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*Presented by the Author*

ELECTROLYSIS  
IN  
THORACIC ANEURISM.

BY  
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## THORACIC ANEURISM TREATED BY ELECTROLYSIS, WITH REMARKS THEREUPON.

BY HENRY I. BOWDITCH, M. D.

T. A. S., forty years old, was by occupation a chief engineer in the United States navy. His father died of inflamed bowels, his mother of carcinoma uteri. In 1851 he entered the United States navy. In general he had been tolerably well, though never very strong; he had never had any long illness, and did not remember ever having severely strained himself. Previously to calling on me he had for three or four years had a little palpitation. In 1869, while at Norfolk, Va., he felt "run down" and generally unwell. A widower, he married a young wife in January, 1872. A cough appeared in the following spring and lasted about ten days, and then suddenly disappeared. He raised, during these days, only a little froth, without blood at any time; but he could sleep only on his right side, because lying on the left side caused cough. During the following summer he considered himself as well as usual. He was able to walk as freely as ever until pulmonary symptoms reappeared three weeks before he called on me. At that time, one morning, when dressing, in the act of straightening his body in order to comb his hair, he was suddenly seized with a violent paroxysm of coughing, which could be relieved by gently bending forward his body; but it was renewed when he placed himself in an erect posture. This condition of things continued ten days, during which he was quite exhausted by the cough; it caused restless nights, and compelled him to lie upon the right side. His appetite, however, continued. He had no hectic. In about ten days the cough was much lessened; but meanwhile, as he expressed himself, "he had lost some flesh" and "all his strength," and "his wind was wholly gone." His wife had heard a kind of "clicking" in the throat, apparently above the collar-bone. He had given up all duty for ten days.

At his first visit to my study he was found to be a well-formed man with evident dyspnoea, not of the severest kind. He had a hard, dry cough. His pulse was 84 and not peculiar. He reported that usually he felt the best in the afternoon.

*Physical Exploration.* — The superficial veins of neck and chest were distended. A distinct rounded prominence was seen between the right



clavicle and the fourth rib. The intercostal spaces, however, were visible. The swelling was most prominent at the second rib, and at that part there was a distinct impulse with each motion of the heart. Semi-bronchial respiration was noted there, without râle. The whole of the prominence was flat on percussion, most so at the centre, and generally a little less sound in the right breast than in the left. Nothing peculiar about the heart. Save in the spot above named the lungs seemed well, front and back. Perhaps the right back had a little less sound on percussion than the left. Laryngoscopic and sphygmographic examinations revealed nothing definitely diagnostic. It appeared to me to be evidently a case of aortic aneurism, projecting from the arch towards the front and pushing forward the ribs. The limited locality in which the impulse was felt, namely, a space about two inches long in the second intercostal space, and the fact that only a very small portion of the lung seemed pressed upon, made the case not inappropriate for the trial of electrolysis. The patient had tried various remedies under other physicians, but had obtained no relief.

November 12th. His nights had been troubled by dyspnœa, but he had been more easy when lying in a semi-recumbent position. Pulse 72, smaller, a little irregular, equal in both wrists. Mind clear and calm in anticipation of the operation, which he had consented to, as he felt that it afforded the only possible chance of relief or cure. It was upon that ground alone that I advised the operation.

Drs. J. Collins Warren and J. J. Putnam consented to aid me. Dr. Warren introduced three steel needles. I chose the softest and most central part of the tumor as the spot for their introduction. The needles were covered with varnish save at the very points. All were within half an inch from one another, and nearly parallel. They passed readily in about an inch and a half, and the extremities farthest from the chest undulated very visibly and undoubtedly under the influence of the aortic current. To these needles, which represented the positive pole, Dr. Putnam attached twelve and, after some minutes, fifteen cells of the Störer battery, increasing the current gradually from zero. The introduction of the needles caused no pain. At the negative pole was a large pad; it was placed on the left breast on a part corresponding to that in which the needles were placed in the right. A slight pricking sensation was caused under this pad, but no real pain or other discomfort was felt during the whole time the operation was continued, except that towards the last the patient had pain low in the left back of the chest. Three minutes after this pain began (fourteen and one half minutes from the commencement of the current), the pulse rose to 92. The needles were still swaying strongly backward and forward as at the beginning of the operation. Soon the patient became pale, and looked faint; the pulse failed and the hands were cold; evi-

dently serious results were threatening. The needles were immediately withdrawn. Only a drop of sero-sanguinolent fluid escaped at each minute aperture. The pulse was lost a few moments at the wrist. The patient was laid flat in bed and was soon relieved from these untoward symptoms. The needles were all discolored and one was corroded. The patient soon recovered wholly his quiet of body and calmness of mind. He was ordered to remain perfectly at rest; to take beef-tea and milk, with a little brandy, for diet. Some strips of adhesive plaster were applied over the tumor.

In a few hours one could not have recognized that the operation had been performed, except that in regard to every symptom the patient had greater comfort than he had had for several days before the operation.

November 13th. I found that the relief had continued. The pulse, by report, had been about 84. The patient had had no uncomfortable symptom, only a slight local soreness where the needles were introduced.

November 14th. Much the same as the day before, although he had required paregoric during the night because of his restlessness. He had perceived nothing materially different in his sensations since the operation. His aspect was that of comfort rather than of distress, and his respiration seemed easy. Pulse 86. The tumor was examined through the adhesive plaster; it had a hard, solid feel, very different from the soft pulsation observed before the operation.

November 15th. Patient more restless and having some dyspnoea; opiates needed twice. At the time of the visit he was lying on his right side. Motion caused pain in front and sometimes in the back of the chest. Pulse 72, quiet.

November 17th. He was sitting up, looking easy. The previous night he had been almost able to lie on his back. Slight sonorous râle was heard in both lungs. He was desirous of having a second operation. I found the tumor more prominent, apparently from external inflammation. It was more solid, and the impulse was less distinct.

The patient being placed, as at the previous operation, in a semi-recumbent posture, three needles were introduced as before; there was much less motion of them. Dr. Warren assisted me, Drs. Putnam and Oberly being present also. Twenty cells were at first used, a galvanometer having been previously introduced into the current; the needle showed a deviation of thirty-three degrees. After three minutes twenty-two cells were used. At the fourth minute six more cells were added, causing a deviation of forty-five degrees. The pulse became a little weakened at the fifth minute. At eight and one half minutes the patient had some pain in the right arm to the elbow. At twelve and one quarter minutes the deviation was forty-six degrees, and the patient felt



faint. The number of cells was reduced to sixteen, and the deviation fell to thirty-nine degrees. At fourteen minutes the pulse became weak, 80, and the needles were removed; the first of these had entered one inch and one eighth; the second, one inch and nine sixteenths; the third, one inch and a half. The introduction of them had been more difficult than at the previous operation, owing to the solidity of the tumor.

During this operation, as at the first, no untoward symptoms appeared until after fourteen minutes, when the pulse and strength fell off. In both instances the removal of the electrical current relieved the patient, and the pulse regained its force.

Six P. M. He was entirely comfortable; the pains in the back and arm had gone; the countenance was bright; he was cheerful and hopeful. Pulse 80, regular, sufficiently full. There was little or no cough.

November 18th. The report was that the patient had had a comfortable night; three drachms of paregoric had been taken. There was a slight redness of the nose, but no pain or dyspnœa or fever. The digestion was normal. Pulse 92, strong. Urine free. The patient was directed to omit the opiate if possible.

November 19th. A very restless night (but without pain or dyspnœa), till the opiate was taken with relief. There was pain in the shoulders towards evening. Pulse 84. The tumor had a very different feel from that which it had before the first operation; it was decidedly firmer, giving the impression of a solid mass; there was no distinct fluctuation, but the swelling projected more. Although there was no external redness or tenderness, it seemed plain that all the parts around the points of puncture were swollen and hardened.

Chloral hydrate . . . . .	gr. xv.
Potassii bromidi . . . . .	gr. v.

To be taken at bedtime and repeated *pro re natâ*.

November 20th. Delirium in the night, after the chloral, although the day was comfortable and the mind was clear. The appetite was fair. A slight wheeze and hoarseness were noticed in the breathing. Pulse 84, smaller; veins slightly distended. Tumor evidently larger, with a deep-seated pulsation. Omit bromide at night, if possible.

November 23d. Owing to the apparent evil influence of the bromide, it had been omitted for two nights. The patient had sat up a good deal for relief. He was able to lie more nearly upon his back. When on the left side he had pain in the tumor.

November 26th. He had been comparatively comfortable. The tumor was smaller and still solid, with only the slightest impulse. But there was bronchial respiration over the whole extent of the tumor.

November 30th. The patient reported that he had lain on the left side, and felt easy.

December 3d. Had lain indifferently on either side, and had walked in his chamber. There were no pains in the back and arms.

December 6th. Rather more wheezing, which, with the slight cough, can be relieved by throwing the head backward. Less appetite. A slight suppuration at one of the points where a needle had entered; otherwise no apparent inflammation or other external result from the operation.

December 11th. Pain in both sides. Pulse 80, less in the right radial than in the left.

December 14th. Some dyspnoea, requiring the patient to sit up at times. Pulse 60 to 70, and quite small in both radials. Digestion still fair.

December 20th. Nights more restless, and the patient was growing weaker. He complained of more pulsation and heat in the tumor. Cough increased. No fever. Digestion still good. For two or three days the left hand had felt cold. The tumor was larger, and extended to the fourth rib; it was quite solid, but towards the axilla there was an evident deep pulsation, and tenderness existed there. There was a little bronchial respiration at the front and in the back. Pure vesicular murmurs generally, in both lungs.

December 28th. Some dysphagia during the past week; otherwise no material change.

January 3d. Severe pain in the chest; more cough; sputa frothy-white. The nights are tolerable; extract of valerian is taken as a sedative. The tumor is still larger, but quite as solid; in fact, the whole of the right breast is pressed out, and vesicular respiration is absent throughout that front and lessened in the right back. Through the left lung, front and back, the respiration is loud, puerile. On the day before (January 2d), owing to pain, two leeches had been applied, which had caused free bleeding.

January 6th. The tumor is larger, more painful. The patient had morphine injections with comfort. His countenance is much worse. Feet swollen. Bronchial respiration behind at the root of the right lung.

January 16th. A letter from the attending surgeon says, "Mr. S. still exists, but no better than when you last saw him. About a week ago he was suddenly seized with dyspnoea resembling asthma, during which his hands and ears became livid; from this he recovered only to have a more severe attack within twelve hours. When I saw him he was gasping for breath, with livid lips, ears, and face, and almost imperceptible pulse. The tumor has grown much larger within a few days." The right lung was almost wholly useless, and the left was much impaired. Both legs, the right arm, and the right side of the thorax were greatly œdematous. Scarcely any pulse in the right wrist; that in the



left was very small and feeble. The impulse of the heart shook the chest and head. He could not lie down; an attempt to do so a few days previously caused such dyspnoea that he was thought to be dying. He sat up, resting his head on a chair in front of him. Little pain. No appetite. The hypodermic use of morphine kept him easy. The mind was terribly disturbed; violent outbreaks of passion occurred; he was delirious at times.

January 21st. He died quietly.

*Autopsy* by Dr. Fitz, January 22d. Body well formed, though small; marked rigor mortis; evident emaciation. Head not opened.

Right chest much less distended than during life. A slight rounded prominence, two inches in diameter, near the cartilages of first, second, and third ribs of the right side. The skin over the upper anterior half of the right breast was firmly united to the ribs, mainly through thickening and condensation of the sub-cuticular areolar tissue. The pectoral muscles were less in size than normal. The intercostals were pale and translucent, containing numerous gray and opaque lines apparently of fibrous tissue. At one part, between the first and second ribs, the intercostal muscle was absent over a space of the size of the fingernail; a pale, friable coagulum filled the space.

The pericardium and heart showed no sign of disease.

The left lung at its apex was adherent; and in the upper lobe, especially towards its upper part, were numerous small, gray nodules, slightly opaque, grouped together in a more or less foliate manner. Elsewhere were occasional minute cheesy spots surrounded by dense pigmental fibrous tissue. The pleura near these spots was puckered and contracted. Similar appearances were observed in the upper part of the right lung. This lung was so firmly adherent anteriorly that to separate it the scalpel was needed. Posteriorly, the pleura costalis could be torn up with the finger. The lower lobe was separated from the diaphragm by about a pint and a half of clear yellow serum. This lobe was a more or less rounded mass; the pleura over it was thickened, contracted, and opaque. The pleura was generally thickened everywhere, but there were no adhesions. From the ascending aorta an aneurism of the size of an infant's head projected and pushed out laterally and upward above the superior vena cava and its branches. Its walls were thick except in the intercostal space formerly alluded to. The branches from the arch were unaffected. The inner surface for half an inch above the valves was comparatively unaltered, though the arch had undergone considerable dilatation. The interior of the sac proper was lined by a dense, partly decolorized, laminated thrombus, spread over the surface with tolerable uniformity. There was no one point where the clot seemed to show any definite relation to the probable entrance of the needles used in puncturing. The thoracic and



abdominal aorta showed occasional patches of chronic endarteritis. In the right subclavian vein was an old thrombus almost completely obstructing the vessel. This vein had been cut off more than an inch and a half from its terminus; hence its cervical extent could not be ascertained. The left subclavian and azygos veins were unobstructed.

The œsophagus showed no signs of pressure. The mucous membrane of the trachea, in the immediate vicinity of the bifurcation, presented marked alterations; extensive ulcerations of it had occurred, exposing the cartilages over half of the circumference of the trachea. The mucous membrane adjacent to this was red and opaque, and both that and the ulcer were covered with a muco-purulent secretion. The spleen was normal. In the kidneys were alterations due to chronic passive congestion. The liver was normal in size; the hepatic veins were gorged with blood. There was an approach to the nutmeg condition of the acini. The stomach and intestines were not examined.

*Remarks.* — I believe this is the first case in this country of aneurism of the arch of the aorta in which electrolysis has been tried. But Dr. Keyes reports a case<sup>1</sup> in which it was applied to an aneurism of the abdominal aorta. Four applications were made, March 30, April 6, May 4, June 22, 1871. Death occurred July 18th. Pain and nausea were relieved and the patient felt generally better, but was exhausted.

As will be seen by the preceding history, although the tumor became harder after both operations, and lost a good deal of its impulse, and although in some respects the patient was relieved, as, for example, of his inability to lie save on one side, there was no real improvement, and death occurred sixty days after the first operation. This is not a very flattering result.

Let me now touch a little upon European and American experience, and finally try if possible to decide under what circumstances we ought to operate.

Ciniselli, a distinguished physician in Italy, first proposed and performed the operation upon aortic aneurism. In 1870, he reported nine cases between 1846 and 1866, fourteen between 1868 and 1870; twenty-three in all.<sup>2</sup> Four of these only had been operated on by Ciniselli; nineteen were treated by others. The earlier cases were more fatal than the later ones. Only four out of the twenty-three seemed cured at the end of four, eight, eight and a half, and nine months. The number of operations in each case was as follows: in one case, twelve operations; in two cases, six; in seven cases, one; in eleven cases, two.

The numbers of needles used in the operations were in four cases,

<sup>1</sup> New York Medical Journal, December, 1871; quoted in Beard and Rockwell's Medical and Surgical Electricity, New York, 1875, page 754.

<sup>2</sup> Annali Universali di Medicina, ccxiv. 292, November, 1870; Schmidt's Jahrbücher, cl. 31, 1871.

two; in seven cases, three; in seven cases, four; in one case, five; in three cases, six; and in one case, seven.

The number of minutes during which electricity was applied was as follows:—

In three cases it continued five minutes; in four cases, thirty minutes; in two cases, ten minutes; in two cases, twenty minutes; in two cases, fifteen minutes; in one case, eighteen minutes; and in two cases, thirty-five minutes.

Ciniselli uses the following arguments for operating:—

(1.) Electro-puncture is the most rational method of treating aneurisms of the aorta, internal as well as those externally visible.

(2.) Electricity causes coagulation of the blood while being applied, and this effect increases after the operation is concluded, till the clot fills the sac and makes it a solid tumor.

Among the favorable circumstances are: (1.) An aneurism inside of the walls of the chest. (2.) A sac projecting from the walls of the aorta with a narrow mouth. (3.) No complication with other inflammations or disturbances of the circulation than those caused by the tumor itself. (4.) A good constitution of the patient.

The above would be favorable even if the tumor were distinctly protruding through the walls of the chest.

Unfavorable circumstances are: (1.) Atheromatous disease of the artery. (2.) Local inflammations. (3.) Large mouth to the sac, or an enlarged artery communicating with the sac. (4.) If the aneurism project much from the surface of the chest and the opening from the artery be large enough to allow the blood freely to circulate, it may circulate in and around the coagulum, and if the covering of the aneurism be soft or sloughy, fatal external hæmorrhage may occur.

In all such unfavorable circumstances we must speak freely with the patient about the risks of the operation.

The electrical apparatus must have sufficient force and tension.

This method of treatment has apparently not been much used by others on the Continent of Europe.<sup>1</sup> In Great Britain, however, it has been employed, and cases are published. Among them are the following:—

Dr. John Duncan, of Edinburgh, in a long article read before the Medico-Chirurgical Society, March 7, 1866, on galvano-puncture in aneurisms,<sup>2</sup> cites a case which he claims as the first of its kind in Great Britain. A man forty-five years old consulted Dr. Duncan in 1864. Various remedies were ineffectually tried. The tumor covered half of the sternum and of each clavicle, and measured thirteen inches. Vari-

<sup>1</sup> Pétrequin, of Lyons (Althaus, *Value of Galvanism*, London, 1846), first used galvanism for aneurisms.

<sup>2</sup> *Edinburgh Medical and Surgical Journal*, April, 1866, page 920.



ous nodules threatened to burst, superficial ulceration occurred and bloody fluid was exuding, and finally, copious hæmorrhage took place just before the operation was done. December 3d, needles were kept in two hours and a half. Gas was disengaged during the operation. December 4th, two more needles were introduced and retained twenty-five minutes, when gas again escaped. The patient died December 11th. In Dr. Duncan's history of the operation, he says that Liston operated in 1832 on subclavian aneurism. He gives Cuiiselli's tables of fifty cases, of which twenty-three were cured, twenty were not cured, and seven died; four only were on the thoracic aorta, and these four were not cured. He states that intense pain is sometimes caused, and he advises needles of the smallest size.

In the *Edinburgh Medical and Surgical Journal* for August, 1867, Dr. Thomas R. Frazer treats of the subject, and gives a case in which sloughing ensued after the operation. The tumor augmented, and a second operation was performed. Clots were formed, but death was not delayed. Dr. Frazer would use galvanism to prevent an external opening, not hoping to cure an internal aortic aneurism. Experiments on the effects of galvanism are subsequently given.

In the *Edinburgh Medical and Surgical Journal* for 1870<sup>1</sup> is a notice of three cases published by De Cristophoris of Milan. In all three instances the disease ended in death, although in the first it seemed mitigated for a time and delayed. In the second, death ensued from external hæmorrhage, two days after the operation. In the third, great relief followed temporarily, but death with internal hæmorrhage in eleven days.

Dr. Charles Bastian<sup>2</sup> gives a very interesting lecture on the whole subject, founded on a case in which he used electrolysis. He speaks of its innocuousness in the cases referred to. He operated October 8th, 13th, and 18th, and the patient died October 29th. A sacculated aneurism of the most favorable kind for an operation was found. A clot unattached, but which Dr. Bastian considered the result of the operations, was found in it. Dr. Bastian used the needles as we did, that is, with the positive pole of the battery applied to them; and he considers that the best method.

In *The Lancet* for June 20, 1874, Dr. McCall Anderson, of Glasgow, reports the termination of a case first published in 1873,<sup>3</sup> in which galvanism was used four times with the result of lessening the tumor to one fourth of its previous size. It had become solid, and the pulsation was much lessened. The patient felt well, though there was still a pulsation in the chest, and Professor Anderson did not claim the case as one of perfect cure, but at the same time he says, "No one can deny

<sup>1</sup> Page 537.

<sup>2</sup> *The Lancet*, November 22, 1873, page 594, and November 29, page 623.

<sup>3</sup> *The Lancet*, February 22, 1873, page 261.

the vast benefit which the patient has derived from galvano-puncture." She went out to heavy work contrary to advice, and continued four months so occupied. The symptoms were all aggravated, and the patient died January 7, 1874, about thirteen months after the operation.

Anderson advises to use the positive pole as we did; he recommends a large-celled battery, but a weak current.

The following is a tabular statement of these facts up to November 7, 1872; it comprises all that I have been able readily to find.

## THORACIC ANEURISM—ELECTROLYSIS.

Date.	Name.	Number of Cases.	Result (unknown in 13 cases).		
			Cure.	Death.	Relief.
1846-70.	Ciniselli. <sup>1</sup>	23	6		
	do. (in Althaus). <sup>2</sup>	2	1	1, after four mos., suddenly.	Great relief in the interval.
1866.	Duncan. <sup>3</sup>	1		1, on eighth day.	
1867.	Duncan and Frazer. <sup>4</sup>	1		1, not delayed.	
1873.	Bastian. <sup>5</sup>	1		1, on twenty-first day.	
1873.	Althaus. <sup>2</sup>	3		1.	2.
	do. (arteria innominata).	1		1, in a few days.	
1874.	Anderson. <sup>6</sup>	1		1, in thirteen mos. 1, late.	Prolonged relief. Mitigated and relieved.
1870.	De Cristophoris. <sup>7</sup>	3		1, in two days.	
1872.	H. I. B.	1		1, in eleven days.	Great relief.
				1.	Relief to certain symptoms.
		37	7	11	6

A little less than one third die soon. A little more than one third are either cured or relieved. Less than one fifth are cured, and even these have relapses.

What ought to be our position now in regard to this operation? I should hold the following principles to be correct:—

(1.) In any case in which treatment such as Valsalva's, as modified by Tuffnell, or still further as suggested by myself,<sup>8</sup> and in which there can be no doubt from the physical exploration of the chest that aneurism of the arch of the aorta exists; if, moreover, we find that the lungs

<sup>1</sup> Sugli Aneurismi dell' Aorta toracica. Milano, 1870; New York Medical Journal, December, 1871.

<sup>2</sup> Medical Electricity.

<sup>3</sup> Edinburgh Medical and Surgical Journal, April, 1866, page 920.

<sup>4</sup> Edinburgh Medical and Surgical Journal, August, 1867, page 101.

<sup>5</sup> The Lancet, November, 1873, page 594.

<sup>6</sup> The Lancet, June 20, 1874.

<sup>7</sup> Edinburgh Medical and Surgical Journal, June, 1870, page 537.

<sup>8</sup> Proceedings of the Boston Society for Medical Observation, February, 1866, and subsequently published in the Boston Medical and Surgical Journal.



are not very much involved, if we have made up our minds that the case tends certainly to death, perhaps attended with severe suffering,— in such a case there can be no doubt that we should be justified in advising electro-puncture, for relief at least, and with the hope of a cure if the aneurism be small.

(2.) As to how it should be done, whether by applying to the needles the positive pole or the negative, or both, or one and the other alternately, I think no decision can be made further than this: the positive pole causes a firmer clot, and disengages less gas than the negative. It was used in our case. A great diversity of opinion exists as to these questions, which cannot be settled till we get further facts.

(3.) A mild current should be used at first, and continued for some time. I have questioned whether in our case we did not too rapidly increase the number of cells, and whether it were not on that account that our patient had the peculiar symptoms.

(4.) Absolute rest before and after the operation, if possible in a perfectly horizontal posture, should be maintained for months, according to the principles laid down by Tuffnell, although I would allow a little more food than he does.

(5.) In regard to drugs, I should be governed by circumstances; gentle laxatives are admissible; perhaps digitalis, if the pulse be too rapid. Iodide of potassium might be tried; also cold or compression; if need be, leeches might be applied.









