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Ligation of the Common Carotid Artery for  
Trifacial Neuralgia with Experiments  
and Observations upon Dogs.

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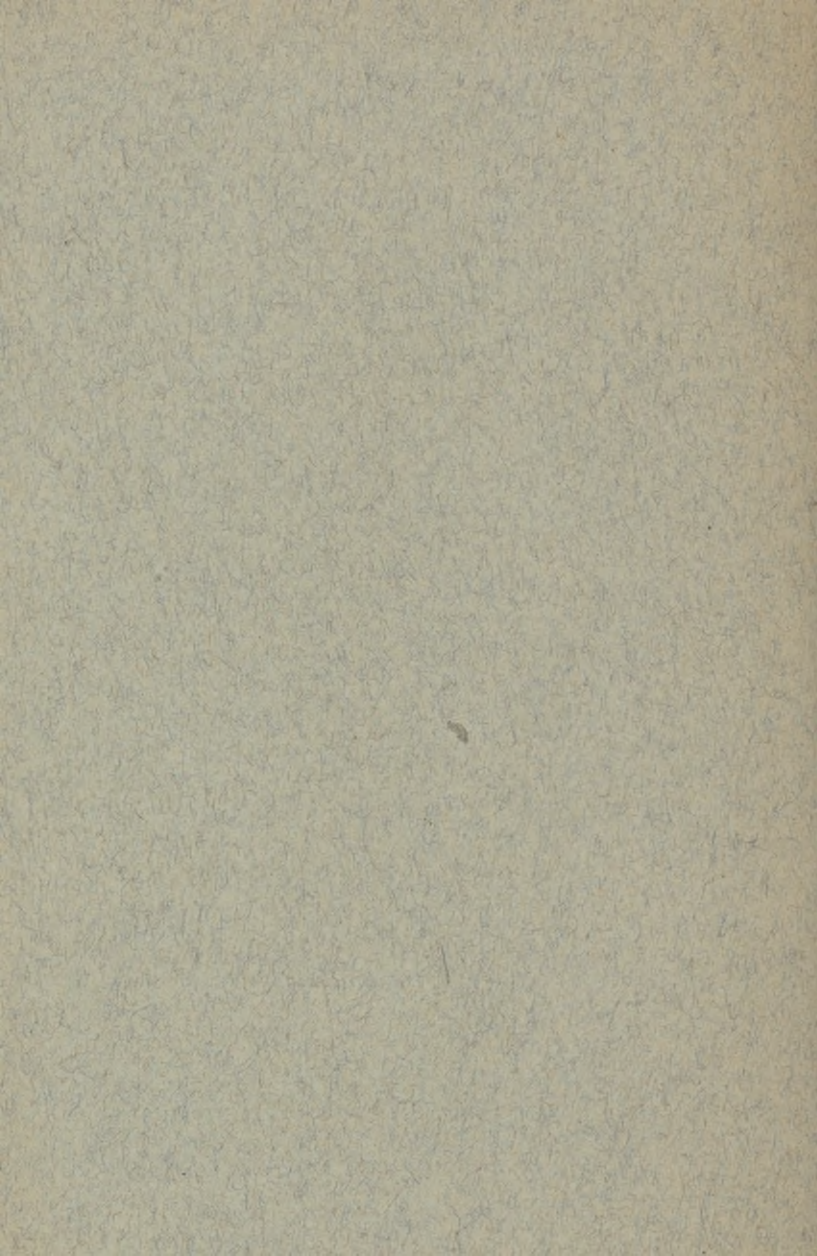
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LIGATION OF THE COMMON CAROTID  
ARTERY FOR TRIFACIAL NEURALGIA  
WITH EXPERIMENTS AND OBSER-  
VATIONS UPON DOGS.

BY B. MERRILL RICKETTS, PH.B., M.D.

The frequency, severity and want of remedial relief from trifacial neuralgia has prompted a most extended research, not only into the literature but also the pathologic conditions of the minute structures involved, as determined from an experimental point of view; and as a report of the case operated upon by myself in July, 1896, was made within several weeks of the operation, I will make but casual mention of the condition found within those few weeks. It is, however, gratifying to state that the good results derived from that operation have been permanent.

Before entering upon the experimental feature it is necessary to understand that the anatomy of the dog is practically the same as that of the human being. Especially is this so in reference to the arterial and nervous system of the head and neck, and even the sympathetic system in this region is but little, if at all, dissimilar to that in man. Literature is not wanting in evidence that the common carotid artery may be ligated in almost any pathologic condition with impunity, but recorded observations are few concerning this procedure as a means of relieving neuralgia of the fifth nerve.

English, German and French investigators have each contributed comments that are highly interesting.

Trousseau did the operation, but Nussbaum was the first, losing the case on the third day by hemorrhage, while case 2,—

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(March 9, 1862, F., aged 22), recovered with slight paresis in the affected side, which disappeared on the fourth day with return of pulsation; he does not say whether this case again experienced pain.

*Case 3.*—Male aged 40 years, duration many years, was operated on October 30, 1862. Stupor lasted for eight days, then sudden return to consciousness without pain. Complete paralysis occurred on the side operated on within twelve hours, lasting four weeks, when sensation returned, followed slowly by motion, relief from pain being constant.

*Case 4.*—F., aged 38 years, duration nine years, had operation November 8, 1862; no result.

*Case 5.*—F., aged 60 years, was of several years' duration. Various other operations had been made. Ligation resulted in cure. Atheroma at bifurcation.

*Case 7.*—Female, five children, operation September 14, 1865. Cured. Died 1876; no return.

*Case 8.*—Male, aged 45 years, ten years' duration. Ligation June 30, 1877. This is the third time this case has been reported cured (Fowler).

*Case 9.*—Male, aged 41 years, operation keratitis; lost eye.

*Case 10.*—Young, hyperemia of side of face. Ligation; instant relief. No recurrence sixteen years later.

*Case 11.*—Female, aged 32 years, right side, hyperemia of face and scalp; ligation; immediate and permanent cure.

*Case 12.*—F., aged 63 years; ligation; cure.

*Case 13.*—Only temporary relief even after dividing nerve at foramen rotundum.

*Case 14.*—Male, relief eleven months, then divided at foramen rotundum with complete cure.

*Case 15.*—A monk, eight years' duration, hyperemia and burning right side of face, head and neck. Died with erysipelas.

*Case 16.*—Male, aged 49 years, thirty years' duration; ligation; no relief.

*Case 17.*—Male, aged 64 years. Ligation, then neurectomy of inferior dental nerve; permanent cure.

*Case 18.*—Parotid tumor removed without relief. The scar pressure gave occasional relief. Ligation of common carotid gave complete cure.

The ophthalmic is the branch most frequently the seat of pain, and the superior maxillary next in frequency. The origin may be either central or peripheral or both.

*Causes.*—While anemia has been ascribed as being perhaps the most common factor in producing pain in this lot of nerves as in others, it must be remembered that any degree of anemia from any cause may exist

without pain in any part of the body. Congestion is also a most potent factor in causing pain, and why not in connection with this ganglion and its branches? The right ganglion is the most frequently affected.

These conclusions are derived from my personal observations. However, there are no apparent reasons why one should be affected more frequently than the other, their anatomic relations being identical.

The first branch passes through a bony canal, and makes its exit through a hole or fissure, which fact creates a reasonable probability that the channel may often be narrowed by exostoses or thickening of the periosteum, either of which would cause pain. To meningeal adhesions it is also an easy matter to assign the cause of trifacial neuralgia, and especially may this be so in circumscribed meningitis about the ganglion. Lying as it does between the dura and the bony ridge and the petrous bone beneath the dura, it is readily conceived that adhesions to the dura or adhesions of the dura to the bone would probably produce pain. Then, too, the weight of the brain pressing upon the ganglion which rests upon a bony foundation, may be found to add to the environments conducive to pain. This is the only ganglion which rests upon bone. Middle ear inflammation and fracture of bones associated with the ganglion and nerves may produce either anemia or congestion sufficient to give rise to pain.

*Experiments and operations on dogs.*—Assisted by Drs. P. C. Logue and P. M. Ashburn. Before entering upon these cases it may be well to give a brief description of the vessels and nerves in the neck, head and face of the dog.

The analogy existing between man and dog as respects these structures is very striking indeed. The carotid artery in the right side arises from the innominate, and on the left side from the arch of the aorta as in the human subject, and pursues a very similar course, inclosed in its sheath and accompanied by the internal jugular vein and pneumogastric nerve. The

size of the vessel is very much smaller in proportion to the size of the animal possessing it than would be expected, and bifurcation takes place at a much higher level than in man. After division the external carotid gives off its branches, position and distribution very similar to the external carotid in man. The internal carotid is also given off at a higher level and appears more as a branch of the external carotid than as a bifurcation of that vessel. It arises from the external carotid at about the level of the hyoid bone, and after passing upward and backward deeply seated beneath the muscles of the neck, enters the carotid canal in the petrous portion of the temporal bone to reach the cranial cavity. The only portion of the vessel that is of very great interest as respects these experiments is the intracranial portion. After entrance into the cranial cavity the artery passes close to the inner side of and below the Gasserian ganglion, giving off one or two and in some cases three delicate twigs to supply it. The middle meningeal branch of the internal maxillary also passes to the inner side of the ganglion and supplies it with arterial blood.

After ligation of the common carotid artery it was hoped that there would be some possible diminution in the size of the vessels, especially those supplying the ganglion above the point of ligation, but this was only apparent in two cases out of the six operated on.

Enough has been said about the gross anatomy of the arteries, and with a brief description of the fifth nerve and its ganglion. I will close this part of the subject. The origin, course, division and distribution of the fifth nerve in the dog is so very like that in man that only light mention will be made of it. The deep portion of the nerve passes over the superior border of the apex of the petrous bone to form the Gasserian ganglion, after which the three branches are given off and make their exit from the skull through their respective foramina. The Gasserian ganglion lies at the apex of the petrous bone on its

anterior surface external to the dura and is exceedingly large, even in dogs of small size.

The technique of the operation was as follows: After etherization (dogs tolerate this anesthetic much better than chloroform) an incision was made in the line of the common carotid, the sternocleidomastoid muscle affording an easy guide to the position of the vessel. After exposure the artery was ligated with silk-worm gut and the skin incision closed by a running suture of the same material. No antiseptic precautions were taken, and in all cases primary union was secured. Apparently the animals suffered but the slightest shock from the operation, as they were up and about a few moments afterward. The time they were allowed to live after the ligation varied from two to eight weeks. The injection used for dissection, with a few modifications by Dr. Layne, my house surgeon, who made the dissections, was given me by Professor Lewis, Professor of Anatomy in the Cincinnati College of Medicine and Surgery, to whom I am indebted for this valuable and novel procedure. The basis of the injection is ordinary corn starch in the proportion of a pound of starch to a pint of water, to which is added anilin in sufficient quantity to give the desired tint. Instead of using water alone, alcohol and water in equal parts was substituted and found to be more efficacious, as the alcohol does away with the necessity of a preservative and it is also possible to throw a larger quantity into the vessels and thereby secure a more perfect injection of the subject. The alcohol is taken up much more quickly by the tissues than is the water, and in a very short time (ten minutes) the starch has hardened sufficiently for work. The injection secured by this method is the best I know of, the smallest capillaries being readily permeated by the fluid starch, an end which is not easily attained with parafin, wax, etc. Dissection was begun as soon as the injection had hardened, and the following observations noted:

*Experiment 1.*—Ligation of the common carotid of two

weeks' duration; vessel obliterated for a short distance above and below the ligation, no apparent alteration in size of trunk or branches above this point; brain beautifully injected on both sides.

*Experiment 2.*—Dissection at the end of three weeks; vessel occluded at point of ligation; no change different from Case 1.

*Experiment 3.*—Dissection on the twenty-fifth day; no noticeable alteration in size of vessel above point of occlusion.

*Experiment 4.*—Dissection on the thirtieth day; vessels on the side opposite the ligation manifestly enlarged, especially the infra-orbital branch of the internal maxillary.

*Experiment 5.*—Dissection at the end of the fifth week. No perceptible change in the size of the vessels on either side.

*Experiment 6.*—Dissection at end of eighth week; vessels on opposite side of ligation perceptibly enlarged.

It will be seen that nothing of value in so far as diminution of the size of the vessel is concerned was gained from the above experiment. This must be attributed to the free anastomosis that exists both inside and outside the cranial cavity in the dog. It was found that after ligation of both common carotid arteries the brain could be perfectly injected, the fluid readily passing through the cerebral arteries. The starvation theory is therefore not tenable, and something else must be sought as the cause of cure after ligation of the common carotid artery.

The microscopic examination of the ganglion of Gassa was made by Dr. D. I. Wolfstein, who writes the following:

May 30, 1897.

*Dear Dr. Ricketts:*—The specimens you gave me to examine, in which you wish to know whether there was any evidence of structural change or any difference in the appearances, were duly stained. The specimens were the Gasserian ganglia, the presumably abnormal one being tied with a piece of string. They were stained both with thionin and with hematoxylin and both showed perfectly normal ganglion cells. With thionin, the usual beautiful differentiation of chromato- and achromatophilic substance seemed identical in both. I am unable to find any difference whatever.

D. I. WOLFSTEIN.

*Conclusions.*—1. Ligation of the common carotid without pathologic conditions is attended with but little danger.

2. It is safer, more certain and attended with fewer

serious consequences than any of the intercranial operations for trifacial neuralgia.

3. The causes seem to be either congestion or anemia.

4. When congestion, the relief is more certain by ligation.

5. The close proximity of the ganglion to the bone upon which it rests, and the weight of the brain upon it, together with localized meningitis, seem to explain in some degree the causes of anemia and congestion of the ganglion.

6. Cell structure of the ganglion is not changed by ligation of the carotid artery, and therefore can not be ascribed as the cause of relief from pain.

7. As the size of the blood vessels on the side ligated do not seem to be lessened at the end of eight weeks, the cause of relief evidently lies in the fact that the tension of blood is much lessened. The lessening of arterial tension in any congested area gives relief, and why not in this instance?

8. However uncertain the cause of pain or its relief may be, ligation of the common carotid for trifacial neuralgia is an established operation.





