PARTIAL OCCLUSION OF THE AORTA WITH THE
METALLIC BAND. OBSERVATIONS ON BLOOD
PRESSURES AND CHANGES IN THE
ARTERIAL WALLS.*

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PLATES 20 TO 26.

(Received for publication, June 27, 1916.)

In all except one of the aortic experiments of Dr. Halsted and myself the constricting aluminum band was applied to the abdominal aorta below its inferior mesenteric branch. At the time of our final observations on these animals records were made of the blood pressures in the femoral and carotid arteries. Obviously, in order to draw any conclusions as to the effect of the band on the blood pressure below the site of the constriction, the normal relation between the pressures in these two vessels must be known.

In a series of experiments performed by Dr. Dawson on dogs, it was learned that the pulse pressure in the femoral artery is normally about twice as high as in the carotid. The femoral systolic pressure is higher and the diastolic pressure lower than the corresponding pressures in the carotid artery (Fig. 1).

After partial occlusion of the aorta the systolic pressure in the femoral is markedly lowered. This lowering of the systolic pressure is due mainly to a fall in the pulse pressure, for the diastolic pressure remains almost stationary, or may be actually increased. In the cases of most marked dilation the femoral pulse pressure was only about one-half the carotid pulse pressure, while the femoral diastolic was actually greater than the carotid diastolic pressure (Fig. 2).

*This communication is to supplement Dr. Halsted's paper on Circumscribed Dilation of an Artery Immediately Distal to a Partially Occluding Band, *J. Exp. Med.*, 1916, xxiv, 271.

During the 1st hour after the application of a moderately tight band the femoral pressures undergo marked changes. At first the systolic and diastolic pressures are both lowered. In a few minutes the diastolic pressure may become even greater than before the application of the band, while the systolic is still subnormal (Fig. 3).

After complete occlusion of the aorta the normal blood pressure relation between the femoral and carotid arteries may, ultimately, in some instances, be reestablished.

Gross Effect of the Band on the Vessel Wall.—In some cases in which the band has been loosely applied, only slight gross alteration in the wall of the vessel under the band is found, even after 6 months. On removal of the band the plications of the wall can be unfolded, and the intima presents a normal looking, smooth surface (Fig. 4).

In the majority of cases there occurs an atrophy or necrosis of the vessel wall included in the band. In some cases the band had made its way through the atrophic wall into the lumen of the vessel (Figs. 5, 6, and 7); in these a new wall had formed outside the band. In no instance was there leakage of blood. On splitting open the artery for examination the band is seen, more or less distinctly, shimmering through the atrophic arterial wall. This wall may be attenuated to a veil-like thinness or, as described, may, in places, have entirely disappeared, disclosing portions of the band. The upper edge of the band, at the posterior surface of the arterial wall, is almost invariably the first part to be exposed (Figs. 5 and 6).

Histologic Changes.—For a short distance below the site of the band there is usually a definite atrophy of the elastic and muscular tissues. In Case 7, Series I, (Fig. 8, c), there was almost a complete break in the elastic tissue below the edge of the band. The connective tissue throughout the wall of the artery seemed to be little affected in amount in the dilated portion of the vessel.

At the site of the band the new wall that forms over it is composed mainly of fibrous tissue (Figs. 7 and 9). Thus far, none of our cases have shown regeneration of the elastic tissue in this new wall.

In the fibrous cord (Figs. 10, 11, and 12) which occasionally forms under the tightly rolled band no remains of the vessel wall have been found. We think it probable that the original arterial wall undergoes complete atrophy and absorption in these cases, and that

the cylindrical cord found under the band consists of new tissue which, growing in from above and below, replaces the old. This cylindrical fibrous cord may be highly vascularized (Fig. 12). We have found no evidence of union between the apposed intimal surfaces.

EXPLANATION OF PLATES.

PLATE 20.

FIG. 1. The normal relation between the systolic and diastolic end pressures in the femoral and carotid arteries of dogs.

FIG. 2. Systolic and diastolic end pressures in Dog 7, Series I, 6 months and 19 days after the band was applied. Good dilation.

FIG. 3. Systolic and diastolic end pressures in the femoral artery during the first 35 minutes after a tight band was placed around the aorta.

PLATE 21.

FIG. 4. Dog 9, Series I. The band was rolled to the early stage of palpable thrill. The band in 6 months has produced only slight thinning of the vessel wall.

FIG. 5. Dog 7, Series II. Marked constriction. The thrill was not obliterated. The band had, in 6 months, cut entirely through at its upper edge, posteriorly. At the lower edge of the band there is still a remnant of the atrophied wall (compare Fig. 7).

FIG. 6. Dog 0, Series II. The band was tightly rolled but not totally occluding. At autopsy, 5½ months later, the lumen under the band was about 3 mm. in diameter. The aortic wall was so thin that the band shimmered through it everywhere, and had cut through at several places along the upper and lower edges. A new arterial wall, almost complete, had formed outside the band.

PLATE 22.

FIG. 7. Dog 7, Series II. Longitudinal section through the arterial walls, old and new (compare Fig. 5). Weigert's elastic tissue stain. *a* is the site of the band; *b*, elastic tissue of the aortic wall proximal to the band; *c*, elastic tissue distal to the band; *e*, the new wall which had formed outside the band where it had cut through, posteriorly. Between *a* and the lumen of the vessel the original wall is greatly thickened.

FIG. 8. Dog 7, Series I. The band was tightened until the thrill disappeared; the pulse was not obliterated. Killed after 6 months and 19 days. Longitudinal section through the arterial wall at the site of the band. Weigert's elastic tissue stain. In this case there was marked dilation below the band. *a* is the

site of the band; *b*, the aortic wall proximal to the band; *c*, the aortic wall distal to the band, showing definite atrophy and a break in the elastic tissue; *e*, the new wall that had formed outside the band; *x* to *x*, the segment of the vessel wall that had been included by the band. In this segment there is marked atrophy of the elastic tissue, particularly at the edges of the band.

PLATE 23.

FIG. 9. Dog 17, Series I. The band was tightened to the vanishing side of the thrill stage. Longitudinal section through the arterial wall at the site of the band. Weigert's elastic tissue stain. Under the band the elastic tissue is rarified. Below the band, where there was a moderate amount of dilation, atrophic changes are noted. *a* is the slit occupied by the band; *b*, the vessel wall proximal to the band; *c*, the vessel wall distal to the band.

PLATE 24.

FIG. 10. Dog 2, Series I. The band was tightened until the pulse had just disappeared. When examined after 7 months, a solid fibrous, cylindrical cord was found under the band.

PLATE 25.

FIG. 11. Dog 2, Series I. Longitudinal section through the fibrous cord shown in Fig. 10. Weigert's elastic tissue stain. *a* is the site of the band, under it the elastic tissue has vanished; *b*, the vessel wall proximal to the band; *c*, the vessel wall distal to the band, showing definite atrophy of the elastic tissue; *d* to *d'*, the fibrous cord; *e*, fibrous tissue that formed about the band. There is almost complete disappearance of the elastic tissue at the site of the band.

PLATE 26.

FIG. 12. Dog 2, Series I. Transverse section of the fibrous cord through *d*, Fig. 11. Hematoxylin and eosin.

FIG. 1.

FIG. 2.

F.S. 188. F.D. 95. Pulse pressure 93. F.S. 124. F.D. 86. Pulse pressure 38.
 C.S. 162. C.D. 103. Pulse pressure 59. C.S. 135. C.D. 72. Pulse pressure 63.

FIG. 3.

- A. Without band 175, 135.
- B. Immediately after band was applied 131, 121.
- C. 5 minutes later 136, 123.
- D. 25 minutes later 155, 133.
- E. 35 minutes later 167, 144.
- F. 35 + minutes later 167, 143.
- G. Band removed 189, 138.

(Reid. Partial Occlusion of the Aorta.)

FIG. 4.

FIG. 5.

FIG. 6.

(Reid: Partial Occlusion of the Aorta.)

FIG. 7.

FIG. 8.

(Reid: Partial Occlusion of the Aorta.)

FIG. 9.

(Reid: Partial Occlusion of the Aorta.)

FIG. 10.

(Reid: Partial Occlusion of the Aorta.)

FIG. 11.

(Reid: Partial Occlusion of the Aorta.)

FIG. 12.

(Reid: Partial Occlusion of the Aorta.)