before evacuation. His condition when evacuated was quite satisfactory. He was still jaundiced, wasted, and anaemic. He stated that he felt quite well, and was apparently convalescing rapidly. When last heard from, on December 27th, 1916, he was up and expecting to be discharged from hospital in a few days.

CEREBRO-SPINAL MENINGITIS.

PRELIMINARY NOTE ON CERTAIN PATHOLOGICAL FINDINGS
AND THEIR BEARING ON TREATMENT.

BY

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OVER a year ago the results of *post-mortem* examinations on our fatal cases of cerebro-spinal meningitis gradually impressed upon my colleague, Captain A. Charles E. Gray, R.A.M.C., and myself the importance not merely of the mechanical blocking of the outflow of cerebro-spinal fluid from the cerebral ventricles by fibrino-purulent exudate in the region of the foramen of Magendie, but also of the actual, and in many cases widespread, involvement of the ventricles themselves in the inflammatory process. In practically every fatal case so examined the cerebro-spinal fluid in the whole chain of ventricles was found to be turbid—often considerably more so than the fluid outside the brain and in the spinal canal. Flakes of fibrino-purulent material were often present in the fourth and lateral ventricles, even in cases where little dilatation had yet occurred, whilst in cases in which hydrocephalus was supervening the inflammatory process was frequently more marked than on the external meninges. Microscopical examination of the fluid and fibrino-purulent exudate from the various ventricles usually showed large numbers of meningococci, sometimes in such numbers as to suggest the appearance of a "culture" of the organism. In many of these cases meningococci had become scanty or had disappeared from the fluid obtained by lumbar puncture during the clinical course of the case, and the important bearing of this finding upon treatment was early impressed upon us. After careful discussion with us, Major Lee, surgeon to the hospital, a year ago performed ventricular puncture upon several of the most serious cases, with a view to relieving the ventricular condition, and giving the patient a last chance of recovery. In the ventricular fluid so obtained meningococci were found in large numbers.

A second point of interest in connexion with the blocking of the outflow of fluid from the ventricles is that congestion and swelling of the brain substance, as well as blocking of the foramina in the roof of the fourth ventricle, may play a part in its production by forcing down the cerebellum into the foramen magnum around and in close apposition to the medulla, so that the foramen is sometimes blocked up as by a cork. The more the swelling of the brain increases, and with hydrocephalus also supervening, the more firmly is this "cork" forced down into the foramen, and the less possibility is there of relieving the pressure by lumbar puncture or any form of spinal drainage. In such cases I would strongly urge the advisability of ventricular puncture and drainage, as well as the introduction of antimeningococcal serum directly into the lateral ventricle, a procedure which Major Lee contemplates carrying out on a more extensive scale than heretofore. This should be done not merely in moribund cases as a last resort, but be thought of in cases in which, often after a preliminary improvement, cerebral symptoms increase. In such cases the examination of the fluid obtained by lumbar puncture alone may lead to an erroneous impression of improvement. Inflammatory cells may become less numerous and more mononuclear in character, meningococci may disappear, and yet the cases do not improve in a corresponding degree. *Post-mortem* examination may show in such cases a "clean" spinal cord but the ventricular infection above described. Nor need there be actual complete blocking by exudate of the foramina in the roof of the fourth ventricle to produce this result, though of course it is a common factor. Captain Gray has occasionally observed that relief of the cerebral pressure, probably by amelioration of the condition and subsidence of the swelling of the brain tissue, may

allow of fluid being drawn off by lumbar puncture where previously little fluid could be obtained—possibly by releasing the cerebellar plugging of the foramen magnum. It appears possible that in certain cases of this nature, while the pressure within the skull remains high, drawing off fluid from below may actually aggravate the condition by pulling the cerebellum still further down against the medulla.

Another point which we investigated over a year ago was the facility with which fluid introduced by lumbar puncture gained access to the meninges and ventricles. In several cases of meningitis and also in non-meningitic cases, as soon after death as possible, we injected a strong solution of methylene-blue by lumbar puncture, under conditions as regards amount, pressure and position as closely as possible approximating to the clinical injection of antimeningococcal serum. We found that, in non-meningitic cases and in meningitic cases without blocking of the openings in the epithelial and pial roof of the fourth ventricle, the 30 c.cm. of fluid injected at 15 in. of water pressure ran readily up the spinal canal and over the surface of the brain to the vertex and inner aspects of the cerebral hemispheres, and also into the chain of cerebral ventricles, reaching to all the tips of the horns of the lateral ventricles. On the other hand, where the foramina were blocked, the methylene-blue either penetrated only very slightly into the fourth ventricle or not at all, even though the surface of the brain was reached by the fluid. In one case, where there was extensive basal fibrino-purulent exudate and "corking" of the foramen magnum, scarcely any staining of the cerebellar and cerebral meninges occurred.

In a large number of cases examined *post mortem*, extensive softening of the spinal cord was found—most frequently in the upper dorsal, or upper dorsal and lower cervical region.

Several cases of the "serum reaction" which occurs in the cerebro-spinal fluid in non-meningococcal cases (tuberculous and syphilitic) in which antimeningococcal serum had been administered have come under my notice. These were punctured outside the hospital, and the serum administered before admission. On the day following such injection of serum the cerebro-spinal fluid withdrawn by lumbar puncture was turbid (in the tuberculous cases markedly so), and on microscopical examination was indistinguishable cytologically from the exudate of cerebro spinal meningitis, a well marked polymorphonuclear reaction occurring early, followed by progressive increase of mononuclears and phagocytic phenomena, etc., completely masking the real pathological condition. It was usually a matter of difficulty to obtain a sample of the first lumbar puncture fluid removed outside, but when this was possible the comparison was interesting and instructive, and often cleared up the doubtful diagnosis. The serum reaction of the cerebro-spinal fluid in meningococcal cases is also very interesting and important, but is beyond the scope of the present note, and I merely mention one of the most outstanding phenomena—namely, the bringing out into the fluid of a fresh "crop" of cells, mainly polymorphs, so that one can distinguish what I have termed double or even triple "broods" of cells—one fresh and undegenerated, staining well, another degenerated and undergoing "phagolysis" in various ways, and perhaps the third almost disintegrated—these crops corresponding to the reactions following the various injections of serum. This reaction appears to vary somewhat with the special brand of serum used.

In addition to the injection of antimeningococcal serum, washing out with saline, etc., we have on various occasions experimented with the injection of sodium citrate with a view to the prevention of the formation of fibrin, and of ensol as an antiseptic, but our results have not so far been sufficiently encouraging to allow of our publishing details. We hope to try the effect of flavine injections as soon as a sample of that substance is at our disposal.

NOTE.—Since the above was written Captain Gray has injected several cases with flavine. The results will be published later.

ON March 7th the American Codes Committee threw out bills intended to legalize the dissemination of birth control literature throughout New York State.