

to death. Unfavourable as the case was I incised, washed out, and drained the side. The man made a good recovery but was left with a sinus about a quarter of an inch in diameter, but several inches long, extending towards the root of the lung, where a tuberculous focus existed. With the exception that he had to wear a tube he became well and strong, returned to work, and continued in light occupation for two or three years, when the phthisis became active again and killed him.

I may remark of this case in passing that excision of a portion of rib was not practised at the time of operation, that it never became necessary, and that no removal of ribs subsequently would have enabled the fistulous tract to close. One such case would arouse thought, but a series of such cases should establish the views I advocate. My own experience does this and I have no doubt that pyo-pneumothorax ought to be, and will be, treated hereafter on the same general lines as empyema and with much more favourable results.

These remarks have been suggested by a paper recently read by Professor D. W. Finlay at the Clinical Society of London. If the views I here express and have so long advocated and which Professor Finlay supports had not been controverted I should not have thought it necessary to write these notes. But it is clear from the question asked, "whether it was worth while to go through so much for the sake of so little benefit," that the true nature of these cases is not generally comprehended or the principles of treatment grasped.

I will conclude by a few general rules for the treatment of pneumothorax. 1. In the early stage when suffocation threatens, the air should be removed and the pressure relieved by paracentesis, repeated if necessary; if this be not sufficient it is justifiable even to lay the side fully open rather than to lose the patient. 2. In the later stage when effusion forms its nature should be at once ascertained. 3. If the effusion be serous the case should be treated on the general lines of serous effusion. 4. If it be purulent evacuation at once by free incision should be carried out. A piece of rib should not be excised, for it is rarely necessary. If it be necessary no more should be removed than is required to get free drainage. 5. An aspirator should never be used in pneumothorax in any circumstances; it is unnecessary and dangerous.

If pneumothorax be treated on these common-sense lines and without subservience to antiquated theories I am convinced that the results will be greatly improved and pneumothorax cease to be regarded so gravely as it now is.

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## DRAINAGE OF THE PERICARDIUM.

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SINCE my contribution, with Dr. Arthur Latham, to THE LANCET of March 21st, 1903, p. 798, in which I described how the operation suggested by Dr. Cyril Ogle and Mr. Herbert Allingham had been performed by me with slight modifications upon a man suffering from pericardial effusion of great quantity and of long duration, two other cases have increased my experience of this operation. I venture to publish my further experiences because I think it will be recognised that the operation, with such slight modifications as may be necessary in individual cases, must become the routine method for drainage of the pericardium. It can be claimed that the operation is simple and of short duration, and that it affords excellent drainage from the lowest available spot of the pericardial cavity. A few additional notes on the operation itself may not be out of place before giving a short summary of my two cases.

*Incision.*—I have so far employed the vertical incision described in our previous paper in preference to one along the lower border of the seventh costal cartilage—(1) because it gives a very convenient access to the pericardium without unduly interfering with the attachments of the rectus abdominis; and (2) because it enables the operator to proceed at once to the removal of the sixth costal cartilage if this be necessary to insure a more careful and extensive examination of the pericardial contents.

*Seventh costal cartilage.*—From my experience, small as it is on the living subject, I would strongly advise the removal of this cartilage in all cases except those of small children or infants.

*Internal mammary and superior epigastric vessels.*—These are pushed towards the middle line or divided and the cellular interval—"costo-xiphoid space"—between the seventh costal cartilage, ensiform cartilage, and the attachment of the diaphragm is broken into. The triangularis sterni, with the intercostal membrane and muscle, is divided in the line of the incision up to the sixth costal cartilage.

*Incision into the pericardium.*—Carefully pushing aside both the right and the left pleura (*vide* Case 2) the operator, in order to avoid all danger of opening the peritoneal cavity, should incise the pericardium just above the level of the base of the ensiform cartilage and with his finger enlarge this incision downwards into the costo-xiphoid space.

*Drainage.*—In each case I have used an empyema tube as thick as the forefinger. My operations have all been performed for simple effusion and in these it seems unnecessary to leave the tube in for more than three or four days. In one case the patient complained of a little pain which he said was relieved by removing the tube, but in no case, so far as we could see, was the heart embarrassed by the presence of a tube.

*Severity and duration of the operation.*—None of my subjects, though each in an almost desperate condition, seems to have been any the worse for the actual operation—indeed, two of them were distinctly less distressed immediately after it. No ill, but rather good, effects were produced upon the circulation by manipulation of the heart. About 20 minutes should suffice in ordinary cases to complete the operation and, other things being equal, I should say that the younger the patient the less time required for the operation. I need hardly emphasise the importance to the operator of a skilled and resourceful anaesthetist.

CASE 1.—The patient, a man, aged 31 years, was suddenly seized by an attack of pneumonia on May 11th, 1904. On the 14th he was admitted into St. George's Hospital under the care of Dr. F. G. Penrose. The left lung was chiefly involved. On June 2nd his notes read: "The temperature remains high; there is considerable cyanosis and dyspnoea; cardiac dulness exists four fingers' breadth to the right of the sternum; the heart sounds are muffled." After a consultation between Dr. Penrose, Dr. H. D. Rolleston, and Dr. Ogle I was asked to explore the pericardium. I reached the pericardium by the method described above, but I removed a portion of the sixth as well as the seventh costal cartilage. Only three or four ounces of fluid were withdrawn. The right heart was bound down by rather firm adhesions to the parietal pericardium both laterally and on the diaphragm. The left heart, both ventricle and auricle, was free and smooth on the surface. Many of the adhesions between the heart and the pericardium were broken down and a tube was inserted. The operation lasted 20 minutes. The patient recovered slowly and steadily from the day of the operation. Whether this definite improvement in his condition was *propter hoc* or *post hoc* it is difficult to ascertain; nor is it possible to say without further experience what part, if any, the breaking down of adhesions between the heart and the pericardium played in the subsequent improvement. The tube was removed on the 6th and the stitches on the 9th. On the 19th the patient was able to go to the seaside. When seen recently he was making rapid progress.

CASE 2.—The patient, a boy, aged 12 years, was admitted into St. George's Hospital on July 4th, also under Dr. Penrose. He had all the signs of pericardial effusion, with marked cyanosis and dyspnoea. There was a history of rheumatic fever with heart troubles. On the 6th I operated as above with a vertical incision, finding it necessary to remove the seventh costal cartilage only. After pushing aside the left pleura I incised the pericardium but in doing so wounded the *right* pleura. The patient was no worse for the wound, which was evidently small, and the pneumothorax disappeared within two days. The fluid in the pericardium was under pressure and rapidly escaped. A tube was introduced and kept in until the 8th. The operation lasted 15 minutes, during the last five of which oxygen was administered. The patient seemed very little better for the operation and his dyspnoea and exhaustion increased day by day till his death on the 11th. At the post-mortem examination there was no evidence of pneumothorax; the wound of the pericardium was not recognisable and the parietal and visceral pericardium were adherent. There was much endocarditis with

valvular verrucosities. The right pleura projected beyond the left side of the sternum down to the level of the seventh costal cartilage.

It is not at all common for the right pleura to extend so far towards the left side at this level, but the case shows that the operator must be careful to push aside the right pleura as well as the left. In this case the thorough exploration of the pericardial cavity and the heart was remarkably easy and the fingers could reach even to the back of the heart.

In conclusion, I must thank Dr. Penrose for his courtesy in allowing me to use the notes of his cases.

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ON THE  
ACTION OF VENOMS OF DIFFERENT  
SPECIES OF POISONOUS SNAKES  
ON THE NERVOUS SYSTEM.

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III.—VENOM OF BUNGARUS FASCIATUS (BANDED KRAIT).

In a previous communication to THE LANCET<sup>1</sup> we intimated our intention of carrying out an examination of the nervous system of animals which had died from injections of venoms from different species of poisonous snakes, with the object of attempting to co-relate any changes which might be found with the symptoms observed during life. In that paper and in a subsequent one<sup>2</sup> we detailed the histological appearances of the nervous system in cases of cobra venom intoxication and advanced the degenerative changes found as evidence in favour of the view that the cobra poison owes its lethal property to a specially selective action on certain motor neurons. In the present paper, working in a manner similar to that which we have already described, we purpose to take up the study of the venom of bungarus fasciatus, pointing out the chief symptoms and detailing the changes which can be demonstrated in the nervous system in cases of intoxication with this poison. This snake belongs to the genus bungarus, which is closely allied to the genus naia, of which genus the cobra is a species. These two genera belong to the same subfamily of colubridæ—namely, elapinae. While, however, the cobra and bungarus fasciatus are so closely allied there are good grounds for thinking that their poisons differ from one another both in constitution and in physiological action. For it has been shown<sup>3</sup> by one of us that a precipitin prepared with cobra venom and causing a marked precipitin with this poison gives no coagulum when mixed in the same way with the venom of bungarus fasciatus. It has also been demonstrated<sup>4</sup> that a serum strongly antitoxic for cobra venom in all its actions has no neutralising effect either for the general action *in vivo* or for the hæmolytic action *in vitro* of the venom of bungarus fasciatus. Further, as we shall presently see, the symptoms of cobra venom intoxication are by no means identical with those of poisoning with the venom of bungarus fasciatus. We have still, however, to ascertain if any difference can be observed between the histological changes in the nervous system caused by these two poisons. The venom of bungarus fasciatus is peculiarly suited for the work in which we are at present engaged. In the first place, when a minimum lethal dose of this poison is injected into an animal the fatal result is much longer delayed than is the case with the venoms of any of the other Indian poisonous snakes. In the second place, the symptoms which are observed in the more or less chronic disease which follows an injection of a comparatively small quantity of this poison point to a serious interference with the proper functioning of the nervous system. In the third place the effects of the action which the venom has on the blood and on the circulatory apparatus in general are much less

evident than is the case with the other poisons with which we have worked. The symptoms, therefore, which result from the action of the poison on the nervous system are not masked by the symptoms resulting from its action on the circulatory apparatus. For these reasons it appeared probable that the histological changes in the nervous system in cases of intoxication with this poison would be well marked and easily demonstrable and that they could be brought forward as quite an adequate pathological cause of the symptoms and of the fatal result. The material which was used in these experiments was collected and conserved in the manner we have already described in the case of cobra venom.

The experiments which were undertaken in order to study the symptoms of intoxication with the poison of bungarus fasciatus were made principally on monkeys and rabbits, although a few pigeons and rats were also used. The injections were made both intravenously and subcutaneously. In this paper we propose to give only a short summary, as far as symptoms are concerned, of the observations made under these varying conditions. A detailed account of the experiments<sup>5</sup> has already been published by one of us. Cases of intoxication with the venom of bungarus fasciatus may be divided into three classes, each class showing its distinctive symptoms. The first class is comprised of those cases in which death follows rapidly—that is to say, in a few minutes—after an intravenous injection of a comparatively large amount of poison. The symptoms which are seen in these cases are of sudden onset and soon terminate in death. Loss of equilibrium, staggering, and violent general convulsions are the most prominent. Death takes place within a few minutes after the injection of the poison. On careful post-mortem examination there is found an extensive intravascular thrombosis chiefly affecting the pulmonary arteries and the right heart. We are dealing here, then, with a similar phenomenon to that which takes place when daboia venom is injected intravenously in small amount or subcutaneously in larger amount.<sup>6</sup> There can be no doubt that the symptoms observed and the fatal result are in this case due to the intravascular clotting and that it would be useless to look for any degenerative changes in the nervous system. In the second, or what may be called the acute nervous, class of cases of intoxication with the venom of bungarus fasciatus death takes place within the first 48 or 72 hours after the injection of the poison. The interval between the time of the injection of the venom and the fatal result varies according to the amount of venom injected and the mode of injection. With comparatively large amounts of venom death takes place in 20 minutes or half an hour after intravenous injection, while with small quantities death may be delayed for two or three days. The symptoms which one observes in all these cases point unmistakably to an action of the venom on the nervous system and are indistinguishable from the symptoms which are observed in cases of cobra venom intoxication. There may or may not be slight swelling at the site of inoculation. Profuse salivation and sometimes vomiting are described by Wall<sup>7</sup> to be common symptoms in dogs bitten by this snake. Ultimately paralysis, accompanied by twitching of the muscles, develops; the paralysis advances rapidly and death follows from paralysis of respiration. An examination made immediately after death shows the heart to be still beating; this pulsation may go on for some time after the thorax has been opened. With the exception of a slight pinkish exudate at the site of inoculation, which, however, is not always present, no gross lesion can be found anywhere.

The nervous systems of two monkeys which showed the above symptoms were examined and the methods of fixing and staining in these and in the subsequent cases are the same as described in our previous papers. The cases are as follows.

TABLE I.—Showing Details of Injections.

—	Weight in grammes.	Dose per kilogramme.	Time before death.
		Milligrammes.	
Monkey No. 14 ...	3110	5 subcutaneously.	14½ hours.
„ „ 15 ...	2480	6 „	44 „

<sup>1</sup> THE LANCET, Jan. 2nd, 1904, p. 20.

<sup>2</sup> THE LANCET, August 20th, 1904.

<sup>3</sup> THE LANCET, August 16th, 1902, p. 431, and April 2nd, 1904, p. 916.

<sup>4</sup> Scientific Memoirs by Officers of the Medical and Sanitary Departments of the Government of India. New series. No. 5, 1903. Ibid. No. 10, 1904.

<sup>5</sup> Ibid., No. 7, 1904.

<sup>6</sup> Ibid., No. 3, 1903.

<sup>7</sup> Wall: Indian Snake Poisons, their Nature and Effect. London, 1883.