor volume; the tongue was very dry, and the breath faecal-smelling. The central nervous system revealed nothing abnormal. The lung fields were clear. The heart was not clinically abnormal. The blood pressure was 70/50. The peripheral arteries were tortuous and thickened in both upper and lower extremities. The abdomen moved freely on respiration; there was no rigidity or distension, but a generalized ill-defined tenderness was present. There was a distinct rebound tenderness even though the patient was well under the influence of morphine. Shifting dullness could be elicited, and auscultation revealed vigorous widespread audible peristalsis. Per rectum the prostate was felt to be somewhat enlarged, but there was no rectal tenderness at the tip of the finger. The urine contained a trace of albumin and of blood. A first enema produced a few flecks of faeces and no flatus. A second enema after half an hour gave a good faecal result, and the enema fluid looked as though it was blood-stained. Two hours after admission the patient vomited a faecal-smelling light-coloured vomit. A plasma drip was started and operation was decided upon.

Operative Findings (Cyclopropane-oxygen anaesthesia).—A right lower transverse abdominal incision revealed a normal appendix and 2 to 3 pints (1.1 to 1.7 litres) of

blood-stained free fluid which was *spontaneously coagulable*. In the upper abdomen two upper loops of jejunum were markedly engorged and contracted, with a mesentery grossly oedematous right up to the border of the intestine. The mesentery was at least 1 in. (2.5 cm.) thick. The bowel was in a condition of haemorrhagic infarction and seemed still viable, so the abdomen was closed without intervention, as it was considered that a patient with a systolic blood pressure of 70 mm. Hg was unfit to withstand any extensive intra-abdominal procedure.

Post-operative Course.—Continuous gastric suction was started and fluids were given by mouth from the first day. Slow intravenous glucose-saline was given to attain rehydration. In addition intravenous heparin, "liquemin" (Roche), 5 ml. (50 mg.), was given every five hours, which kept the capillary coagulation time between 10 and 20 minutes. This was continued for five days. On the first day the blood pressure was 114/64 and the suction fluid dark and foul-smelling. The intravenous fluids were continued. On the second day the blood pressure was 138/84, the suction fluid was clearing, and the intravenous fluids were still being given. On the third day the blood pressure was 138/84, and the suction and intravenous fluids were discontinued. On the fourth day the blood pressure was 152/90; there was no gastric residue and the patient was beginning to feel hungry. Nourishing fluids were started and the bowels opened normally. On the fifth day the blood pressure was 156/98; the patient was now feeling quite well and was taking a normal diet. Heparin was discontinued. From then on convalescence was uninterrupted, and the blood pressure finally remained at 150/90.

Comment

Diagnosis.—In retrospect I feel that the diagnosis could have been made with some confidence, for here was a patient presenting the picture of (a) really profound shock, (b) partial intestinal obstruction with repeated and progressive vomiting but with good peristalsis and an adequate result from two enemas, and (c) peritoneal irritation evidenced by marked rebound tenderness and the presence of clinical free fluid. The blood-stained second enema should really have clinched matters, and is of interest as denoting that the vigorous peristalsis had propelled blood-stained contents of the small intestine into the colon sufficiently to be evacuated with the enema. This picture in a man with obvious peripheral arteriosclerosis was very suggestive indeed.

Differential Diagnosis.—Such profound shock is likely only in the following conditions: (1) *Coronary thrombosis*, which was ruled out in this case as all the signs were so obviously abdominal; (2) *Acute pancreatitis*, which would not be associated with progressive vomiting or with a blood-stained enema and in which the pain is much more severe and constant in character; and (3) *Long-loop strangulation*, which would present a very similar picture but in which some previous operative intervention would probably be noted and the second enema would be unlikely to produce any result, but certainly not a blood-stained one.

The Causation of Shock.—In this case there is little doubt that the shock was due to the escape from the circulating blood of a large quantity of plasma by transudation from damaged intestinal and mesenteric capillaries, and approximately 3 pints (1.7 litres) of spontaneously coagulable fluid was evacuated from the abdomen.

According to the literature, shock and blood-stained intra-peritoneal fluid are common findings in these cases. I would suggest that really massive plasma infusions of 2 to 3 pints (1.1 to 1.7 litres) should be given immediately and be continued till the blood pressure reached a satisfactory level and haemo-dilution to 110% Hb was obtained, as the condition of this patient was certainly closely allied to the condition of shock in burns.

Summary

The aetiology and pathology of superior mesenteric arterial occlusion are discussed, and arterial "stupor" is suggested as being of importance.

The history, clinical findings, and course of a case of "spontaneous recovery" are detailed and the diagnosis and differential diagnosis noted.

The causation of shock is discussed and suggestions are made as to its treatment.

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CHEMOTHERAPY OF INFECTED URINES IN PARAPLEGIA

BY

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During the routine bacteriological examination of urines from patients with complete transverse lesions of the spinal cord and suffering from chronic cystitis it was noticed that a large percentage of the lactose-fermenting colonies grown, which on staining were seen to be composed of Gram-negative bacilli, were distinctly mucoid in appearance. They occasionally contained a bubble of gas trapped in the substance of the colony, which suggested that the organisms were *Bact. aerogenes* rather than *Bact. coli*. This observation, together with the increasing interest in the treatment of urinary infections with streptomycin and penicillin, prompted this investigation. Fifty strains of coliform organisms from the above-mentioned paraplegic patients were tested to determine the incidence of *Bact. aerogenes* and their sensitivity to penicillin, streptomycin, and sulphathiazole.

Materials and Methods

Fifty strains of these Gram-negative organisms, which produced acid and gas from a fluid medium containing 1% lactose, were primarily isolated from the routine litmus-lactose-agar plate cultures of paraplegic patients' urines. These were either the predominating or the only organisms grown. A single colony was picked off the plate, spread on a second plate, and reincubated; after incubation overnight at 37° C. a single colony was picked off the second plate and inoculated on a broth-agar slope in a cotton-wool-plugged centrifuge tube (4 in. × 5/8 in. —10.2 cm. × 1.6 cm.). After incubation overnight the slopes were covered with sterile liquid paraffin as described by Morton and Pulaski (1938), who showed that organisms kept under such conditions did not alter their characteristics. After six months at room temperature all cultures were viable. During this period the organisms were subcultured and subjected to biochemical tests for identification and tests for sensitivity to streptomycin, penicillin, and sulphathiazole.

The stock cultures were subcultured on to litmus-lactose plates to check purity. The following day one colony was picked off into peptone water. The peptone water was

then incubated at 37° C. for 4 to 6 hours, when subcultures were made into the following media: (1) Clark and Lubs's glucose phosphate medium, (2) Koser's citrate broth, (3) McConkey's broth. The first two were incubated at room temperature and the latter at 44° C. The peptone-water cultures were retained and incubated at 37° C.

Indole Test.—This was performed on the original peptone-water cultures with equal parts of culture and Ehrlich's reagent and one drop of saturated potassium persulphate. The test was performed at 3, 5, and 10 days. All positive reactions were obtained on the third day and remained positive on the fifth and tenth days.

Voges-Proskauer Reaction.—Glucose-phosphate medium was used and incubated at room temperature, and the α-naphthol test of Barritt (1936, 1943) was used. The test was performed at 48 hours.

Methyl-red Test.—Glucose-phosphate medium was used and incubated at room temperature. The test was performed at 3 days.

Growth in Citrate.—Koser's citrate was inoculated with a straight wire from the peptone-water culture and incubated at room temperature. The cultures were not discarded for 10 days, but if growth occurred it was evident in the first 48 hours.

Gas at 44° C.—McConkey's broth was inoculated after being warmed to 44° C. The cultures were incubated in a water-bath running at 44 ± 1° C.

In the case of four anomalous cultures the tests were repeated; the ability to grow in citrate was also tested at 37° C., with a normal as well as a large inoculum, all with the same results.

Penicillin and Streptomycin Sensitivity Tests.—The appropriate concentration of the drug was diluted in infusion broth and approximately 1 ml. of this solution transferred to sterile cotton-wool-plugged tubes, 3 in. × 1/2 in. (7.6 cm. × 1.25 cm.). These were inoculated with a drop of broth culture of the organisms under test and incubated overnight. The following morning the tubes were examined with the naked eye for growth.

Sulphathiazole Sensitivity Tests.—Poured-broth-agar plates were used with the appropriate concentration of sulphathiazole added and containing laked horse's blood to neutralize sulphonamide antagonizers, as described by Harper and Cawston (1945).

Results

Table I shows the incidence of the different types of organisms and their biochemical reactions. Table II shows the results of the sensitivity tests. Those organisms which were resistant to 500 units of penicillin per ml. were subjected to a further series of tests for sensitivity to penicillin; the results of these and of the tests for sensitivity to sulphathiazole are shown later.

The results of the streptomycin-sensitivity tests show that 9 out of 12 (75%) of the strains of *Bact. coli* are sensitive

TABLE I

Organism	No. of Strains in Each Group	Per cent Incidence	Gas at 44° C.	Methyl-red Test	Indole Production	Voges-Proskauer Test	Utilization of Citrate
<i>Bact. coli</i>	12	24	+	+	+	—	—
Irregular <i>Bact. coli</i> type 1* ..	2	4	—	—	—	—	—
<i>Bact. aerogenes</i>	32	64	—	—	—	+	+
Unclassified	4	8	—	—	—	+	+
Total	50	100					

* An atypical form of *Bact. coli* (Wilson and Miles, 1946).