that in the control group many of the throat infections were due to organisms other than haemolytic streptococci, or that the carrier condition after faucial infection was less persistent than in rheumatic subjects.

Regarding the Lancefield grouping of the isolated strains, it was interesting to find that 87 per cent. of those from rheumatic subjects were of the important pathogenic Group A, whereas only 42 per cent. of strains from controls were of this type. Nevertheless even in the control group the majority of carrier strains from persons with a definite history of recent infection were also members of Group A.

Conclusions

1. Of a group of 200 subjects with acute rheumatic manifestations 78 per cent. gave a history of antecedent throat infections; 46 per cent. of a non-rheumatic control group gave a similar history.

2. Throat swab cultures for haemolytic streptococci were positive in 58 per cent. and 30 per cent. of the rheumatic and control groups respectively.

3. Of the strains of haemolytic streptococci from throat swabs of rheumatic subjects 87 per cent. were serologically classified in Lancefield Group A; 42 per cent. of strains from non-rheumatic controls were of this group. Group A strains were therefore isolated from 50.5 per cent. and 12.5 per cent. of the rheumatic and control groups.

4. The evidence supports the relationship between infection with haemolytic streptococci and the rheumatic state.

I am indebted to the physicians of the Royal Hospital for Sick Children, the Royal Infirmary, and the Municipal City Hospitals of Edinburgh for granting access to cases under their charge. It is a real pleasure to acknowledge the co-operation of Dr. John G. Sclater in the collection of specimens.

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REFERENCES

- Bertram, M. (1925). *British Medical Journal*, **1**, 496.
 Birkhaug, K. E. (1927). *J. infect. Dis.*, **40**, 549.
 Boas, E. P., and Schwartz, S. P. (1926). *Amer. Heart J.*, **2**, 375.
 Bradley, W. H. (1932). *Quart. J. Med.*, n.s. **1**, 79.
 Coburn, A. F. (1931). *The Factor of Infection in the Rheumatic State*, Williams and Wilkins, Baltimore.
 — and Pauli, R. H. (1935). *J. exp. Med.*, **62**, 137.
 Collis, W. R. F. (1931). *Lancet*, **1**, 1341.
 Davis, L. J., and Guzdar, J. S. (1936). *J. Path. Bact.*, **43**, 197.
 Gibson, H. J., Thomson, W. A. R., and Stewart, D. (1933). *Arch. Dis. Childh.*, **8**, 57.
 Glover, J. A. (1930). *Lancet*, **1**, 499.
 — and Griffith, F. (1931). *British Medical Journal*, **2**, 521.
 Hare, R. (1935). *J. Path. Bact.*, **41**, 499.
 Hiller, R. I., and Graef, I. (1927–8). *Amer. Heart J.*, **3**, 271.
 Ingberman, E., and Wilson, M. G. (1924). *J. Amer. med. Ass.*, **82**, 759.
 Kodama, T. (1937). *Kitasato Arch. exp. Med.*, **14**, 29.
 Lambert, A. (1920). *J. Amer. med. Ass.*, **74**, 993.
 Lancefield, R. C. (1933). *J. exp. Med.*, **57**, 571.
 — and Hare, R. (1935). *Ibid.*, **61**, 335.
 McCulloch, H., and Irvine-Jones, E. I. M. (1929). *Amer. J. Dis. Childh.*, **37**, 252.
 Mantle, A. (1885). *British Medical Journal*, **2**, 960.
 Medical Research Council (1927). *Special Report Series*, No. 114, London.
 Plummer, H. (1935). *J. Bact.*, **30**, 5.
 Poynton, F. J. (1925). *British Medical Journal*, **2**, 788.
 — and Paine, A. (1900). *Lancet*, **2**, 861.
 Raven, M. O. (1923). *Ibid.*, **2**, 1227.
 St. Lawrence, W. (1920.) *J. Amer. med. Ass.*, **75**, 1035.
 Schlesinger, B. E. (1930). *Arch. Dis. Childh.*, **5**, 411.
 Sheldon, W. (1931). *Lancet*, **1**, 1337.
 Small, J. C. (1927). *Amer. J. med. Sci.*, **173**, 101.

ACUTE EPIDURAL ABSCESS

BY

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Recorded cases of acute epidural abscess are still uncommon, and even more rare are reports of recovery. Hence I feel justified in describing one further successful case.

Dandy in 1926 collected twenty-five cases from the literature; of these, four were diagnosed during life, two ending in recovery, the mortality therefore being 50 per cent. Abrahamson, McConnell, and Wilson in 1934 were able to collect records of sixty cases. Operation had been performed in thirty of these, with survival in twenty—a total mortality of 66 per cent. In many of those operated on the recovery was incomplete. Craig and Doyle, who in 1932 reported a case in which operation was successful, came to the conclusion that up to that time Pulvirenti's was the only authentic case of complete recovery. Incorrect as this statement appears to be in view of MacDonald's case report in 1928, it shows how extremely small must be the number of cases where full recovery has followed operation. It will thus be seen that the prognosis in the untreated case is uniformly fatal. There is no recorded instance of recovery without the aid of surgical intervention.

Pathology

The epidural space exists only on the dorsal aspect of the dura, and is present from the seventh cervical to the second lumbar vertebra. It contains a quantity of loose areolar tissue, which, in common with similar tissue elsewhere, is slow and ineffective in combating infection. The dura anteriorly is in close apposition to the canal throughout its length. Infection, therefore, is usually found in the dorsal space, except where osteomyelitis of a rib or vertebra, or extension from an extrapleural abscess, is the cause. Once the infection has entered the epidural space rapid spread would be expected, and in most of the published cases the space was widely infected, necessitating removal of many laminae. However, sometimes a circumscribed form of abscess occurs, and it is reasonable to suppose that most cases go through a stage where infection is localized and therefore more amenable to surgery.

Softening of the cord is a common finding in cases which come to necropsy, and it has been suggested that this is due to toxins travelling in by way of the nerve roots, or to ischaemia following on a thrombosis of the vessels, as the changes are much more than can be explained by mere mechanical compression. The organism in the reported cases has been either *Staphylococcus albus* or *Staphylococcus aureus*.

Aetiology

Cases fall into three groups: (1) those where extension from a neighbouring source of infection can be traced; (2) those arising by metastasis from a distant infection; (3) those in which no primary focus can be demonstrated. Trauma is mentioned by several writers as an inciting agent, but it is difficult to prove that it is.

Diagnosis

Diagnosis may present difficulties, but writers are unanimous in stressing the appearance of early and persistent pain localized over the site of the abscess or radiating along the nerve roots. Temperature varies, but

it is usually indicative of an infective process. Motor symptoms may take several days to appear and then develop slowly, or, on the other hand, a complete paralysis of the lower limbs may occur in a few hours. In some cases the toxæmia seems to have so overwhelmed the patient that paraplegia has not had time to develop before death. The paralysis may be partial or complete, and of flaccid or spastic type. Probably most cases go through a stage of spasticity with increased tendon reflexes and extensor plantar responses. Sensation in the reported cases varies from widespread anaesthesia to little or no disturbance at all. It has, however, in several instances given the clue to the position of the abscess. Localized oedema over the tender area is mentioned by a few, and is probably found more often than reports would indicate. Usually the sphincters are affected, and retention of urine may be a comparatively early sign.

Clinically, therefore, the diagnosis is based on: (a) pain over and in the spine, with or without root radiation; (b) variable signs of toxæmia; (c) a variable degree of cord lesion. Of these, the first-named is the most constant, but the case may present itself with any one of the three signs as the outstanding feature. Radiographs are of no value unless there is an accompanying osteomyelitis of a rib or vertebra.

Lumbar puncture at the usual site should be performed; this may reveal pus from the abscess, xanthochromia and increased protein, or a normal fluid which may or may not be under tension. Puncture at the site of maximum tenderness, while it may yield valuable information, is not without danger. It should be borne in mind that if the subarachnoid space is not obliterated by the abscess pressure it will be very easy to introduce infection and start a purulent meningitis. Lipiodol is advocated as an aid to diagnosis, but its value seems limited, and it may serve only to prolong the pre-operative period and so prejudice the patient's chance of recovery. The more severe pain and tenderness, with the evidence of spinal block, differentiates acute epidural abscess from myelitis, thrombosis, and embolism. Examination of the cerebrospinal fluid, and the different type of pain, eliminate meningitis and poliomyelitis. Stiffness of the neck and a positive Kernig sign are found in many spinal conditions, and help very little with the diagnosis.

Treatment

Treatment consists in early and adequate drainage by laminectomy. Where the infection is widespread the extensive removal of laminae, as done in some of the published cases, seems hardly justified in view of the extremely poor prognosis. In the case of local collections of pus the removal of one lamina is probably sufficient.

Complications and Prognosis

All writers emphasize the extreme acuity of the condition and the rapid deterioration of the patient where surgery is either not employed or is delayed until the infection is generalized and septicaemia established. Without operation all the patients die of extreme toxæmia, septicaemia, or meningitis in one to three weeks.

Prognosis obviously depends on (1) the virulence of the infection; (2) the resistance of the patient; and (3) the stage at which operation is performed. Where the operation is done early and the infection is found to be localized, full and complete recovery may be expected.

Case Report

The patient, a girl aged 15, was admitted to hospital on September 15, 1937, complaining of pain in the back and

headache. She was at work on September 12, but had to leave on account of pain low in the back and a feeling of weakness in the legs. Appetite was poor, the bowels were constipated, and when admitted she was unable to void urine.

Examination.—On admission her temperature was 101° F. and pulse 90. There was no demonstrable focus of infection, and nothing abnormal was found in the heart and lungs. The pupils were equal and reacted to light and accommodation. The cranial nerves were normal, as were the upper arms. Abdominal reflexes were absent. The lower limbs showed marked rigidity. Kernig's sign was positive, knee- and ankle-jerks were very exaggerated on both sides, and there was a bilateral extensor plantar response. No hyperaesthesia or loss of sensation was observed. The abdomen was distended and the bladder well above the pubis. Tenderness was present over the second lumbar vertebra, with some redness and oedema of the overlying skin. The bladder was catheterized and 40 ounces of urine were drawn off. Lumbar puncture between the second and third lumbar vertebrae resulted in 3 c.cm. of pure pus.

A few hours later, as pain and paralytic symptoms seemed to be on the increase, a diagnosis of acute epidural abscess was made and operation decided upon. In order to eliminate a purulent meningitis, cisternal puncture was performed after the patient was anaesthetized, and as the fluid was quite clear, though under considerable tension, it was decided to proceed with the laminectomy.

Operation.—This was performed under open ether anaesthesia, and consisted in removal of the first, second, and third lumbar spinous processes and the second lamina only. Pus welled up immediately the extradural space was opened, and seemed to come from under the third lumbar lamina rather than from under the second. At this stage it was thought that the third lumbar lamina should be removed as well, but when the forceps broke under the considerable pressure needed it was decided to be content with the drainage already provided. The dura was thickened and was covered by granulation tissue, and all subarachnoid space seemed to have been obliterated by the abscess pressure. No pulsation of the dura was noticed. A thick rubber tube of one inch diameter was inserted, resting on the cut-off laminar processes, the muscles and skin being sutured loosely around it.

Subsequent History.—The patient was nursed on her face on a water-bed, and the bladder catheterized twice daily for five days. Cystitis was prevented by the use of cystopurine and full aseptic precautions in catheterization. On the day following the operation the patient was completely comfortable, and remarked that her previous pain had gone. Incontinence of urine took the place of retention on September 20, and this was accompanied by incontinence of faeces as well. The latter ceased on September 28, and normal bladder control was resumed on October 5. Spasticity of the legs with exaggerated jerks and extensor plantar responses continued till December 14, and on discharge from hospital the reflexes were normal and the patient walked with a normal gait. Massage and electrical stimulation of the muscles prevented gross loss of muscle tone, and enabled the patient to walk six weeks after operation. Discharge from the wound was considerable at first, but soon ceased, and the drain was removed on the sixth day. Temperature was never above 101° F., and fell to normal sixteen days after operation. The pulse varied from 90 to 100, but settled with the temperature.

The patient was discharged on January 6, 1938, with a small granulating wound and slight serous discharge. When last seen on January 20 there was still a small granulating area, but the patient felt well and had resumed her full activities.

Pathological Examinations

Urine.—Acid; specific gravity 1010; no albumin, sugar, or organisms.

Pus from Abscess.—Pus cells and numerous Gram-positive cocci were present, but *B. tuberculosis* was not found. A pure growth of *Staph. aureus* was obtained after aerobic cultivation at 37° C.

Cerebrospinal Fluid from Cisternal Puncture.—White cells, 23 per c.mm.; red cells, *nil*. Differential count: small mononuclears, 20 per cent.; large mononuclears, 80 per cent.; polymorphs, *nil*. *B. tuberculosis* was not detected, and no growth was obtained after aerobic cultivation at 37° C.

The Wassermann reaction was negative, and the blood sedimentation rate 22 mm. per hour on October 26, 1937, and 11 mm. per hour on January 1, 1938.

Summary

1. A short review of the literature and an account of the condition are given.
2. A case is described in which early operation was followed by complete recovery.
3. The importance of full investigation in cases presenting severe and persistent pain in the back with motor symptoms in the lower extremities is stressed, in order to eliminate a diagnosis of myelitis or poliomyelitis, which would prevent an operation that might be the means of saving the patient's life.

BIBLIOGRAPHY

- Abrahamson, L., McConnell, A. A., and Wilson, G. R. (1934). *British Medical Journal*, 1, 1114.
 Allen, S. S., and Kahn, E. A. (1932). *J. Amer. med. Ass.*, 98, 875.
 Craig, W. McK., and Doyle, J. B. (1932). *Ann. Surg.*, 95, 58.
 Dandy, W. E. (1926). *Arch. Surg.*, 13, 477.
 Hisamoto, M. (1937). *Zbl. Chir.*, 64, 139.
 MacDonald, N. S. (1928). *J. Amer. med. Ass.*, 90, 1114.
 Mintzman, J. (1934). *British Medical Journal*, 2, 593.

SULPHONAMIDE CHEMOTHERAPY IN GENITO-URINARY (NON-GONOCOCCAL) INFECTIONS

BY

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During the past year I have treated with the recently introduced compounds containing the sulphonamide (NH_2SO_2) and aniline ($\text{C}_6\text{H}_5\text{NH}_2$) chemical chains upwards of 900 cases infected by various organisms. A preliminary report (Cokkinis, 1937) described my experiences in the treatment of gonorrhoea; below are recorded the results obtained with these preparations in non-gonococcal genito-urinary conditions. Experiences in their use for acute abdominal lesions and other surgical infections have also been extensive, but are not reported in this paper. They have, however, been of considerable interest, and although there have been enough failures and disappointments to show the limitations and difficulties of this form of treatment, the successes have been sufficiently numerous and striking to convince me that the new chemotherapy has very definite surgical possibilities which are worthy of further exploration.

The Drugs Employed

Sulphanilamide (syn., prontosil album, streptocide, sulphonamide, etc.).—In my hands this appears to have the widest range of use and to offer the greatest bacteriostatic activity. Unfortunately it is much the most toxic of all these compounds, and although haemolytic anaemia and agranulocytosis have not been my experience, the less serious toxic manifestations have proved extremely common, often troublesome, and occasionally alarming.

In surgical cases and after major operations (particularly abdominal and genito-urinary) the most troublesome toxic effects have been prostration (sometimes severe), gastric irritation, and cyanosis. I am now developing the conviction that sulphanilamide should not be given to debilitated patients or to major operation cases if a less toxic chemotherapeutic substance can be used, even though this may be of slightly lower bacteriostatic potency.

Prontosil Soluble.—This azo dye compound, which I have given by deep subcutaneous injection, has shown itself especially useful in operation cases, for it causes neither gastric irritation nor prostration. The only toxic effect I have seen with it is a slight cyanosis, and this in a very small proportion of cases. To obtain bacteriostatic action comparable to that of sulphanilamide it has to be given in rather large doses—for example, 30 to 50 c.cm. of the 5 per cent. solution daily.

Prontosil Rubrum.—Of this I have as yet had little experience.

Proseptasine and Soluseptasine.—These are remarkably free from toxic effects, but in my experience their bacteriostatic action has proved somewhat disappointing, and I have used them in only a few of my surgical cases.

Uleron.—This new disulphonamide product, which I am now trying extensively, has shown a bacteriostatic potency in infections by several bacteria, which include gonococci, streptococci, and coliform bacilli. In 100 cases of gonorrhoea (not reported here) and in a smaller number of surgical cases it has been extremely well tolerated and has shown no immediate toxic effects. The absence, following its use, of such symptoms as prostration, cyanosis, gastro-intestinal irritation, and cardiovascular effects makes it particularly suitable for debilitated and seriously ill patients—for example, after major operations. One disadvantage, however, should be mentioned. This is the possibility of the appearance of toxic peripheral neuritis of a curiously constant and symmetrical motor distribution (adductors and opponens pollicis, interosseous muscles of the hand, and flexors and extensors of the foot and toes). This has occurred in less than 4 per cent. of my cases, and only when the drug was continued over a period of weeks. There is good reason for supposing that if administration is limited to a few days this toxic effect will not make its appearance even when large enough doses are used to obtain a rapid bacteriostatic action. Though uleron, for the reason given above, should not be used for long periods, I believe that, employed judiciously, it may prove to be the non-toxic substitute for sulphanilamide which I have been looking for, although on the whole it appears to be less potent.

In debilitated cases, and those suffering from a severe surgical illness or recovering from a major operation, when rapid bacteriostatic effect is required over a short period, the drug used should not add in the way of toxic manifestations to the strain already imposed on the patient. For this purpose I have employed prontosil soluble in the past, but I am now combining it with uleron, with promising results. When, however, a bacteriostatic action is required for longer periods—that is, more than a week or ten days—I still believe that sulphanilamide, however toxic it may be, is the best and safest substance to employ in most infections by sulphonamide-susceptible organisms.

A total of fifty-seven genito-urinary cases have been treated. These can be divided into three main groups: (a) non-gonococcal genital infections (thirty cases); (b) "primary" urinary infections (twelve cases); and (c) "secondary" urinary infections (fifteen cases).