

BRYANT (W.S.)

VALVES

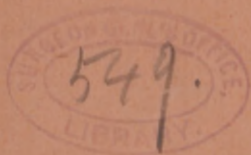
IN THE

Veins of the Human Intestines.

BY

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VALVES IN THE VEINS OF THE HUMAN INTESTINES.¹

BY W. S. BRYANT, A.M., M.D.

HISTORY.

CHARLES ETIENNE described valves in the portal system of man, which he called apophyses, and which he compared to the valves of the heart. Bauer met valves in the short veins which run from the stomach to the splenic veins in man, which Cruveilhier was unable to verify.

Milne Edwards says that among mammals there are no valves in the portal system, but that in some species one meets in these vessels valves more or less numerous.

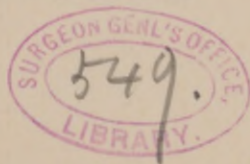
“Dr. Crisp, of England, has described valves in the splenic veins in some of the inferior animals. In one of the mesenteric veins of the reindeer he showed forty-two pairs of valves.” (From the *N. Y. Med. Journal*, 1865.)

Hyrtl, in the *Lehrbuch der Anatomie*, says: “Only in the portal vein of the rodents have I found a very pretty spiral valve of three to eight revolutions.”

Sappey has described some valves belonging to the portal system of veins. These were found in the falciform ligament of the liver in very small veins.

Dr. Hochstetter recently, in the *Archiv für Anatomie und Physiologie* (1887), from whose article I take the liberty to quote at some length, because his is the most complete work on the subject, notes the following observations, which I have been able to confirm for the most part. He found that in the newborn infant the venous branches upon the stomach were furnished with valves, one in each minor branch, very rarely two. These valves were bicuspid, and usually placed in those vessels at or near their openings into the main branches. The branches of the coronary vein of the stomach oftentimes appeared to

¹ A Graduation Thesis. The investigations were made in the Anatomical Department of the Harvard Medical School in the winter of 1887-8.



have a relatively small number of valves. In the great omentum the veins had valves at the venæ gastro-epiploicæ, and wherever smaller branches emptied into greater. "With increasing age, the valves become little by little incompetent: first, in the gastric branches of the vena gastro-epiploica dextra near the pylorus, next along the great curvature in the branches of the vena gastro-epiploica sinistra and in the venæ gastricæ breves, so that they persist longest in the branches which empty into the communication (if there is any) between the two venæ gastro-epiploicæ. Towards the twentieth year of life no venous branches along the great curvature of the stomach seem any longer to possess competent valves. Comparatively late the valves of the superior branches of the coronary vein become incompetent, and, last of all, usually those in the veins of the great omentum, where I sometimes found, even in very old people, perfectly competent valves."

"The valves become incompetent with increasing years by becoming smaller little by little, so that the two opposite edges of the valves no longer touch when the vessel is completely filled. Finally, only two bow-shaped linear seams, corresponding to where the valves had been attached, remain, and these can disappear, so that no trace of the valves is left." Dr. Hochstetter goes on to state that in many animals valves are found in the gastric veins, and in some they are more numerous than in man.² In the horse, he found them throughout the gastro-splenic veins. He also found them in the main, as well as the small branches of the gastric veins in antelope dorkas, sheep, goat, and in carnivora (dog, fox, cat, and otter). They were most numerous and best developed in the dog and cat. He found valves also as well developed and as numerous in the horse and hog as in the beasts of prey. In the rabbit he found only a very few valves, and these were in the gastric veins; while in the hedge-hog and bat (*Vesperugo noctula*) he found none. On a close examination of two monkeys, he found good evidence of valves in the smaller veins, especially towards the great omentum and here and there in the branches of the gastric tributaries of the venæ gastro-epiploicæ, or there were dilatations, indicating the former presence of valves. Dr. Hochstetter says it is not surprising that the valves in the branches of the portal vein become incompetent with age when we consider that

² Henle had already mentioned valves in the branches of the portal vein of mammals. Weigle found them in ruminants and the horse. G. Leising, C. Müller, and F. Müller mention some valves in the splenic vein of the domestic animals.

many of the valves of the extremities do not last to maturity.

METHODS.

Professor Dwight has aided me with his able supervision in making the following observations :

Last winter, while making general injections of the abdominal veins in dogs, I noticed that the injecting mass rarely entered the small veins of the intestines, and, on close examination, found the obstruction was due to valves. I then made injections of the portal system in several animals and in the infant at birth, and lastly in adult man, with what results will be shown later.

The methods I used were calculated to show only competent valves. A coarse injecting mass that would not pass through the capillaries, such as gelatine thickened with Prussian blue, was used. If competent valves occurred, their presence was at once shown by the arresting of the mass in the course of the vein. When the mass is thus brought to a standstill, a minute examination is necessary to show the nature of the obstruction, and a microscope of low power is useful.

A number of the valves discovered in this way, with the vessel still distended, were hardened and sectioned with a microtome. The valves were then seen cut at various angles according to the plane of the section.

Figure 1 is from a microphotograph by Mr. G. W.



FIG. 1.

Fitz, of a vessel from the jejunum of a woman, prepared and cut in the preceding way. The section is longitudinal to the vessel di-

viding the two cusps of a valve.

For a thorough view of the structure of the valves in contradistinction to their position, clear gelatine can be used for an injecting mass. The advantage of this is its transparency, for when a vein having a valve distended with clear gelatine is cleanly dissected, the outline of both its parts can be seen through the walls of the vessel, either with the naked eye, if the valves are large, or with a low power of the microscope if they are in the smaller veins.

OBSERVATIONS.— ANIMALS.

In the search for valves the veins of the intestines in the following animals were injected — guinea pig,

rabbit, cat and dog. No evidence of valves was found in the guinea pig. In only one rabbit the veins of the last four or five inches of the large intestine were found well furnished with valves. These valves were placed along the attached border of the intestine in the



FIG. 2.

mouths of the *venæ breves*. Figure 2 shows a portion of that intestine (rabbit), natural size, with the valves diagrammatically represented.

The cat was found to have a considerable number of competent valves at varying intervals along the intestine. They were usually most numerous in the vicinity of the *cæcum*, above and below, and occurred in a double series, one at the mouths of the *venæ breves*, and the other at the mouths of their principal tributaries.

The dog was found to be furnished with a more efficient set of valves than any of the other animals examined. The valves were found the whole length of the intestine with only here and there a spot where the injecting mass had entered the fine veins. In these places there was usually some indications of the presence of an incompetent valve. The valves usually occurred in a double series, more rarely triple or single. The most constant valves were at the mouths of the main tributaries of the *venæ breves*. The next most constant were at the mouths of the *venæ breves*, and the least constant were placed somewhere in the secondary tributaries. In one dog a valve was found in the inferior mesenteric vein a short distance from its lower extremity.



FIG. 3.

Figure 3 represents a portion of a dog's small intestine, actual size, with diagrammatic valves.

MAN.

Infants at birth, children, and adults were examined.

INFANTS AT BIRTH.

In infants, valves are found at irregular intervals along the whole course of the intestines, more numerous on the large intestines than on the small. On the large intestine they occurred in the intestinal veins (*venæ breves*) at or near their mouths, and sometimes in the mouths of the main tributaries of these veins. This was more frequently the case on the cæcum. The number of valves varied with the individual; in the majority of cases more than half of the *venæ breves* of the large intestine contained valves.

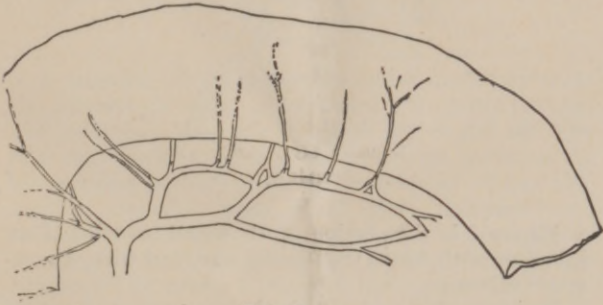


FIG. 4.

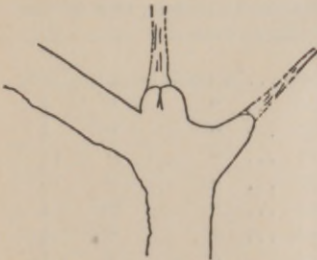


FIG. 5.



FIG. 6.

Figure 4 is a portion of the large intestine of an infant at birth, one and one-half natural size with diagrammatic valves.

Figures 5 and 6 are from microphotographs by Mr. G. W. Fitz, of the valves themselves of the large intestine, injected with clear gelatine, showing the outline of both cusps of a valve, through the anterior wall of the vein. On the small intestine the venous valves

were arranged in somewhat the same way. They were found in the intestinal veins (*venæ breves*) at or near their mouths, and at the mouths of the superficial branches of these veins. There is a much smaller number of valves here than in the large intestine; however, they are rarely entirely absent and occasionally are found in as many as one in five of the *venæ breves*.

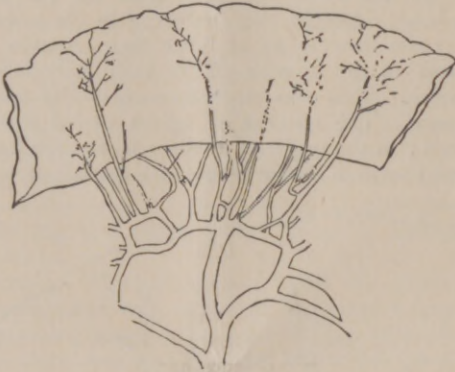


FIG. 7.

Figure 7 is the portion of the small intestine of an infant at birth, twice the natural size, and with diagrammatic valves.

The following table shows the percentage of valves found in a number of the infants examined, taking 100 as the greatest possible number; that is, one at the mouth of each one of the *venæ breves* :

No.	1.	In large intestine, 100% . . .	In small intestine, 20%
2.	"	100 . . .	" $\frac{3}{5}$
3.	"	90 . . .	" $\frac{1}{2}$
4.	"	87 . . .	" $1\frac{1}{5}$
5.	"	85 . . .	" 12
6.	"	84 . . .	" 4
7.	"	80 . . .	" $\frac{1}{5}$
8.	"	77 . . .	" $\frac{1}{10}$
9.	"	63 . . .	" $\frac{17}{100}$
10.	"	32 . . .	" 1
11.	"	25 . . .	" 10
12.	"	20 . . .	" 0
13.	"	10 . . .	" $\frac{1}{2}$
14.	"	4 . . .	" $\frac{1}{10}$
15.	"	2 . . .	" 0
16.	"	0 . . .	" $\frac{1}{20}$
17.	"	0 . . .	" 0

CHILDREN.

Only three children were examined. The youngest was about two weeks old. The large intestine had valves in about ten per cent. of the venæ breves, and in the small intestine three valves only were seen. The next child was about five months old. In this there were only four valves found which were on the jejunum. The third child was ten years old and quite rachitic. No valves were found on the large intestine. The valves found on the small intestine were most numerous in the jejunum. There were twelve valves in the venæ breves, and thirty valves in as many superficial branches of the venæ breves. These superficial tributaries arise from the surface of the intestine and empty into the venæ breves a short distance from the intestine.

ADULTS.

A number of human adults were examined with the following results. Few valves were found in any one individual, even the youngest, and it did not appear that age after adolescence had much influence on the number of valves on the intestines. When the veins in the other parts of the great omentum were intact, I noticed that valves were less numerous along the free border in those veins which in the erect position would be nearly horizontal. Also that the disappearance of valves seemed to begin in one or two of the main veins lying near the centre of the omentum, and that the valves disappeared in the direct course of these veins before they did in their tributaries.

In the intestines of most adults there were a few valves remaining in the venæ brevis. These were usually on the ileum near the cæcum.

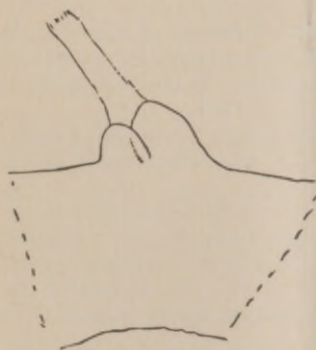


FIG. 8.

Figure 8 is from a microphotograph by Mr. G. W. Fitz of a valve from the cæcum of an adult. The injecting mass is clear gelatine, and the outlines of both the cusps of the valve are seen clearly through

the wall of the vessel. Valves in the superficial branches of the venæ breves occur very frequently on

the jejunum. They are most numerous at the mouths of these veins, but there are sometimes two more sets of valves in other portions of the superficial vessel, making in all three sets of valves.



FIG. 9.

Figure 9 is a fragment of the small intestine of an adult man considerably enlarged, showing superficial branch of vena brevis, containing diagrammatic valves.

As autopsies were the chief source of material, in but few cases the whole intestine could be examined, and in many only a small portion, so that the table is not as complete as might be desired.

The table on the following page shows the number of competent valves found in the various parts of the intestines of human adults.

The valves of the intestinal veins, like those of the rest of the portal system, are bicuspid. They are also thin and delicate, and in the infant extremely elastic. In man the line of contact of the two halves of the valves, in the majority of cases, is nearly parallel with the course of the intestine.

The number of subjects intermediate between the infants at birth and the adults which were examined is very small, and the conclusions based on them may have to be altered after a wider experience.

No.	On Cæcum.	On rest of Large Intestines.	On Small Intestines.		Total.
			In venæ brevis.	In superficial branches.	
1	5	2 on ascending colon.	22 (2 feet examined.)	56 (2 ft. examined).	85
2	Not exam.	6	3	43	52
3	1	11	18	20	50
4	1	None in ascend. col.	9 (mostly in ileum).	37 (mostly in jejun.).	47
5	1	3	7	23	34
6	None.	5 (also 4 non-comp.).	3 (mostly in ileum).	15 (mostly in jejun.).	23
7	"	6	13 " "	None.	19
8	"	None.	1	12	13
9	"	1	3	7	11
10	5	None in ascend. col.	Not examined.	Not examined.	5
11	None.	" "	None.	3	3
12	"	None.	"	None.	
13	"	None.	"	"	
14	"	None.	"	"	
15	Not exam.	Not examined.	"	"	
16	"	" "	"	"	
17	"	None in transver. col.	Not examined.	Not examined.	
18	"	" "	None in jejunum.	None in jejunum.	
19	"	" "	Not examined.	Not examined.	
20	"	Not examined.	None (2 ft. exam.).	None (2 feet exam.).	

CONCLUSIONS.

These observations show that at birth the valves on the intestines are quite numerous in man, and at this age they are more abundant on the large intestine. Also that in a few months the valves either disappear or become incompetent, with few exceptions. In adult man there are usually a few valves, and these are more abundant in the small intestine, especially in the superficial tributaries of the venæ breves. These valves are more numerous in the jejunum, and disappear as we approach the cæcum.

Though the valves just described were discovered since Hochstetter's paper was written, his remarks on the significance of valves in the portal system will apply to them. After alluding to the fact that the presence of valves in the branches of the portal vein seems widely spread among mammals, he says: "But only in individual species, as in the beasts of prey, do the valves possess great importance in connection with the circulation. In many species they are to be considered much more as rudimentary organs, which act either only in youth, as in men and perhaps the ape, and later in part or wholly disappear, or for the most part, as in the rabbit, are very imperfect."

