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ORIGINAL COMMUNICATIONS.

ON THE CAUSES, CONSEQUENCES, AND TREATMENT OF INFLAMMATION OF THE VEINS.

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IN the numbers of the LONDON JOURNAL OF MEDICINE for March and July 1850,¹ I have attempted to establish the following points, in reference to the Pathology and Treatment of Inflammation of the Veins.

1st. That inflammation, both of the veins and of the capillary vessels, usually depends upon irritation, communicated to them through their contents.

2ndly. That pus is capable of producing such irritation when detained in contact with the lining membrane of the veins; but that it may be conveyed along their channels, without leaving any trace of its passage.

3rdly. That pus, under ordinary circumstances, cannot circulate in living vessels, in consequence of its power of determining the coagulation of the first portions of the blood with which it is brought in contact.

4thly. That when pus is carried along a vein, it is in consequence either of the disturbance of the coagulum which has first detained it, or of the blood having in some measure lost its natural power of coagulation.

5thly. That when, in consequence of either of these conditions, pus does find its way into the circulation, it may nevertheless determine the coagulation of the blood in its passage, either in a different part of the same vessel, or in distant parts of the system.

6thly. That when the coagulation occurs in a distant part of the body, it is usually observed in capillary vessels.

¹ Mr. Lee's valuable Essay has been published in a separate form by Mr. Renshaw. ED. LOND. JOURN. OF MED.

7thly. That when it occurs in a large vein, it may affect the circulation through the whole of the vessels which supply it; and that if, for example, a coagulum be formed in, or extend to, the common iliac vein, the obstruction produced may give rise to all the symptoms of *phlegmasia dolens*.

8thly. That, under any of the circumstances above mentioned, bleeding and the use of mercurial medicines are of at least doubtful efficacy.

The evidence upon which these propositions are established it is unnecessary to recapitulate. It will rather be my object at present to review some of the labours of physiologists in connection with this subject, and to endeavour, by the assistance of the information derived from the action of foreign substances on the blood, to reconcile the discordant evidence which is found in their writings.

The direct action of foreign matter upon the blood opens an extensive and hitherto comparatively unexplored field of observation to the physiologist; while the admission of diseased secretions into the circulation affords an equally extensive and interesting sphere of study to the pathologist.

The direct effects of extraneous matters, when introduced into the circulation, may be divided into four principal classes, namely:—

I. Those which are occasioned by simple irritation as the foreign substance passes through the vessels.

II. Those which result from the particles of the matter introduced being of such a size, as to pass with difficulty through the small tubes, in which they consequently become entangled.

III. Those which are the result of the coagulation of the blood, determined by the presence of foreign matter.

IV. Those which depend upon a disposition communicated to the blood, to separate into its different parts, or to decompose.

I. Dr. Hales has left us the following experiment. He introduced a tube into the aorta of a living animal, and filled it with a column of water, which by its pressure would inject all the branches with a force supposed to be equal to that of the heart. He then cut a knuckle of intestine, so as to divide the small branches in the length of the intestine, on its free margin. The water from the tube was found to pass from the cut vessels in forty-six seconds, while, under the same circumstances, brandy took sixty-eight seconds before it found its way through the divided vessels. On a second trial, the brandy took seventy-two seconds in its transit.

By the same mode of experimenting, Dr. Hales found that warm water, of the temperature of the animal, passed much quicker than cold water from the pump. He thence concluded, that the contents of the vessels are capable of exciting them so as to contract their calibre, and to diminish the velocity with which fluids are circulated. Mechanical irritation may likewise, as proved by microscopical observation, cause the capillaries of a part to contract, so as to impede the flow of blood through them.

II. In the Museum of St. George's Hospital are preserved different portions of the femoral vein of a man, who was admitted into the hospital in consequence of a severe attack of erysipelas, which produced

several abscesses in the leg and thigh. "The femoral vein is filled with coagula of blood which had manifestly formed before death; and in some parts of the centre of the coagulum, there was found a light semi-fluid substance somewhat resembling pus, but which appeared to be only the dissolution of the coagulum."

It is evident, in such a case, that, whatever may have been the nature of the semi-fluid substance, it was retained in its position by the coagula which surrounded it; and had these been removed, it would then have had free access to the circulation. It is also more than probable that the particles, of which it was composed, were much larger than the blood corpuscles, and would consequently have met with a mechanical obstruction, had they been conveyed in the course of the circulation.

The following case illustrates the circumstance before insisted upon, viz.: the ready access that such vitiated fluids may have to the circulating system, when the coagulating power of the blood has, by disease or other causes, been impaired.

CASE XLI.¹ Wm. Stubbs, æt. 30, of a swarthy complexion and emaciated appearance, was admitted into St. George's Hospital, Dec. 25, 1844. A year previously he had suffered from pain in the head and nausea. Three months before his admission, the pain in the head had become very severe, and was accompanied by frequent rigors, occasional vomiting, pain in the epigastrium, and region of the heart. The throbbing pain in the head was occasionally so severe, that he would frequently say that "all the disease was in the head".

He continued in the same state, with occasional rigors, till the 31st, when he vomited incessantly.

A soft pulpy tumor on the neck now attracted attention, which he said had existed since the beginning of October, when the previous symptoms had become so much aggravated. It was of the size of a small walnut, situated immediately over the carotid artery; pulsating, but not expanding with impulse.

He sank into the semi-comatose state, and died January 9th 1845.

This tumor,² upon examination, was found to be a small, perfectly circumscribed abscess, bounded on all sides by condensed cellular tissue. It contained a darkish coloured pus, and corresponded to the middle of the jugular vein. The cavity of the abscess here communicated with the vein by an opening of the size of a pea, and a probe could be passed through the opening into the cavity of the vessel. When first examined, the opening was partly blocked up by a thin coagulum. The internal coat of the vein presented its usual smooth and polished surface, and was but slightly discoloured, except in the neighbourhood of the opening. Here it was somewhat injected, and presented some yellow spots, apparently of pus, on the surface of the inner membrane. The outer covering of the vein was in this situation thickened and partially destroyed; the vein itself contained no blood.

A very small loose clot, presenting anything but the appearance of

¹ The Cases and Experiments are numbered in continuation of those related in my papers published in the LONDON JOURNAL OF MEDICINE for March and July 1850.

² The *post-mortem* examination was conducted by Mr. P. Hewett.

blood, was found in the right auricle. It was of a brown rusty colour, mixed with streaks of a yellow hue. Examined by the microscope by Dr. Bence Jones, it was found to contain a remarkably small quantity of blood globules; but there existed a great number of large granular cells, the microscopic characters of which did not identify their nature.

It is remarkable in this case, that, although the contents of the abscess must from time to time have partially emptied themselves into the vein, yet, not being detained in it, they had excited little or no irritation.

The mode in which purulent fluid, when mixed with circulating blood, becomes altered in its characters, also deserves attention.

The coagulating power of the blood had evidently in this case been greatly impaired; and this circumstance can alone account for the ready admission which the pus gained to the circulation. On the other hand, how completely a coagulum will circumscribe purulent matter before the blood has lost its coagulating power, is illustrated by a case mentioned by Hunter,¹ in which an abscess formed in the substance of the left ventricle of the heart. "The inner wall of the abscess was formed, in this instance, by a solid coagulum of blood of an oval figure. This coagulum was of old standing, from its appearance, and was firmly entangled in the fasciculi of the ventricle."

Experiments illustrating the effects of the introduction of substances into the blood, which have afforded a mechanical impediment to the circulation, have been but too frequently repeated. The following are among those performed by M. Gaspard.

EXPERIMENT XXI. Half a drachm of liquid mercury, in half an ounce of common water, was injected into the saphena vein of a middling-sized dog. The animal, at first, experienced no inconvenience from the operation; but six hours afterwards the respiration became embarrassed, accompanied by fever, symptoms of pain in the chest, and disinclination for food. On the third day the animal appeared slightly relieved, and the appetite was returning when he was killed, fifty hours after the injection.

Post-mortem Appearances. Nearly the whole of the mercury was found to have lodged in the lungs, which were inflamed in hardened circumscribed patches, and in some places hepatised. The mercury escaped from the indurated tissue when it was divided.

EXPERIMENT XXII. Twenty-two grains of fluid mercury were injected into the jugular vein of a little dog by means of a glass tube. At the expiration of some days, there was a frequent dry cough, with occasional shiverings.

Post-mortem Appearances. The mercury was found, after death, in the lungs, which were inflamed in indurated patches in different parts.

EXPERIMENT XXIII. Twenty-two grains of mercury were injected into the jugular vein of a large dog.

Post-mortem Appearances. Four days afterwards, the mercury was found detained in the lungs, in about thirty inflamed spots of induration, varying in size from a pea to a filbert. In some of these supuration had commenced.

EXPERIMENT XXIV. Two drachms of mercury were introduced into the jugular vein of a very large dog. Six hours afterwards, the animal

¹ Pathological Catalogue of Coll. of Surg., vol. ii, p. 4, from M.S. Cat.

refused his food, became feverish, and presented the usual symptoms of inflammation of the lungs; subsequently he appeared better, the appetite returned, and a very frequent cough was the only remaining prominent symptom. On the ninth day, a number of globules appeared in the fecal matter, and continued to pass till the thirteenth day, after which they disappeared. The animal's health was now in some measure restored, when he was killed.

Post-mortem Appearances. The lungs were found much altered by inflammation, adherent to the pleura, and solidified; they contained a great number of indurated tumours, filled with pus and mercury. No mercury was found in the other organs, with the exception of a few grains in the pleura, and in the liver. The stomach and the intestines contained a considerable quantity, but none could be detected in the vessels of those parts; some was, however, met with in the œsophagus, in the trachea, and in the bronchi. These last also contained some *débris* of the pulmonary tissue. The presence of the mercury in the liver is attributed by M. Gaspard, in this case, to its having regurgitated from the right cavity of the heart into the inferior vena cava, and having thence gravitated into the *venæ cavæ hepaticæ*.

These experiments are in accordance with that of Clayton, who, having injected mercury into the jugular vein, found it again four months afterwards in an abscess in the lung.

From all these cases it appears, that liquid mercury cannot circulate in the living vessels, because it becomes mechanically stopped in the capillary system of the lungs, where it impedes the circulation, and causes inflammation and suppuration. It has been asserted, that the abscesses thus found differ in their characters from secondary abscesses, arising from purulent infection. The difference, however, as we shall hereafter see, arises simply from the fact of a larger number of capillaries being obstructed at once (in consequence of the tendency of the blood to coagulate) in the latter than in the former case.

Experiments Nos. XVI and XVII, before recited,¹ show that where mercury is introduced through one of the branches of the aorta, the terminal vessels are affected in the same way as when it is carried along the pulmonary artery. The first system of capillaries to which the foreign matter is sent, is that in which, and in which alone, in these instances, the inflammatory symptoms are developed.

The same principle may be illustrated with regard to the portal circulation. If fluid mercury is injected into one of the mesenteric veins, it is arrested in its progress in the capillary system of the liver, where each globule of mercury becomes the centre of a small patch of congestion, which terminates in suppuration. In all the cases now mentioned, it certainly does not appear to be the size of the globules which prevents the passage of the fluid through the capillary tubes; for, even in the dead body, these may be perfectly injected with mercury. Another explanation must therefore be sought for, and one presents itself which appears to throw considerable light upon this question. If fluid mercury be agitated with recently drawn blood, it will have little effect in coagulating it *en masse*, but some of

¹ LONDON JOURNAL OF MEDICINE, March 1850, vol. ii, pp. 237-8.

the globules of the mercury become very firmly attached to small portions of fibrine, and the two will be found to adhere very firmly together. In this experiment, the fibrine of the blood is no doubt separated to a certain extent from its other parts (as it would be if beaten with a twig), and adheres to the foreign substance with which it is brought in contact. May we not suppose that something of the same kind takes place in the living vessels,—that, as the globules of mercury are shaken with the blood, the latter parts with some of its fibrine, which adhering to the former, prevents it from being carried forward in the course of circulation?

Impalpable powders, when suspended in water and introduced into the blood, are likewise mechanically arrested by the first capillary system to which they are sent. Oily and viscid fluids, as illustrated in the following experiments, are also unable to pass through the minute tubes of the different organs of the body.

EXPERIMENT XXIV. A full half-ounce of chicken's fat, refined and melted, was injected into the jugular vein of a very large dog. The animal was immediately affected with extreme dyspnoea, faintness, and prostration of strength, accompanied by a very slow pulse and inability to stand. An hour afterwards, there were fever, shiverings, symptoms of pain in the chest, and a frequent pulse. These symptoms continued during the second day; and on the third, the animal was enabled to get up and to walk, although with a very unsteady motion. On the second day, the excrements were soft, yellow, pultaceous, and oily; similar evacuations also occurred on the fourth day, after which they were not observed. On the sixth day, the animal was convalescent.

EXPERIMENT XXV. Some mercurial ointment was injected two days afterwards into the opposite jugular vein of the same dog; the quantity employed was about a fourth part of that used in the last experiment. There was immediate prostration of strength; the body was rendered immoveable, and the pulse was reduced to twenty-four beats in the minute. The respiration became very slow and short. An hour afterwards, the pulse rose to thirty, and the respiration became more free. Extreme dyspnoea, however, followed, and the animal died an hour and a half after the injection of the ointment.

Post-mortem Appearances. The lungs were found inflamed and hepatised from the former experiment. The branches of the pulmonary artery were obstructed with a dark concrete fibrous and elastic clot. This had moulded itself to the branches of the pulmonary artery, and followed its ramifications.

EXPERIMENT XXVI. Three drachms of olive oil, warmed, were injected into the jugular vein of a fox. As in the former experiments, there was complete loss of power; the respiration was interfered with, and the pulse faltered. The animal died at the expiration of twenty minutes.

Post-mortem Appearances. The body was examined four hours afterwards. Some bloody fluid was contained in the bronchi; the venous system, the right cavities of the heart, and the lungs, were greatly gorged with blood. The pulmonary tissue, for the most part, no longer crepitated upon pressure, and portions of it sank when

placed in water. Some drops of oil could be distinguished exuding from its structure, which left an oily feeling upon the fingers.

A considerable difference of opinion appears to have existed respecting the effect of the introduction of milk into the veins. Hunter found that the injection of milk into the veins of a dog proved fatal; while M. Gaspard affirms that as much as six drachms may be made to pass into the circulation, without in any way interfering with the animal functions. In trying the effect of milk upon recently-drawn blood, I find that, if the milk is fresh, it tends to retard the coagulation of the blood; but if it is sour, it promotes it in a very marked degree. It is not improbable, that this circumstance may account for the different effects which have been observed by different physiologists upon this point, and may reconcile the discordant evidence which they have left us.

EXPERIMENT XXVII. A grain and a half of corrosive sublimate, dissolved in water, were injected into the veins of a middling-sized bitch. This was followed by a kind of dysentery, and vomiting of sanious jelly-like matter. From time to time, there was great increase in the secretion of saliva; symptoms of inflammation of the lungs supervened, and death occurred three days afterwards.

Post-mortem Appearances. On opening the body, the rectum was found much inflamed, the liver dark-coloured, and the gall-bladder full of thick viscid black bile. The lungs were studded with a number of little abscesses, separated from each other by nearly healthy pulmonary tissue.

EXPERIMENT XXVIII. A grain of corrosive sublimate introduced into the jugular vein was soon followed by increased secretion of saliva, dyspnoea, and symptoms of inflammation of the lungs. Death occurred on the fourth day.

Post-mortem Appearances. Scattered through the lungs were found very dark tumours, varying in size from a pea to a filbert. Some of these were inflamed, some had suppurated, while others were gangrenous. The liver was dark, and soft in structure; the gall-bladder full of black, thick, and viscid bile.

In repeating this experiment with five grains of the salt, dissolved in an ounce and of half a distilled water, the animal died in a few seconds.

In these last experiments, we find that the foreign matter is not confined in its influence to the first system of capillaries to which it is conveyed. There is a disposition manifested to expend its morbid action on the liver and the mucous membrane of the intestines—a disposition which we shall find still farther developed in the fourth class of cases above mentioned.

(To be continued.)