Technical Papers

Spinal Cord Circulation in Poliomyelitis

NORMAN NELSON
Department of Public Health, University of California at Los Angeles

A promising phase of research in poliomyelitis, so obvious as to have been completely overlooked, should no longer be neglected. Overwhelming evidence exists that disturbed circulation of the spinal cord is one factor in the production of paralysis in poliomyelitis; yet no real attempt has been made to alter the outcome of poliomyelitis by altering the circulation of the cord.

Years ago W. Lloyd Aycock (*1*) described edema of the spinal cord as one of the major pathologic findings in poliomyelitis and suggested that the large eventual recovery from the paralysis of the acute state of poliomyelitis might be due in part to subsidence of this edema. Yet what does edema mean? Every physician knows that edema, whether local or generalized, means some sort of circulatory disturbance. The perivascular infiltration seen in sections of the cord in poliomyelitis also points to circulatory involvement.

That the circulation of the body is intimately tied in with the sympathetic nervous system has been known for many years. In acute poliomyelitis localized areas of sweating, indicating involvement of the sympathetics, may be seen.

It is a well-established fact that postpoliomyelitis paralytics frequently have markedly disturbed circulation in the involved extremity. In fact, the majority of these paralyzed extremities are cold and extremely susceptible to temperature changes. It has also been suggested that the lack of growth and relative shortening that sometimes results in extremities paralyzed from poliomyelitis may be due to this circulatory inadequacy.

DISTRIBUTION OF PARALYSIS

The paralysis of poliomyelitis, while varying from individual to individual, shows a remarkable constancy when one group of cases is compared with another. Legs are more frequently involved than arms; arms more than trunks, etc. In fact, certain muscles of the leg (*i.e.* the anterior tibials and peroneals) and certain muscles of the arm (*i.e.* the deltoid) show a special predilection to become paralyzed in poliomyelitis. For years it has been explained by the superficial suggestion that the anterior horn cells of the different parts of the cord vary in their susceptibility. It seems more reasonable that the anterior horn cells of the cord vary in their environment (for instance, circulation) rather than in their intrinsic nature.

A consistently characteristic distribution of paralysis in poliomyelitis that also demands explanation and points even more to circulation as a factor in determining the ultimate residual paralysis is the significant predominance of paralysis in the left arm over the right as contrasted to equal paralysis in both legs. In a study of the distribution of paralysis in 1,200 poliomyelitis patients at the Harvard Infantile Paralysis Clinic (1925–41) (*3*), the writer found a statistically significant preponderance of paralysis in the left arm. This difference was greatest with completely "gone" muscles (Fig. 1).

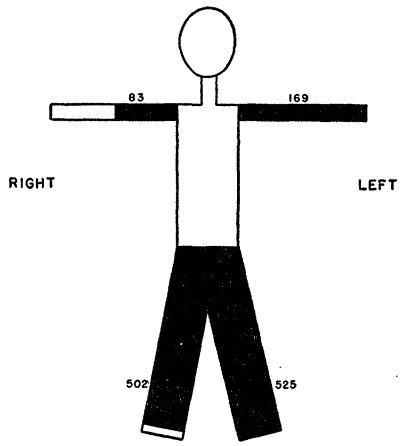

FIG. 1. Number of "gone" muscles, left and right, in 1,200 poliomyelitis paralytics (extremities only).

Robert W. Lovett, of Harvard University, dean of American orthopedists, in 1915 (*2*) called attention to this predominance of paralysis in left arm over right and pointed out that, whereas under the age of 5 years left and right arms were equally involved, from 6 to 38 years of age (when right-handedness is better developed) there were three left arms involved for every right arm. Ivan Wickman (*4*) in 1913 described this same preponderance of paralysis in the left arm over the right.

Further careful analysis of the distribution of paralysis in poliomyelitis brings out these facts: Although better than 95 per cent of all cases of poliomyelitis have at least one extremity which escapes paralysis, *"when an extremity is involved at all, more than two thirds of its muscles on the average show demonstrable paralysis* three weeks to three months after onset" (*3*). Why should the muscles in one ex-

tremity be so completely involved when other entire extremities in the same individual have completely escaped? "It would seem that all of the anterior horn cells of an extremity are probably affected together, with the resulting paralysis depending on intrinsic factors, such as blood supply, pressure from edema, or activity" (*3*).

Localization of Paralysis

There have been many peculiar individual occurrences of localization of paralysis in poliomyelitis, each of which might be well explained as a coincidence, but all of which, when accumulated, can be explained by the common factor of alteration of circulation. A few examples follow:

In the *Journal of the American Medical Association* for 8 September 1945, Brown, Francis, and Pearson describe a peculiarly significant occurrence of poliomyelitis in a child 19 days after the virus of poliomyelitis was first isolated from his stools. Although this child was harboring the virus for 19 days (the usual incubation period is 7–14 days), he remained well until immediately after a canoe race in which his arms were used as paddles. That evening he developed paralysis only in his arms. To deny the significance of association between the canoe race and the development of paralysis in the arms, one would have to postulate two unusual simultaneous coincidences: (1) the onset of paralysis immediately after the canoe race in a child infected at least 19 days previously; (2) the limitation of paralysis to the extremities used, the arms (a relatively rare distribution of paralysis in poliomyelitis).

A recent case of poliomyelitis in Los Angeles developed his only paralysis in a leg which four months previously had had a compound fracture and in which a plate had been inserted to hold the femur. Obviously, such an accident and surgical procedure would alter the circulation of that extremity.

The writer in his personal experience has seen three individuals develop poliomyelitis within 14 days of an immunization procedure, with its usual subsequent localized edema and induration, residual paralysis remaining only in the extremity in which the inoculation occurred.

The peculiar localizing effects of definitely established trauma or overactivity on the paralysis in such cases force one to consider seriously the common factor of circulatory disturbance as a determining factor in the development of paralysis.

Recent attempts to explain the action of Sister Kenny's therapy have revealed that interference with the circulation of the cord of the dog causes damage to the internuncial cells similar to that seen in poliomyelitis.

Alteration of Spinal Cord Circulation in Poliomyelitis

We are attempting in Los Angeles to alter circulation of the spinal cord in animals and humans with poliomyelitis, with a view toward altering the course of the disease. The paravertebral block is one method being tried.

A successful paravertebral block will, of course, increase the circulation of an extremity. That the circulation of that part of the cord supplying that extremity is increased has not as yet been shown. We are, however, proceeding for the time being on the inference that the extremity and that part of the spinal cord supplying the extremity operate as a single physiological unit, and anything which alters the circulation of the extremity will also alter the circulation of the cord involved.

It should be clearly understood that this is merely a preliminary report of work going on, made with the hope that it will stimulate others to investigate this field. Our results are too inadequate to warrant any conclusion that paravertebral block is a treatment for poliomyelitis. We do feel, however, that similar studies to determine the effect of alteration of circulation on residual paralysis and muscle spasm are indicated by much evidence.

Conclusion

A careful analysis of the distribution of paralysis in 1,200 cases of poliomyelitis and localizing effects of trauma or strain points toward alteration of the circulation of the spinal cord as being a determining factor. The paravertebral block is being studied as one possible means of altering that circulation.

References

1. Aycock, W. Lloyd. *Science*, 1924, **60**, 85.
2. Lovett, Robert W. *J. Amer. med. Ass.*, 1916, **67**, 42.
3. Nelson, Norman B. Dr.P.H. Thesis, Harvard School of Public Health, 1942.
4. Wickman, Ivan. *Nerv. ment. Dis. Monogr. Ser., 16*, 1913.

The Effect of Thiouracil and Thyroactive Substances on Mouse Susceptibility to Poliomyelitis Virus[1]

D. Frank Holtman

Department of Bacteriology, University of Tennessee

An investigation of the effect of environmental temperature on the resistance of Swiss white mice to poliomyelitis virus (*1*) suggested that the marked tolerance of these animals to the infectious agent, when acclimated to low temperatures, might be due to an altered metabolic rate of their tissues, inter-

[1] The writer wishes to acknowledge the technical assistance of H. R. Neal in certain phases of this investigation.