particularly sensitive to these small doses (Bauer and Marble, 1932). On the other hand, the immediate and considerable improvement in calcium and phosphorus balance on massive doses of calciferol indicates that osteomalacia is present but "resistant" to doses of calciferol which would cure other types of the disease than resistant rickets. It has been shown by Bauer, Marble, and Claffin (1932) that normal subjects on large doses of calciferol will show a prompt improvement in absorption of calcium and phosphorus, but, unlike osteomalacias, there is an equally great increase in urinary calcium and phosphorus, so that the calcium and phosphorus balance is not improved. In our case the marked improvement in calcium and phosphorus balance on high doses of calciferol confirms that the patient was suffering from osteomalacia.

The histological criterion of active osteomalacia is the presence of excessive osteoid disposed as wide bands of palely staining tissue on the surface of both compact and trabecular bone. In the present case, although evidence of osteomalacia had been clear, the absence of this histological feature at the time of biopsy after three months of high dosage with vitamin D indicates that remineralization of osteoid had been effected.

Summary

Metabolic balance studies on a case of von Recklinghausen's neurofibromatosis with osteomalacia is presented.

The association of the two diseases is noted, and proved cases previously mentioned in the literature are quoted.

The aetiology of the osteomalacia is shown to be a renal tubular defect, presumably congenital, which brings it into the group of diseases usually known as resistant rickets.

Bone biopsy showed that there is osteoporosis as well as osteomalacia. The cystic appearance of bone is due to combined osteoporosis with deep indentation of bone by mucoid fibrous tissue originating from the periosteum. There was no histological evidence of osteomalacia at the time of biopsy, presumably as a result of treatment.

We wish to thank Dr. James Dow for referring this case to us; Mr. John W. Woollen for the serum analyses and fat balances; Miss Patricia Carroll for her help in the routine chemical investigations; and the nursing staff of the metabolic unit for their care of the patient during the prolonged periods involved in these balances.

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POST-OPERATIVE STAPHYLOCOCCAL ENTEROCOLITIS DURING ANTIBIOTIC THERAPY

BY

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Staphylococcal enteritis during antibiotic therapy is now of clinical importance. An antibiotic-induced intestinal bacterial vacuum in the recipient renders conditions very suitable for colonization by resistant staphylococci (Smith, 1952). Though chlortetracycline ("aureomycin") and oxytetracycline ("terramycin"), the most potent producers of an intestinal bacterial vacuum, have normally been incriminated, chloramphenicol, and penicillin and streptomycin together, have also been blamed. Zischka (1950), quoted by Herrell *et al.* (1953), even described a case following sulphaguanidine therapy. Parenteral administration has also produced the condition (Reiner *et al.*, 1952; Fairlie and Kendall, 1953; Herrell *et al.*, 1953). The normal post-operative increase in adrenocortical hormones may account for the infection gaining a hold, even in some cases without the aid of antibiotics (Herrell *et al.*, 1953). It seems justifiable to differentiate staphylococcal enteritis from post-operative pseudo-membranous enteritis; Prohaska *et al.* (1954), Dearing and Heilman (1953), and Pettet *et al.* (1954) are also of this opinion.

Cross-infection is the main factor in its causation. Cases have been described by Kramer (1948), Reiner *et al.* (1952), Dearing and Heilman (1953), Gardner (1953), Terplan *et al.* (1953), Wakefield and Sommers (1953), Hay and McKenzie (1954), Choremis *et al.* (1954), Williams (1954), Spink (1954), Bowie (1954), and Fairlie and Kendall (1953).

Three further cases are now recorded.

Case 1

A small, ill woman aged 68 had a strangulated femoral hernia repaired, 4 cm. of severely affected ileum being returned to the abdomen. She received 1 g. of streptomycin and 300,000 units of aqueous procaine penicillin intramuscularly twice daily for 4½ days. The streptomycin totalled 9 g. The wound suppurated and local infection increased over the next two days. The pus was not cultured. Her general condition deteriorated. Oral chloramphenicol, 0.5 g. six-hourly, was begun at 10 a.m. on the sixth day after operation. Two days later the wound was only slightly inflamed, and her general condition had so improved that provisional arrangements for her return home were made.

However, the next day she vomited several times and had severe diarrhoea. Her throat was red and sore. Chloramphenicol was stopped, a total of 6.5 g. having been given. She deteriorated with vomiting, diarrhoea, and circulatory collapse, and died ten days after operation.

At necropsy, otherwise healthy small and large intestines were full of a creamy and practically odourless light-yellow fluid. Acute infantile gastro-enteritis was simulated. This observation led to culture of the fluid, which gave a growth of coagulase-positive staphylococci insensitive to penicillin, sulphathiazole, streptomycin, chloramphenicol, and chlortetracycline. It was concluded that staphylococcal enteritis caused death.

Case 2

A man aged 35 with Crohn's disease received pre-operatively 26 g. of succinylsulphathiazole in 5½ days and streptomycin 2 g. and 1 g. on the two days before operation.

Right hemicolectomy was performed. Post-operatively he received 300,000 units of "distaquaine" and 0.5 g. of streptomycin intramuscularly twice daily. Apparently well, he passed a large loose stool on the evening of the day after the operation and a loose greenish stool the next morning. At 5.45 p.m. that day he collapsed with severe diarrhoea, dyspnoea, and cyanosis, lapsing into semicoma. The pulse was rapid and the blood pressure unrecordable. Penicillin and streptomycin therapy was discontinued. A total of 1.5 g. of intramuscular streptomycin had been given. Examination of a direct smear of anal discharge showed Gram-positive cocci, later proved to be *Staphylococcus aureus*.

Despite massive intravenous therapy his general condition failed to improve. Erythromycin, 400 mg., was administered via an indwelling Ryle's tube at midnight and again at 6 a.m. three days after operation with 0.5 g. of chlortetracycline intravenously. Diarrhoea continued. The patient died at 10.45 a.m. on the third post-operative day.

At necropsy a normal stomach contained 300 ml. of bile-stained fluid. Loops of intestine were bound together by thin fibrinous adhesions. The jejunum and ileum were acutely inflamed with a very red mucosa, containing much mucus and soft yellow exudate. The colon contained mucus and similar yellow fluid. The anastomosis was perfect. The exudate showed large numbers of Gram-positive cocci and relatively few faecal organisms, although a culture of anal discharge taken a few moments before death had shown enterococci only. Culture gave a growth of coagulase-positive *Staph. aureus*, enterococci, and coliform bacilli insensitive to penicillin and streptomycin.

Case 3

A stout, well-preserved woman aged 82 had a perforated gastric ulcer oversewn. Premedication had included 500,000 units of aqueous penicillin and 1 g. of streptomycin.

During a satisfactory post-operative course she received 300,000 units of distaquaine and 0.5 g. of streptomycin twice daily. Her bowels moved normally on the morning of the third day. However, at 2 p.m. the same day persistent vomiting and severe diarrhoea developed. Later, yellowish mucoid fluid was frequently voided. Her general condition rapidly deteriorated. Penicillin and streptomycin were stopped. The streptomycin given totalled 3.5 g. Despite intravenous fluid and chlortetracycline she lapsed into coma and circulatory failure, dying at 2 a.m. on the fourth post-operative day.

Necropsy showed an oversewn healing gastric ulcer in the fundus of the stomach. The small intestine was injected and contained thin pale fluid. No ulceration was present. Culture of the fluid gave a moderate growth of staphylococci, coagulase-positive and insensitive to penicillin and streptomycin. Enterococci and coliform bacilli were also present.

Discussion

Sudden severe diarrhoea, collapse, vomiting, and the finding in the intestinal fluid of staphylococci resistant to the antibiotic used were the salient features of these cases. The sudden onset and severe cholera-like course are noteworthy.

Under oral erythromycin the intestinal fluid in Case 2 became free from staphylococci. Nevertheless these organisms were obtained from the mucosa and membrane at necropsy. Terplan *et al.* (1953) recorded the same state of affairs. It probably represents the first stage in the elimination of the staphylococci.

Penicillin active against Gram-positive organisms and streptomycin against Gram-negative organisms are, when given together, similar in action to, but less powerful than, the wide-spectrum antibiotics. This paper and the experiences of Fairlie and Kendall (1953) and Choremis *et al.* (1954) show that penicillin and streptomycin given together can give rise to antibiotic-resistant fatal staphylococcal enteritis.

The advent of antibiotic-resistant staphylococci makes the administration of antibiotics potentially hazardous. Their prophylactic post-operative "umbrella" use in abdominal surgery becomes inadvisable. McKittrick and Wheelock (1954) could find in their cases no evidence that routine antibiotic measures, in the absence of specific indication, lessened post-operative morbidity. Moreover, should infection ensue after such routine use, there is a very real danger that the causative organism will be resistant to the antibiotics used.

Neither of the two patients treated responded to the intravenous fluid given. Frequent vomiting militates against efficacious oral therapy even though the staphylococci may be presumed to be still sensitive to erythromycin. Early diagnosis and, better, prevention is important.

Diagnosis is made on the clinical picture and confirmed by the finding of Gram-positive cocci in a direct smear of the anal discharge. Intravenous fluid replacement must be commensurate with the intestinal loss of fluid. Isolation nursing of the patient to limit spread of the numerous antibiotic-resistant staphylococci is required.

If in special cases wide-spectrum antibiotics have been used pre-operatively, a specimen of the bowel contents taken at operation should be cultured. Should staphylococci be found, treatment with erythromycin will avoid overt superinfection (Dearing and Heilman, 1953).

Though the poorly absorbed sulphonamides have greatly reduced sepsis in large-bowel surgery, the search for more thorough sterilization continues. Neomycin alone, or fortified with phthalylsulphathiazole or bacitracin, may be such an antiseptic (Fog, 1953, 1954; Poth, 1953; Anlyan *et al.*, 1954). These, however, produce the most complete and prolonged bacterial vacuum so far known. The possible advent of new clinical syndromes consequent upon the disturbance of the normal intestinal flora should be remembered (Smith, 1952). Animal experiments suggest that too thorough bowel disinfection renders implantation of carcinoma at a suture line more likely (Vink, 1954).

The lesson to be learned from these cases is that, at present, pre-operative large-bowel antisepsis should be obtained by the use of the poorly absorbed sulphonamides alone and that the combination of penicillin and streptomycin can give rise to staphylococcal enteritis. The use of penicillin and sulphadimidine has not, so far as I know, given rise to staphylococcal enteritis.

Summary

Three further cases, all fatal, of antibiotic-induced post-operative staphylococcal enteritis are reported.

Established cases respond poorly to treatment.

At present, pre-operative large-bowel antisepsis should probably be confined to the use of the poorly absorbed sulphonamides alone. With scrupulous anastomotic suturing, free from tension, an uneventful recovery should follow.

Post-operative use of wide-spectrum antibiotics should normally be reserved solely for the treatment of established complications of some magnitude.

Staphylococcal enteritis is a heavy price to pay for prophylaxis against possible sepsis.

It is now quite evident that in an attempt to banish the risk of sepsis in abdominal surgery—an infection which the unmolested patient will overcome provided it is not excessive or continuing—we may subject the patient to infinitely more serious hazards by the precipitate administration of wide-spectrum antibiotics.

I wish to thank Dr. D. Evans and Dr. I. MacKenzie for the bacteriological work; Mr. J. R. Ratcliffe and Mr. G. Harrison for access to the cases; and Mr. H. Blacow Yates and Mr. F. O'Gorman for help and encouragement in writing this paper.

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REPAIR OF INJURIES TO THE TENDONS OF THE HAND

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In our country, Pirogov as early as the middle of the nineteenth century demonstrated experimentally the role of haemorrhage within the tendon sheath in the regeneration of damaged tendons. He was the first of many to contribute to the study of the circulation in relation to problems of regeneration and repair of tendon injuries.

During the last thirty-five years improvements in the surgery of tendon injuries have been made by Janelidse, Girgoloav, Rufanov, Gorinovskaya, Nikilaev, Rosov, Priorov, Kotschergein, Bogdanov, Grigorieva, Weinstein, Nikiforova, and others. They have studied the methods of foreign authors, and particularly of Bunnel, Iselin, Allen, and Mason. With this as a basis there has been issued a guide to surgeons on the treatment of these injuries related to factors such as the site, type of injury, and occupation of the injured worker. A number of points remain in dispute, but we believe that certain general principles have been agreed. I will attempt to outline our policy as concisely as possible.

If it were possible to exclude mistakes at the time of primary surgery in all medical institutions it would certainly greatly decrease the number of difficult problems of tendon repair, which so often lead to unsatisfactory results. The first condition for success in the treatment of tendon injuries is the availability of qualified surgeons able to carry out the necessary technical procedures immediately, carefully, and gently, in a well-equipped operating theatre, following early admission to hospital. The organization of the Health Service in the Soviet Union has endeavoured to make such treatment widely available.

We have put particular emphasis on the organization of the surgical care of industrial injuries. Every industrial plant includes a health department with a surgery for traumatic cases, and hospital beds are available day and night. This organization primarily means that surgery can be carried out within two hours of the accident. The operating surgeon retains responsibility for the patient until recovery is complete.

This report is based on the results of operations on tendon injuries of the wrist and fingers in 375 patients (see Table I). Special attention is paid to industrial injuries as shown in Table II. It will be seen that only 28 of a total of 123 patients had isolated injuries of the tendons, the remaining 95 had accompanying extensive

TABLE I.—Summary of Data of Soviet Surgeons on Primary Tendon Suture

Author	Year	No. of Cases	Site		Good Results (%)	
			Flexors	Extensors	Flexors	Extensors
Weinstein ..	1936	71	26	45	42	80
Svigaskaja ..	1938	131	76	55	81	82
Atanov ..	1939	83	34	49	82	67
Michelson ..	1939	92	92	—	40	—
Choranov ..	1941	40	24	16	83	100
Grigorieva ..	1948	106	49	57	65	95
Lebedev ..	1951	70	45	25	64	100
Rosov ..	1951	444	189	255	71	86
Bogdanov ..	1953	355	167	188	75	89

TABLE II.—Types of Industrial Injuries to Tendons of the Hand

With fracture ..	..	..	..	..	43
Isolated injuries ..	..	..	..	..	28
With fracture and defects of soft tissue ..	..	..	..	..	19
With soft tissue defects ..	..	..	..	..	19
With damage to nerves and blood vessels ..	..	..	..	..	7
With injury to joints ..	..	..	..	..	7

123

skin defects, fractures, or nerve lesions. These complications must be taken into account in evaluation of our surgical technique.

Primary Suture

As a first-aid measure we insist on the immediate immobilization of the hand, with the fingers flexed into a fist for damage to the flexor tendons, and with the fingers extended in rupture of the extensors. This prevents retraction of muscles and torn tendon ends and facilitates primary surgery.

The role of surgery is then to transform the accidental wound into a surgical wound. Operating early with adequate assistance, we aim at accurate suturing of damaged nerves and tendons. This is followed by accurate skin apposition or grafting. Fractures are immobilized in the required position. Primary and accurate surgery during the first hours after injury can make a great contribution to the results obtained in these injuries. Primary suture of tendons restores the anatomical relations of the tissues; it removes a situation in which abnormal nerve impulses are engendered by the damage; it contributes to the re-establishment of normal physiological interrelations between the central nervous system and the local motor apparatus; and it predisposes to early recovery of function without rigidity or contracture.

Primary suture, if antibiotics are available, is in our opinion indicated for all tendon injuries when an experienced surgeon is available, except in the "no-man's-land" area. Outside this zone there are absolutely no contraindications to primary suture even with fractures or skin defects, unless associated with severe disturbance of the circulation. The results of treatment depend not so much on the extent of the damage as its site.