The Use of Tetraethylammonium Chloride in Treatment of Phantom Limb

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The increased number of amputees resulting from World War II has undoubtedly produced many cases of phantom leg symptoms, a condition difficult to manage at best. One is tempted to try every available means to alleviate it, as will be seen in the case reported. In this instance tetraethylammonium chloride proved to be of some value.

Much has been written in regard to the treatment of phantom leg symptoms. It is readily conceded that there is no comprehensible explanation for the phantom illusion, yet this does not exclude the fact that there is such a symptom complex. After amputation of an extremity it is usual for the patient to have sensations which seem to originate in the absent limb. In the majority of cases these sensations are most vivid immediately after the amputation, and as time passes they tend to fade from consciousness. The painless variety of phantom limb does not long persist; after a few weeks it tends to melt into the stump and disappear. The painful form lasts longer, and ultimately the surgeon may have to intervene for the relief of these sensations.

The case herein reported was one which proved to be a very serious problem, both to the patient and the physician. The use of tetraethylammonium chloride was decided upon after all other accepted methods of treatment failed.

The report by Berry, Campbell, Lyons, Moe, and Suter reveals the value of tetraethylammonium chloride compared with lumbar sympathetic block, spinal anesthesia, and local nerve block in patients with vascular diseases and causalgia.

Case Report

L. G., a 77 year old man, was first seen in May 1946 complaining of pain, burning, and cold sensation of his right foot and toes. These symptoms had begun gradually about two years previously, but were becoming progressively worse. He was referred to a physician in Chicago who advised hospitalization for one month with complete bed rest, to be followed by amputation if no relief was obtained.

The patient was admitted to St. Therese Hospital in Waukegan, Illinois, on May 14, 1946. The essential physical findings at that time were as follows: blood pressure 150/90, pipe-stem radial arteries, and tortuous temporal vessels. The patient’s feet were cold, there was no dorsalis pedal pulsation, the toenails were hypertrophic, and there was evidence of a beginning gangrenous lesion on the tip of the right little toe. The electrocardiogram showed a right bundle branch block. HB, 82 per cent; R.B.C., 4,070,000; W.B.C., 6,500 per cu. mm. of blood. The fasting blood sugar value was 87 mg. per 100 cc. of blood. The Kahn reaction was negative. It was quite obvious that this man had an obliterating type of arteriosclerosis. In spite of bed rest, high vitamin diet, vascular exercises and pancreatic extract, he failed to show any evidence of improvement. During this stay in the hospital he required only two hypodermic injections of morphine for the relief of his pain. He refused to have the extremity amputated, and left the hospital on May 22, 1946. However, on June 10, 1946, he was readmitted because the pain was so severe that he readily agreed to amputation, which was performed on June 12. Amputation was done at the level of the junction of the middle and lower third of the right thigh. At the time of operation the nerves were injected with alcohol and were cut several inches shorter than were the muscles and stump. The patient made an uneventful recovery, and was discharged from the hospital on June 22.

On October 14, 1946, he was readmitted to the hospital because of the development of symptoms in the left leg similar to those originally present on the opposite side, with comparable physical findings. The same surgical procedure was followed in performing this left midthigh amputation. The patient left the hospital twelve days following this second amputation. Several weeks after this operation he developed severe burning sensations in his “toes” which seemed equally as painful as before operation. After the appearance of this symptom, numerous hospital admissions followed, during which attempts
were made to alleviate this most annoying condition. For the purpose of following the chronologic order of the hospital admissions, the dates were as follows: Dec. 13, 1946; April 14, 1947; Aug. 6, 1947. On Oct. 15, 1947, a sympathetic block was performed, followed by little or no relief.

The patient continued to have excruciating pain and choreiform movements of his stumps regardless of therapy. His daughter was shown how to administer the hypodermics and he was given \( \frac{1}{2} \) grain of morphine as required to relieve the pain. After several weeks the use of morphine had to be discontinued because of nausea. Pantopon and dilaudid each had their trial and afforded some relief of pain. The patient was becoming addicted to narcotics; he received as many as five and six injections daily. On each of the hospital admissions, an attempt was made to substitute placebos for the narcotic, but it always became necessary to revert to opiates.

At this point, it was decided to try tetraethylammonium chloride (Etamon), since the literature advocated its use in causalgic states. The patient was again admitted to the hospital on November 26, 1947, at 5:30 in the afternoon. A placebo given for relief of pain failed to produce any effect and frequent injections of Dilaudid, grain \( \frac{1}{16} \), were required. On November 28, six hours after the last opiate, while he was having excruciating pain, 2 cc. of tetraethylammonium chloride were slowly injected into the right cephalic vein over a period of five minutes. While the drug was being injected the patient stated that he noticed a sensation of warmth in his stumps, along with a complete cessation of pain. His blood pressure prior to receiving the drug was 180/74, and following the injection was 138/68. An electrocardiogram made during and immediately following the injection showed no change. He did, however, complain of a dry metallic taste in his mouth, which disappeared in a few days. On November 29, December 1, and December 6, he was given 6 cc. of Etamon intramuscularly. During the interval between these injections he received several hypodermic injections of sterile water for some slight discomfort in his stumps. Each of these placebos gave relief. We believe that these injections were required to satisfy the addiction phase of his complaints. However, at no time since his initial dose of Etamon was a narcotic required to alleviate pain.

He left the hospital on Dec. 8, 1947, free from any discomfort and continued to remain relatively comfortable for a period of nine months without the use of opiates.

In August 1948, he had some recurrence of pain, and again entered the hospital to receive a series of injections of Etamon. He is now free of any symptoms and at the time of this writing he is very comfortable.

**Discussion**

Autonomic blockade which produces alleviation of pain may do so by means other than by relief of vasoospasm alone. It is postulated by Coller and associates\(^2\) that many of the results observed in several series of cases might be explained upon the basis of altered tissue metabolism secondary to sympathetic block. The possibility of a vicious reflex arc being interrupted by ganglionic block with subsequent modification of the pain mechanism must, of course, be given due consideration. According to these authors, if such actually occurs, it still leaves unexplained the duration of relief of symptoms far outlasting the expected duration of the block. It is also possible that certain afferent pathways (if such exist) in the autonomic nervous system may be blocked by the injection of tetraethylammonium chloride and thus contribute to the relief of pain.

**Comment**

Perhaps some of the results in the case which has been reported may be explained on the basis of the work by Roberts\(^3\) who showed that the vasa nervorum, by being obliterated, may produce an ischemia of an involved nerve segment with resulting pain, numbness, tingling, paresthesia, and other disturbance of the extremity. Karnosh\(^4\) has attributed sciatic causalgia to ischemia of the sciatic nerve. Therefore, we may conclude that the same process that caused the original pathologic state, namely, obliterating arteriosclerosis, was also responsible for occlusion of the vasa nervorum. Thus we can postulate that amputation relieved the peripheral obstruction of the large vessel; it in no way affected the obstructing process in the nutrient vessel to the proximal remaining portion of the sciatic nerve. Since no definite satisfactory explanation for the cause of phantom leg has yet been offered, it is the author's opinion that the neuro-ischemic theory can best explain the causative factors in the greatest number of cases, especially since it has been shown that trauma, sepsis, and vascular diseases are the reasons for the greatest num-
ber of amputations, and are the causes for the involvement of the vasa nervorum. Postmortem examination of the nutrient vessels of the stumps of amputees who had phantom leg symptoms would offer additional information that would prove of great value.

This postulation would conform with the statement of Livingston: “The occurrence and persistence of severe phantom limb pain in a comparatively small proportion of the patients with phantom symptoms, suggests an irritative disturbance that is superimposed on the underlying phantom limb mechanism.”

SUMMARY

A case of severe phantom-limb pain is reported. The prolonged and severe pain was resulting in the patient becoming a morphine addict. After all other methods of treatment had failed, the use of tetraethylammonium chloride was attempted and a favorable result was obtained.

An explanation, based on the work of Roberts, is offered for the physiopathologic mechanism which may occur in the production of phantom limb disturbances.

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