than in the two earlier cases, but of the same type; and surgically only the lower third of the stomach was involved. Gastroscopy left little doubt of the diagnosis, but, as in some of these cases, infiltration at the angulus probably imitated the pylorus closely.

Other Cases

Case 8 was that of a woman of 60 with a four-year history of anaemia needing continued intensive liver therapy. She was found at operation to have a small stomach, only 2 to 3 in. (5 to 7.5 cm.) in diameter, with a dumbbell-shaped tumour in the fundus; this was removed with difficulty, and consisted of a benign leiomyoma. Case 15 is that of a man of 77 with a one-year history who has a sedimentation rate, repeated at several months' interval, of 30 mm.: normal for the method, 0-10 mm. only. X-ray examination showed a normal stomach, but gastroscopy revealed a reddish nodule on the greater curve of an otherwise (gastroscopically) normal pyloric antrum. This patient is still under observation, though unsuitable for operation without stronger reason.

These cases illustrate the recognized liability of patients with pernicious anaemia to gastric abnormality, and the desirability of watching them from this point of view.

Discussion

The limitations of this investigation are recognized. Swayed by the weight of others' experience (Wilkinson, 1945) and by the apparently negative result of the first case, observations have been more casual than now seems desirable. The results justify further observation. Investigation in these cases is not difficult: the patients are generally placid and co-operative, their stomachs are easy to examine radiologically (Rigler, Kaplan, and Fink, 1945) and gastroscopically, and they tolerate operation well even in the eighth decade.

Of 15 patients examined for gastric lesions while free from dyspepsia, carcinoma has been found in three. In these cases the carcinomatous area was in the lower third, where radiology demonstrated narrowing even in the two cases which were at a very early stage. There seems to be no pathological reason for this general contraction of the pyloric area, though it may be the first indication of carcinomatous change. On the other hand, it may be a permanent characteristic of these stomachs. It was not productive of delay, and is not mentioned by Jacobson and Palmer (1943) in a radiological study of gastric emptying in pernicious anaemia. The lower stomach is not usually abnormal in pernicious anaemia (Magnus and Ungley, 1938), and gastroscopy confirms this. An abnormal antral mucosa, especially when associated with a narrow antral canal, may predispose to malignancy. It is well recognized that the prepyloric area is particularly liable to develop cancer. Cases of pernicious anaemia showing an abnormal mucosa there should be viewed with as much suspicion as hyperchlorhydric cases with prepyloric ulcers. There is reason to believe, also, that simple neoplasms of the stomach are unduly frequent in pernicious anaemia. Carcinoma originating in these may appear in any gastric area, and is characteristically a bulky polypoid tumour. No such case has been found in the small number now reported, though I have records of other casual ones.

Conceivably, therefore, in pernicious anaemia carcinoma may arise in two ways. It is suggested as a basis for further full observation that the commoner prepyloric carcinoma does not arise in localized polyposis but is associated with rather diffuse mucosal changes detectable by gastroscopy at an early stage, and with narrowing of the prepyloric area demonstrable radiologically.

The patients developing carcinoma were all over the age of 65, and had been treated for ten years or more. With

increasing age abnormal stomachs would be expected to become more liable to malignant change; and liver treatment, by keeping patients alive, may predispose to this form of cancer—if liver extract is not a carcinogen (Kaplan and Rigler, 1947).

The cases observed indicate once again how late in the course of gastric cancer symptoms appear. If, however, these cases are operated on early, then, as Mallory (1940) remarks of early gastrectomy for other prepyloric lesions, histological appearances are not infrequently doubtful. To cure more cancers we must alter our pathological, radiological, and gastroscopic criteria so as to present our histologists with precisely this problem. Kaplan and Rigler (1947) urge that watching cases of pernicious anaemia is the main method of achieving this object obvious at the moment, few as such cases are.

Summary

Examination of 15 symptom-free pernicious-anaemia patients revealed cancer in three. Periodical x-ray and gastroscopic studies are strongly indicated in all cases of Addison's anaemia in remission or relapse.

I am grateful to my hospital colleagues, especially to Dr. L. R. Janes, for much help and restraining criticism. I am indebted to Prof. T. L. Hardy for encouragement and advice, and to Prof. M. J. Stewart for comments on the histology of Case 2.

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THE COMPLICATIONS OF MUMPS

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In 1946 a few cases of mumps occurred in a military camp in New Zealand just before the departure of a contingent of about 2,000 soldiers for Japan. A number of cases occurred on the ship during the journey, and after the arrival of the force in Japan the disease spread rapidly, giving rise to a sharp epidemic of 235 cases in seven months. It has since been possible to follow up 208 of these cases and to examine and to interrogate them. This paper embodies the result of the investigation, which was of particular interest so far as the complications of the disease and their permanent after-effects are concerned. Of the 208 patients 189 were white men, 14 were Maoris, and 5 were white women. There was no difference in the course of the disease in the Maoris except that they did not report sick until much later in the illness. Except where specially mentioned the figures refer to the 203 men, whose average age was 22 years, the women being considered separately.

We believe the value of this investigation lies largely in the fact that such a complete follow-up was possible so long

after the illness, and that any residual disabilities may be considered unlikely to improve further. The average time of follow-up was seven months after the onset, but in individual cases it varied from four to eleven months. Each patient was interviewed, and so far as possible his notes were studied simultaneously.

The commonest mode of onset of the illness was the appearance of parotid enlargement. However, in 54 cases the onset was with general symptoms (tiredness, malaise, headache, etc.), which were present for up to two days before any glandular enlargement. Enlargement of the submandibular glands alone occurred in 13 cases. Orchitis was the only manifestation of mumps in five cases.

Nervous Complications

At the follow-up each patient in the series was directly interrogated for these symptoms: headache, neck stiffness, drowsiness, facial weakness, disturbances of hearing, and acroparaesthesiae. The statements were noted and compared with the case records written at the time of illness.

There had been symptoms or signs of meningeal involvement in 60 cases: 18 patients complained of moderate headache only, and this single symptom is of rather doubtful significance as no lumbar punctures were performed; 36 complained of severe headache and, in addition to marked pain, were drowsy and had a positive Kernig sign or neck rigidity; and six showed a definite meningo-encephalitis, these being recorded below. One man complained of deafness and vertigo, and two men had vague aural symptoms on one side during the early stages of the illness.

Unfortunately, owing to the size of the epidemic and the limited facilities available at the time, lumbar puncture was not performed in some cases in which the results would have been interesting and probably abnormal. Where performed the findings are recorded with the individual cases.

Case Histories

Case 1.—A. J. S., aged 21, noticed the onset of throbbing retro-orbital headache with slight sore throat and swelling below the right ear on Aug. 19, 1946. The swelling increased until the 21st, when he was admitted to 6 N.Z.G.H. He was found to have tender swelling of both parotid glands, more marked on the right, and a small non-tender swelling of the left submandibular gland. By Aug. 25 both submandibular glands had become grossly swollen and tender. Next morning he complained of swelling and pain in the left testicle, and was found to have a well-developed epididymo-orchitis. At 7 p.m. on the same day he complained of frontal headache, drowsiness, nausea, and photophobia. His temperature, which had varied between 98.4 and 100° F. (36.9 and 37.8° C.) rose to 105° F. (40.6° C.) at 10 p.m. Flexion of the neck caused pain in the lumbar region, but no other abnormality was found. On Aug. 27 he felt better but was still drowsy, and he vomited all food and drink. Neck rigidity was still present and Kernig's sign was positive. The enlarged salivary glands were subsiding. The same evening he became more drowsy and disorientated. On examination marked weakness was found in both legs, right more than left, absent knee- and ankle-jerks, and extensor plantar responses. Cerebrospinal fluid examined on the 28th contained 30 mg. of protein per 100 ml. and 4 lymphocytes per c.mm. By Sept. 3 he felt quite well and was symptom-free, although examination of his nervous system revealed a marked right-upper-motor-neurone facial weakness, weakness and incoordination of right arm and leg, with normal tendon reflexes and an extensor plantar response on the right. Appreciation of light touch, pain, and temperature was impaired on the right side of the face and body. Position sense was impaired in the right hand. After convalescing for a further two weeks he returned to his unit, where he began to suffer from "dizzy attacks and blackouts." These at first occurred at any time of day when up and about, but by

the end of the year they occurred only if he stood at attention for any length of time. His symptoms were immediately relieved by sitting or by lying down. When examined at this time he still had obvious facial weakness, with slight weakness of grip in the right hand and of dorsiflexion of the right wrist. There was slight sensory impairment to light touch, pain, and temperature over the right face, chest, and arm. The right leg was normal, with a flexor plantar response. The left testicle was slightly smaller than the right. After a month's physical training at a convalescent camp his fainting attacks ceased. Eight months later the patient was completely normal apart from a still apparent facial weakness.

Case 2.—G. H. M., aged 22, was admitted to 6 N.Z.G.H. on July 5, 1946, complaining of a sore throat and swelling under the right jaw for 18 hours. Frontal headache and flitting limb pains had been present for eight hours. Examination revealed a swollen right submandibular gland, marked neck rigidity, and a positive Kernig sign. There was slight weakness of the right arm and leg, with normal tendon reflexes and an extensor plantar response on the right. Temperature was 103° F. (39.4° C.). That evening he became very restless and complained of aching pains all over his body; his headache was worse. The weakness of his right arm and leg became more marked and a left facial paresis developed. Lumbar puncture gave a slightly turbid fluid containing 680 cells per c.mm. (97% lymphocytes, 3% polymorphs); total protein, 100 mg. per 100 ml.; Pandey's reaction positive; chlorides, 659 mg. per 100 ml.; 13,700 white cells per c.mm. (79% polymorphs, 9% lymphocytes, 12% monocytes). On July 8 the patient felt much better, but still had slight neck rigidity. The right hemiparesis and left facial weakness had not improved. On the 10th the left parotid gland became swollen, but his general and neurological condition had improved. He made a rapid recovery and was discharged to his unit, with no abnormal physical signs after four weeks in hospital. When seen 11 months later he had no complaints, and his nervous system was normal except for a mild left facial weakness.

Case 3.—F. B. C., aged 20, developed a frontal headache and bilateral parotid and submandibular enlargement on Aug. 22, 1946. On Sept. 3 he developed bilateral orchitis. Two days later he complained of frontal and occipital headache and his temperature rose to 103° F. (39.4° C.). Kernig's sign was positive. Next day the headache was more severe, with photophobia and neck rigidity, and he had diplopia on looking upwards. No definite ocular muscle paresis could be detected clinically. White blood cells numbered 6,600 cells per c.mm. (60% polymorphs, 36% lymphocytes, 4% monocytes). The diplopia lasted seven days. On Sept. 17 he went to a convalescent camp, where he continued to complain of dull frontal headaches. These continued intermittently for five months, although they may have been partly due to an infected maxillary sinus for which he was being treated.

Case 4.—R. H., aged 22, was admitted to 6 N.Z.G.H. on Aug. 29, 1946, with an enlarged right parotid gland. Next day he complained of malaise, severe frontal headache, and nausea, and he vomited several times. The temperature was 102° F. (38.9° C.). On Sept. 3 he was still vomiting; the temperature was 103° F., Kernig's sign was positive, and the knee-jerks were absent. Marked neck stiffness developed during the course of the day. Lumbar puncture gave a slightly turbid fluid containing 700 cells per c.mm. (95% polymorphs, 5% lymphocytes); total protein, 60 mg. per 100 ml. On the 5th he felt better (temperature 102° F.), and there was slight weakness of flexion of the right hip, knee, and ankle. Knee-jerks were still absent. White blood cells numbered 5,200 per c.mm. (42% polymorphs, 52% lymphocytes, 4% monocytes, 2% eosinophils). His pulse rate fell below 50 on the 14th and 18th days of illness. By Sept. 24 he was quite well and there were no abnormal signs in his nervous system.

Case 5.—A. J. M., age 22, was admitted to 6 N.Z.G.H. on Feb. 18, 1947, complaining of headache and shivering, with pain in the right hypochondrium and nausea for eight hours. Examination revealed tenderness and rigidity in the right hypochondrium and tenderness in the right loin. The psoas sign was positive on the right. Next day he was drowsy

and developed photophobia, slight neck rigidity, and tenderness in the right iliac fossa. On Feb. 20 the left parotid gland became swollen. Lumbar puncture showed: C.S.F. pressure of 160 mm.; 545 cells per c.mm. (99% lymphocytes, 1% polymorphs); total protein, 70 mg. per 100 ml. Pandy's test was positive and urinary diastase normal. There were no abnormal physical signs in the nervous system except a positive Kernig sign and neck rigidity. His headaches ceased gradually over a period of about a month. On Feb. 27 the C.S.F. contained 220 cells per c.mm. (99% lymphocytes, 1% polymorphs); total protein, 50 mg. per 100 ml. Pandy's test was negative. On March 7 he complained of epigastric discomfort after food, and on the 10th the C.S.F. contained 62 cells per c.mm. (all lymphocytes); total protein, 40 mg. per 100 ml. On March 25 a small area of pulmonary collapse developed at the left base, with hilar gland enlargement. This cleared up completely after two weeks, and he was symptomless throughout. The indigestion persisted for several weeks in spite of treatment; it was considered to be largely psychological in origin. Several examinations for urinary diastase gave normal figures. When last seen ten weeks after leaving hospital the patient was quite fit.

Case 6.—J. A. G., aged 21, was admitted to 6 N.Z.G.H. on Sept. 9, 1946, complaining of malaise. The following day both parotid glands became slightly enlarged. On Sept. 12 he developed a right-sided orchitis and next day he complained of severe headache and vomited. On Sept. 15 his speech was slurred and there was marked neck rigidity. Kernig's sign was positive. On the 17th he developed a left facial paresis; there was weakness of his right leg, with normal tendon reflexes and bilateral extensor plantar responses. On the following day the plantar responses became flexor, but his condition was otherwise stationary. The cerebrospinal fluid was slightly turbid and contained 420 cells per c.mm. (98% lymphocytes, 2% polymorphs); total protein, 90 mg. per 100 ml.; Pandy's test positive. By Sept. 30 he had completely recovered except for a slight left-upper-motor-neurone facial paresis. In February, 1947, he had an attack of measles with severe headache. Lumbar puncture performed when the rash was fading (sixth day) showed that the C.S.F. contained 33 cells per c.mm. (32 lymphocytes, 1 polymorph); total protein, 40 mg. per 100 ml. Pandy's test was negative. White blood cells numbered 9,150 (64% polymorphs, 32% lymphocytes, 4% monocytes). There were no physical signs in the nervous system except for the slight left facial paresis, a relic of his previous illness.

Case 7.—F. H. G., a woman aged 27, was admitted to 6 N.Z.G.H. on Sept. 7, 1946, complaining of headache and malaise; there was bilateral parotid swelling, more marked on the left. On the second day she developed a dull peri-umbilical pain with tenderness. Next day the headache became worse and she became drowsy; slight neck rigidity was present. On the ninth day a right facial paresis developed. There was mild bilateral mastitis during the illness. She was discharged fit after three weeks, although the facial weakness was still obvious. At the follow-up seven months later there was still a trace of facial weakness, and the patient complained that she had had amenorrhoea since the illness.

Case 8.—C. O. N., aged 26, developed bilateral parotitis on June 6, 1946. Next day he noticed a slight degree of deafness in the left ear, which became severe during the next 24 hours. There was also vertigo. At the follow-up nine months later he was found to have a pronounced degree of nerve deafness in the left ear.

Discussion

The literature on the nervous complications of mumps is adequately reviewed by Lightwood (1946), Church (1946), and Holden *et al.* (1946). The incidence is reported in various studies as varying from *nil* to 40%. Meningitis is undoubtedly the most frequent manifestation of nervous involvement in mumps, in addition to which numerous neurological syndromes have been recorded less commonly—generalized meningo-encephalitis with or without fits, dysphasia, monoplegia, hemiplegia, tetraplegia, cranial-nerve palsies (particularly 3, 7, and 8, acoustic and

vestibular divisions), optic neuritis, bulbar palsy, involuntary movements, and myelitis. From all of these complete recovery is usual, and consequently pathological studies are few. Demyelination of the corona radiata and encephalitic patches in the cerebral cortex and brain stem have been observed. The changes in the C.S.F. have been recorded often and at length, and are well known.

The nervous symptoms and signs are generally said to have their onset at the height of the illness, usually before the development of orchitis. In the eight cases recorded above the onset ranged from one in which the patient reported sick with nervous involvement and possible pancreatitis (Case 5) to one in which there was no nervous involvement (unless the early headache is regarded as such) until the 14th day (Case 3). The average day of onset was the fifth. In most of the cases recorded above it was not possible to localize the encephalitis to a single site, which is what would be expected in this type of disease. Case 1 presented a rather mixed picture, which could be accounted for by bilateral involvement of the corona radiata, more marked on the left. During convalescence the picture of an uncrossed hemiparesis, most pronounced in the face and arms and less severe in the leg, with sensory change over the upper part of the body, supports a subcortical localization, although affection of the brain stem could also account for it.

Case 2 showed a crossed hemiparesis (left face and right limbs), which is most likely to be due to a brain-stem lesion. Case 6 was of considerable interest in that the patient had an abnormal C.S.F. during an attack of measles five months later. It is not known whether the fluid was normal in the interval, but usually it fairly rapidly becomes so after mumps encephalitis, and it would therefore seem that this man is constitutionally susceptible to potentially neurotropic viruses or that this susceptibility dates from and is due to the mumps encephalitis. Case 8 showed involvement of both the acoustic and the vestibular portions of the eighth nerve. Recovery from the facial weakness in Cases 1, 2, 6, and 7 was still incomplete at the follow-up, and it seems more likely that some permanent damage has been done. Apart from this and the vasomotor instability of Case 1 and the deafness of Case 8, all recoveries from nervous involvement were fairly rapid and complete.

Orchitis

Orchitis occurred in 53 (26%) men—in 17 cases while still confined to bed, in 5 at onset, in 6 before reporting sick, and in 21 after starting to get up. For the remaining 4 no information was available. The follow-up period was four months in two cases, five months in one case, and between six and ten months for the remainder. The onset occurred during the first week in 34 cases and during the second week in 16. One case developed on the 15th day and two cases on the 22nd day. The disease was bilateral in five patients. Orchitis was the first definite sign in five cases, appearing on the second or third day after a prodromal stage of lassitude and anorexia. In four of these, the orchitis was the only clear manifestation of the disease, there being no subsequent parotitis.

In the follow-up 31 cases (57%) were perfectly normal. There was no testicular atrophy, the consistency and the sensation of the testes were unaltered, and sexual activity was unimpaired. In four cases there was or had been some residual pain after exercise, mild in all cases and usually transitory. In two the aching still occurred seven months after onset, and was associated with some degree of atrophy. In the other two there was no atrophy; one man's discomfort had ceased three to four months after onset, while the other's was improving at ten months.

Assessment of atrophy was based mainly on a difference of more than $1/4$ in. (0.6 cm.) between the length of the two testes. This criterion is open to certain objections, including some degree of difference between the two sides in healthy people. It was applied only when the unaffected side appeared to be well developed and healthy. In none of the bilateral cases was there any reason to suspect any degree of atrophy. The patients' observations were invited in each case as a rough check. There was no case of complete atrophy in the series. Some degree of difference between the healthy and the affected sides was noticed in 22 cases (42% of those with orchitis), amounting to $1/2$ in. (1.25 cm.) in 3 men, $3/4$ in. (1.9 cm.) in 10, 1 in. (2.5 cm.) in 7, and $1\frac{1}{4}$ in. (3.2 cm.) in 2. Of these 22 testes 4 were softer than on the healthy side. Testicular sensation was normal in all. A decrease in size after the orchitis had been noticed by 13 patients, no change had been observed by 2, while the remaining 7 had no observations.

Sexual activity, as judged by intercourse, masturbation, or nocturnal emission, was unimpaired throughout the whole orchitis series. It remained unaltered in one man whose other testicle was completely atrophied from a preceding and independent cause; no atrophy of the remaining testis followed the mumps orchitis.

One patient had had an attack of mumps two years earlier, with orchitis on the same side in each attack. By contrast, another man had had orchitis with mumps five years earlier without developing orchitis in his second attack.

Considering the absence of complete atrophy in the series, the fact that 1 in. or more of atrophy occurred in only nine cases and that there was a lack of any impairment of sexual activity, it is doubtful if we are justified in recommending a decompression operation in all cases of mumps orchitis. It might perhaps be advised for those with orchitis of a single functioning testicle or for those with severe bilateral orchitis, though the present small series would hardly justify the latter indication; but for the remainder it is not indicated in the present state of our knowledge.

Other Complications

Pancreatitis and Mastitis.—Some degree of pancreatitis was considered to be present in 16 (8%) of the complete series. Symptoms lasted from one to five days. No sugar was found in the urine of 11 cases tested at follow-up, nor were there any sequelae. One woman complained of tenderness of the breasts during the early part of the illness, and one man had vague fleeting pains round his nipples soon after the onset of mumps.

Cardiovascular System.—Myocarditis has been reported in mumps, and Rosenberg (1945) undertook a full electrocardiographic study, in which he obtained abnormal records in 15% of cases. Although no thorough investigation could be carried out in this epidemic it was thought that it might be of interest to note the number of patients in whom the pulse rate fell below 50. Only 131 pulse charts were available, and 52 showed readings of less than 50 for varying periods, chiefly in the second and third weeks. One of these cases also had an apical systolic murmur which was still present at the follow-up. There were five cases of apical systolic murmur without bradycardia: in only one of these had the murmur disappeared at the follow-up several months later. It is not proposed to attempt to draw any conclusions, as there are obviously insufficient data, but these results seem to confirm the opinion that the cardiovascular system deserves more attention in cases of mumps than it has hitherto received.

Relapse and Second Attack.—Two cases relapsed with recurrence of glandular enlargement after discharge from

hospital. A third patient relapsed with submandibular sialoadenitis after an initial orchitis. Eighteen men gave a definite history of a previous attack of mumps and six thought they had probably had mumps before but were not certain.

There were no cases of urethral discharge, pericarditis, arthritis, nephritis, or suppuration of glands, all of which have been recorded as complications of mumps.

Complications in Women.—In one case the disease started with diarrhoea and vomiting, and the patient had amenorrhoea for six months afterwards and felt generally run-down. A second case (No. 7) showed evidence of mild meningo-encephalitis and mastitis. The remaining three cases complained spontaneously of tiredness since the illness—a complaint which was not made by any of the men.

Summary

An epidemic of mumps was investigated with the view of determining the incidence of complications and any permanent after-effects resulting from them. Eight cases of meningo-encephalitis are described. It was found that recovery tended to be slow and that when facial palsy occurred recovery was incomplete.

The incidence of orchitis was 26%. There were no cases of complete testicular atrophy following this complication, but 42% showed minor degrees of atrophy. Sexual activity was unimpaired.

We thank Col. C. R. Burns, senior medical officer of 2 N.Z.E.F. (Japan), for encouragement and permission to carry out this study, and also the regimental medical officers of the units concerned for their help in collecting the men for the follow-up examinations.

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FATAL AIR EMBOLISM DURING MASTECTOMY

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Air embolism may be associated with a large number of conditions. The circumstances in which it most frequently occurs are as follows: (1) Gynaecological and obstetrical (often criminal) procedures involving the manipulation of the pregnant or puerperal uterus. Many deaths have been recorded after insufflation of the vagina during pregnancy or the puerperium, and death has even occurred following insufflation of the Fallopian tubes. Placenta praevia is also an especially dangerous condition. (2) Intentional introduction of air or other gas into cavities or potential cavities such as the bladder, joint cavities, paranasal sinuses, and peritoneal and pleural cavities. Perirenal insufflation has given rise to air embolism. (3) Unintentional introduction of air into vessels during transfusions or infusions or into solid organs such as the liver. (4) Operative procedures to the breast, thyroid, lungs, etc. Air embolism may follow injury to vessels by stab wounds, bullet wounds, etc.

The effects of air embolism are very variable in severity, depending mainly on the condition of the patient, the