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# Aortic Ring Rupture in Stallions

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An extensive literature has accumulated on aortic rupture in horses[2]. In most of the reported cases the tear occurred through the aortic wall close to or above the level of closure of the aortic valves. Medionecrosis has been frequently incriminated as a predisposing lesion[4].

The purpose of this report is to describe eight ruptures in stallions which occurred through the aortic ring (aortic annulus fibrosus) and not through the wall of the aorta itself. Rupture of this type has, apparently, not been reported previously.

## Case Reports

1. This was a 10-year-old Thoroughbred stallion that staggered and went down immediately after covering (breeding) a mare. He got up in a few minutes, was very weak and cyanotic, went down again, and died fifteen minutes later.

*Autopsy:* There was a tear of the aortic ring in the right coronary sinus. Dissection had proceeded from the rupture site into the right ventricle (Figs. 1, 2). There was marked right ventricular dilatation.

2. This was a 17-year-old Thoroughbred stallion that was reported to have shown signs of heart failure for a month. Tachycardia and jugular pulse were the only signs described.

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*Fig. 1.* Rupture of aortic ring in right coronary sinus. The aortic valve leaflet has been cut and reflected. The rupture is apparent between the end of the forceps and the orifice of the right coronary artery. Endocardial scarring from turbulent blood flow is apparent under the forceps.

*Fig. 2.* The opening of the dissection tract (cardioaortic fistula) into the right ventricle deep to the atrioventricular valve.

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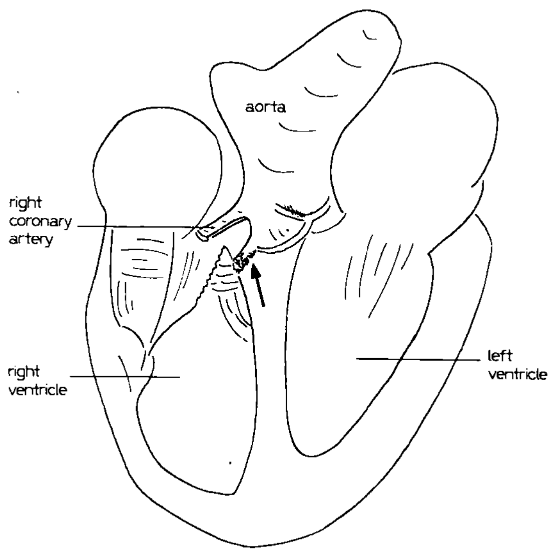


*Fig. 3.* Schematic dorsal view of heart to illustrate the site of the dissection from aorta to right ventricle (arrow).

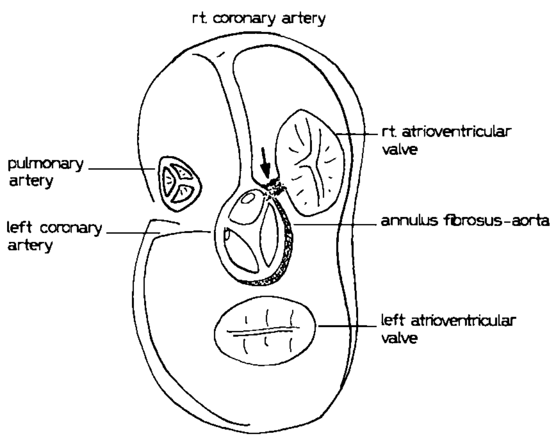


*Fig. 4.* Schematic side view showing dissection tract (arrow).

*Autopsy:* There was a tear of the aortic ring in the right coronary sinus with dissection into the right ventricle. There was severe endocarditis of the right atrioventricular valve and dilatation of the right side. The endocarditis was considered to be secondary to jet streaming of blood through the dissection tract (cardioaortic fistula) against the valve (Figs. 3, 4).

3. This 13-year-old Thoroughbred stallion showed signs of heart failure 6 weeks before the final episode. At that time there was a jugular pulse, tachycardia, and a distinct diastolic murmur over the aortic valve. Recovery seemed complete. The second episode was characterized by marked tachycardia, weakness, depression, patchy sweating, and a jugular pulse. There was a murmur over the aortic valve which, apparently, was both systolic and diastolic. The animal was given digitalis; his condition gradually worsened during the second day. On the morning of the third day there was a systolic-diastolic prolonged, hard pounding sound over the aortic valve. Electrical conversion was attempted and the animal died in ventricular fibrillation.

*Autopsy:* There was a rupture of the aortic ring in the right coronary sinus with dissection into the right ventricle. Dissection had also proceeded parallel to the right coronary artery for a short distance. Both sides of the heart were dilated and the left ventricular musculature was hypertrophied (Fig. 5).

4. This 22-year-old Thoroughbred stallion was destroyed because of advanced age and gradual loss of condition over the past few months. There was no history of heart failure.

*Autopsy:* There was symmetrical cardiac hypertrophy and dilatation. There was an old rupture of the aortic ring in the right coronary sinus which had dissected toward the apex of the heart in the interventricular septum. The dissection tract was surrounded by masses of fibrous tissue, plates of calcified tissue, and bone.

5. This 18-year-old Thoroughbred stallion covered his first mare of the season normally. He fell to the ground and died while being walked back to his stall.

*Autopsy:* The heart was symmetrically dilated. There was a fresh tear of the aortic ring in the right coronary sinus with blood dissecting into the interventricular septum (Figs. 6, 7) There were multiple ecchymotic hemorrhages in the mesentery.

6. This was an 11-year-old Standardbred stallion. He bred a mare uneventfully and was returned to his paddock. Within 15 minutes he 'lay down and died'.

*Autopsy:* There was a tear of the aortic ring in the right coronary sinus with dissection of a hematoma-like mass of blood into the interventricular septum. There were multiple ecchymotic hemorrhages in the mesentery.

7. This was an American Saddlebred stallion of undetermined age. He had bred a mare and fell dead soon afterward.

*Autopsy:* There was a tear of the aortic ring in the right coronary sinus with dissection of blood into the interventricular septum.

8. This 17-year-old Thoroughbred stallion had bred a mare several days previously. He had been 'sick with a heart problem' since that time.

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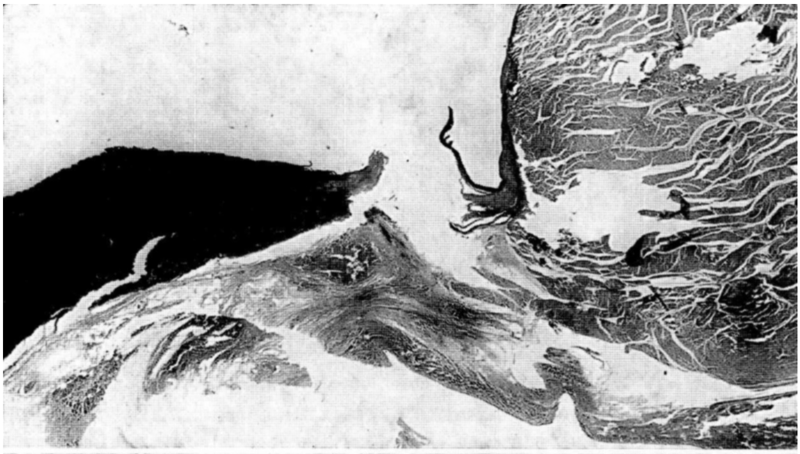
*Fig. 5.* Case 3. Rupture of aortic ring. Aorta at left and myocardium at right. Orcein-Van Gieson, 3 ×.

*Fig. 6.* Case 5. Rupture of aortic ring. There is dissection of blood in the connective tissues (→). Aorta at left and myocardium at right. Barbeito-Lopez, 10 ×.

*Fig. 7.* Normal aortic ring and adjacent tissues. 1 Aorta, 2 myocardium, 3 loose connective tissues. Van Gieson 10 ×.



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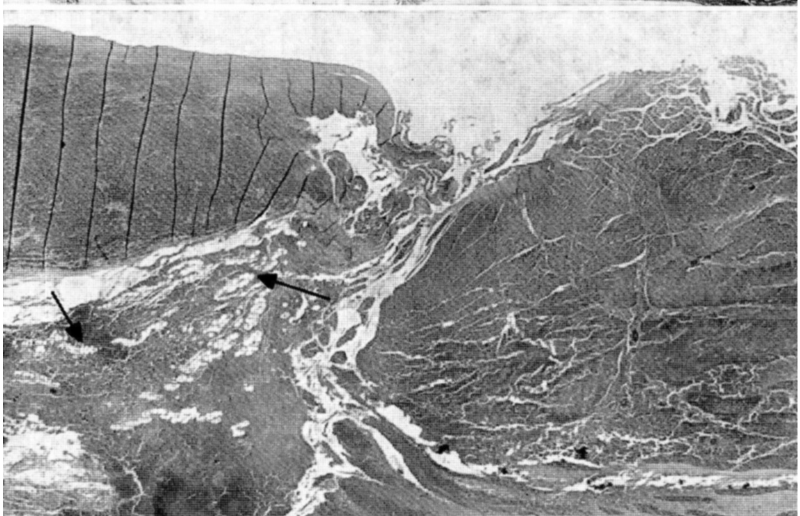

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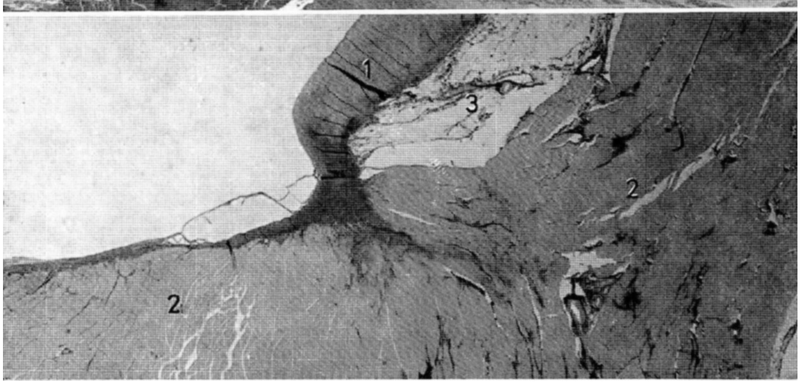


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*Autopsy:* There was a tear of the aortic ring in the right coronary sinus. Blood had dissected toward the apex of the heart beneath the endocardial surfaces of the interventricular septum. Blood had, also, dissected dorsally around the aorta. There was cardiac tamponade and large amounts of free blood in the abdominal cavity as a result of blood dissecting along the aorta through the aortic hiatus of the diaphragm.

## *Histopathology*

The rupture, in all cases, appeared to occur through the chondroid fibrous tissue adjacent to the edge of the cartilaginous plate. Although medionecrosis was found in all cases, to varying degrees, no evidence of pre-existing degeneration or necrosis could be detected in the fibrous tissue of the aortic ring itself.

The possibility of medionecrosis predisposing to the aorta tearing away from the ring could not be critically evaluated. Once tearing had occurred, precise evaluation of whether the ring tore or the aorta tore away at the poorly defined junction of the ring and aortic media was impossible.

## Discussion

The several factors involved in rupture of the aortic wall have been given[1] as follows: The aortic wall is normally thinner in the area where rupture occurs. The thoracic aorta is firmly held in place by its large branches and attachments to the ventral surfaces of the thoracic vertebrae. The recoil of the column of blood at the end of systole (closure of the aortic valve) will tend to push the heart down while the aorta is held firmly in place, thereby putting tension on the convex part of the aorta close to the aortic valve. Excitement—with elevation of heart rate and blood pressure—would exaggerate the phenomenon and lead to rupture with or, exceptionally, without pre-existing medionecrosis.

All eight of our cases were in stallions. The acute cases—sudden death related to breeding—occurred early in the breeding season (February, March, April). In several cases, there was additional evidence of greatly elevated blood pressure—hemorrhages in the mesentery.

The stringent localization of the tear to the right coronary sinus requires explanation.

Greatly elevated blood pressure and increased peripheral resistance would increase the acceleration and, hence, force of the recoiling column of blood. Angular acceleration has two components, tangential and normal. With an increase in acceleration, the tangential component will tend to direct the column of blood toward the cranial part of the aorta—the position of the right coronary sinus.

Since the tear always occurred in the chondroid fibrous tissue close to the end of the cartilaginous plate, one may postulate an anatomical-mechanical *locus minoris resistentia* at this junction.

Similar ruptures of the aortic sinus have been described in the human as the result of congenital or acquired aneurysms of the aortic sinus[3]. The acquired cases were associated with aortic disease (syphilis, bacterial endocarditis, atheroma et cetera). The congenital aneurysms, which may rupture to form cardioaortic fistulas, are believed to arise from defective development of the distal bulbar septum. There was no evidence of either factor—congenital defect or aortic disease—in our equine cases.

To summarize, then, we feel that this type of tearing of the aortic ring occurs as a result of greatly elevated blood pressure during breeding. The localization of the tear is related to the anatomical-mechanical construction of the ring and the tensile force exerted by the recoiling column of blood. The cause of death in acute cases is postulated to be disruption of the atrioventricular bundle by the mass of dissecting blood. Microscopically, dissection of blood through the bundle could be demonstrated. In the more chronic cases the bundle was not disrupted on microscopic examination and cardiac dilatation and eventual failure were caused by the shunting of blood from the aorta to the right ventricle.

## *Summary*

Eight cases of acquired rupture of the aortic ring in the right coronary sinus with dissection (cardioaortic fistula) into the interventricular septum and into the right ventricle have been described in stallions. It is postulated that the ruptures are due to increased blood pressure during breeding and the direction of a recoiling column of blood against an area of anatomic weakness.

## *Zusammenfassung*

Es werden 8 Fälle mit Ruptur der Aorta im Bereich des Annulus fibrosus des rechten Koronarsinus (Cardio-Aorten Fistel) mit Zusammenhangstrennung von Kammerscheidewand und rechter Ventrikelwand beschrieben und die Pathogenese der Veränderungen diskutiert.

## *Acknowledgement*

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