On the transference of poisons from the blood to the alimentary canal / by Alfred S. Taylor.

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ON

THE TRANSFERENCE OF POISONS

FROM THE

BLOOD TO THE ALIMENTARY CANAL.

By ALFRED S. TAYLOR, M.D., F.R.S.

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Physiologists and toxicologists have long recognised the fact that poisons received into the stomach and intestines found their way by absorption into the blood, and were thence either temporarily transferred to the solid organs, or eliminated by the various excretions. The fact that, conversely, they might find their way into the stomach and intestines from the blood itself, when this fluid is the seat of poisoning, is a truth which is not commonly known, and has hitherto been only doubtfully accepted. The mucous fluids poured into the stomach and bowels must, however, be regarded as media of elimination, although poisons appear to be more frequently and more abundantly conveyed out of the body through other channels.

This question was briefly considered in reference to antimony in a former volume of these 'Reports.'[1]

Orfila found arsenic in the alimentary canal of a dog which had been killed in four hours by the application of three grains of the poison to the cellular tissue. In an experiment, Dr. Brinton injected ten grains of tartar emetic, dissolved in four ounces of water, into the superficial femoral vein of a dog. At the end of fifteen minutes it was killed, and antimony was found in the con-

[1] "On Poisoning by Tartarized Antimony," 'Guy's Hospital Reports,' October, 1857.

tents of the stomach.[1] It thus appears that there is not only a transference of arsenic and antimony from the blood to the stomach and intestines, but that this transference takes place with great rapidity.

There was a practical difficulty to the admission of this doctrine of transference in the case of a human being. As the mineral poison was generally introduced into the body by the mouth, and not by a wound or by injection into the blood, the discovery of it in traces in the stomach after some days might reasonably be referred to the residue of a portion which had been swallowed. Thus, arsenic has been found in the stomach a week after it had been taken by the mouth; and in one instance I found antimony in the stomach of a person six days after the last dose, amounting to three grains of tartar emetic, had been taken. Its presence could not here be ascribed to mucous elimination, for the reason that it was not found deposited in any organ; and unless present in the blood or soft organs, there could be no source from which it would undergo elimination. Another objection to the general reception of the mucous elimination of mineral poisons, exists in the fact that the stomach and intestines frequently contain no traces of arsenic or antimony, while these metals are found in the blood, liver, spleen, and other soft organs of the body.

Notwithstanding these apparent objections to the view that poisons are transferred to the stomach and intestines from the organs in which they have been deposited, facts occasionally present themselves which do not appear to be explicable on any other theory.

In a case of antimonial poisoning recently tried at Liverpool ('Regina *v.* Winslow,' Liverpool Summer Assizes, 1860), it was proved in evidence by Dr. Edwards, who conducted with great skill a most difficult investigation, that, after the deceased, Mrs. Ann James, had been removed from any source of administration of the poison, the contents of the stomach discharged by vomiting continued to yield antimony up to the day of her death, *i. e.* for fourteen days after she had been placed in the Infirmary, under proper superintendence. Dr. Edwards's evidence was to this effect: The matter vomited by deceased on the 10th June (the day of admission) yielded a well-marked

[1] 'Poisons,' 2d edition, p. 409.

quantity of antimony. On the 11th a trace was found; on the 12th and 13th it disappeared; on the 14th there was antimony; on the 15th none. There was none on the 17th and 19th; it reappeared on the 20th, and was again absent on the 21st; but on the 22d, the last day on which the vomited matter was examined, there was a trace. During the whole of this period the fæces and urine were found to contain more or less antimony. Here, then, we have the remarkable fact, that not only may antimony be found in the contents of the stomach up to the twelfth day after the last dose, but the elimination of this metal may assume an intermittent character. The reader will find a notice of this intermitting elimination of antimony in the second edition of my work on 'Poisons,' p. 52.

Was this discovery of antimony in the mucous contents of the stomach of the deceased to be referred to the retention in that organ of any portion of tartar emetic administered previously to the 10th June, or to the mucous elimination of that which was already in the body, but which was rapidly disappearing from the soft organs? It is difficult to suppose, from the known solubility of tartar emetic, that under such constant vomiting the stomach would not have been cleared of the last dose in a much shorter time than a period of twelve days, especially when it is considered that at no time, probably, had more than one or two grains been given to the deceased at a dose. Any intermediate administration, although at first suspected, was negatived, not only by moral circumstances, but by the chemical results. At no time was the antimony found in the vomited matters in more than the merest traces; whereas a fresh administration would have been at once indicated by a marked increase or difference in the amount. In short, the quantity throughout corresponded to that which might have passed off by the secretions; and after death, traces of antimony were discovered in the stomach and intestines, in the spleen, liver, and lungs. The whole quantity, however, left in the body after the period of fourteen days, could not be estimated at more than one tenth part of a grain. This strongly confirms the opinion given at the trial of Palmer, and elsewhere recorded—that antimony does not commonly remain in organs important to life for a longer period than from fifteen to twenty days after the last administration.

If the antimony found in the vomited mucous matters depended on any residuary antimony in the stomach, there is no reason why some should not have been found in them daily. The intermission in the appearance of the metal in the mucous fluids is in favour of its having been eliminated from the blood, at least in the latter part of the illness of deceased.

It would seem, therefore, in Mrs. James's case, that there was no reasonable explanation of the facts, except that the antimony found by Dr. Edwards, was really eliminated in the mucous secretions of the stomach during life. He gave this opinion in his evidence, and thus put an end to a suspicion which had arisen, that the accused person who had seen the deceased once or twice while in the infirmary had taken the opportunity of administering to her one or more doses of the poison.

The views here expressed receive confirmation from some experiments performed by Dr. Pavy and myself in the summer of 1859, and therefore wholly irrespective of the case of Mrs. James.

Experiment 1.—Dr. Pavy injected a solution of six grains of tartarized antimony into the jugular vein of a dog. The animal was found dead in the morning, within eight hours of the performance of the experiment. Dr. Pavy brought to me the stomach and intestines of the animal. The mucous membrane of the stomach was much corrugated, but there were no marks of irritation, nor any signs of unnatural redness. In the middle portion of the duodenum there was slight redness, and there was injection and ecchymosis about the lower part of the jejunum and ileum. The ileo-cæcal valve was very much injected. The lower half of the large intestines had its mucous membrane highly corrugated and strongly reddened, and the redness of the membrane was particularly marked in the rectum.

The substance of the stomach, with the mucous matter adhering to it, was examined by the process of Reinsch, and a quantity of antimony was extracted, which was calculated at about 1-700th of a grain. Antimony was also found in the rectum in about the same proportion.

Experiment 2.—July 4th 1859. Three grains of tartar emetic

in solution were injected by Dr. Pavy into the jugular vein of a dog. The animal was found dead, and is supposed to have died in about eighteen hours after the injection. In this experiment, the analysis was confined to—1, the contents of the stomach; 2, the contents of the large intestines, and 3, the contents of the small intestines. The liquids were free from blood, but those of the intestines obviously contained biliary matter. The largest quantity of liquid amounted to six fluid drachms. On the application of Reinsch's process, antimony was distinctly separated from each of the liquids, a well-marked violet film of metallic antimony being obtained on the copper in each case. The quantity was small, probably not exceeding the 1-1000th of a grain in any one instance.

These experiments, therefore, clearly prove by the results that antimony may not have entered the body of ~~a human being~~ by the stomach or bowels, and yet be found both in the coats and in the liquid contents of these parts of the body.

Experiment 3.—Two grains of tartarized antimony were dissolved in four drachms of water, and injected by Dr. Pavy into the jugular vein of a dog, without apparently producing any effect beyond vomiting. Twenty-six hours afterwards, three grains, dissolved in four drachms of water, were injected into the jugular vein on the other side of the neck. Speedy vomiting was induced; but, in spite of this, the animal died during the night. The appearances were,—a strongly rugose condition of the mucous membrane of the stomach, with slight injection towards the pylorus; the duodenum was slightly injected; the mucous membrane, however, was for the most part pale. The mucous membrane of the lower part of the small intestines, especially in the rugæ, was decidedly reddened. The margin of the ileo-cæcal valve was much injected, and the mucous membrane of the large intestines was reddened in patches. On analysis, antimony was found in the coats of the stomach and of the intestines. There were no contents.

This experiment shows that, whether antimony finds its way into the body by the blood or by the alimentary canal, the appearances present very much the same character, and are chiefly manifested in the cæcum and the large intestines. It is here worthy of remark, that in the case of Isabella Bankes

('Reg. *v.* Smethurst,' 1859), and of Mrs. Ann James ('Reg. *v.* Winslow,' 1860), the parts of the body chiefly affected were the cæcum and large intestines.

Arsenic.

Experiment 4.—Dr. Pavy injected into the jugular vein of a dog, a quantity of Fowler's solution of arsenic, corresponding to one grain of arsenious acid. The dog died in about ten or twelve hours. Dr. Pavy delivered to me for analysis—1, the contents of the stomach; 2, the contents of the small intestines; and 3, the contents of the large intestines. Arsenic was found in each of the liquids, by Reinsch's process, in about five minutes. It was deposited on copper, in a steel-blue film. The quantity obtained was in imponderable traces.

Experiment 5.—June 22d, 1859. Half an ounce of Fowler's solution (corresponding to two grains of arsenious acid), was injected by Dr. Pavy into the jugular vein of a dog. The animal vomited almost immediately, and it died in about eighteen hours. On inspection, the mucous membrane of the stomach and intestines was found intensely injected; in fact, in a state of acute gastro-enteritis, chiefly marked from the stomach to the cæcum. The coats of the stomach and intestines, with the adhering mucous fluids, were analysed, and arsenic was distinctly found in them.

Experiment 6.—Two drachms of Fowler's solution, corresponding to one grain of arsenic, and two grains of tartar emetic, dissolved in two ounces of water, were injected into the jugular vein of a dog. The animal was found dead within twelve hours.

The mucous membrane of the stomach presented dark-red patches; the upper part of the duodenum and the central portion of the small intestines were also reddened. The mucous membrane of the lower eight inches of the ileum had the dark colour of venous blood. The ileo-cæcal valve and lower part of the rectum were much injected; the cæcum and upper part of the large intestines were only slightly reddened.

The stomach and large intestines were examined by Reinsch's process, and yielded both antimony and arsenic in small quantity.

From these results it appears that arsenic as well as antimony may find its way into the stomach and bowels and their contents, although not taken by the mouth or injected by the rectum. These facts may be of some importance in cases where reliance is placed on the presence of mere traces of either of these poisons in the stomach or bowels, as furnishing evidence of recent administration by the ordinary channels. When arsenic or antimony ~~are~~ found in more than traces in the stomach and intestines, *i. e.* in powder, or in solution in large quantity, no objection can be ~~taken~~ to the medical inference that they have been ~~taken~~ by the mouth. It is impossible to admit that the solid sulphides of arsenic or antimony found in the coats of the stomach or intestines of a body, in a case of exhumation, can have been derived from the metal eliminated by the mucous secret~~ories~~ from other parts.