ACTA THERIOLOGICA
Vol. 33, 25: 361—365, 1988

Abnormal Development of the Caudal Vena Cava in European Bison

PRZYPADEK NIEDOROZWOJU ŻYŁY GŁOWNEJ DOOGONOWEJ U ŻUBRA

Stanisław PYTEL, Mieczysław WĘGRZYN & Franciszek KOBRYŃCZUK

Pytel S., Węgrzyn M. & Kobryńczuk F., 1988: Abnormal development of the caudal *vena cava* in European bison. Acta theriol., 33, 25 : 361—365 [With 2 Figs].

A case of underdevelopment of the caudal *vena cava* was observed in an European bison, *Bison bonasus* (Linnaeus, 1758) aged 49 days, anaesthetized and bled until death because of congenital blindness. The animal had an inbreeding coefficient of 0.389. The abdominal part of this vein was not connected with its thoracic part but was continued as the right azygos vein. Other findings included increased mass of the spleen, its partial division into lobes, and its shifting to the visceral surface of the rumen which was also deformed. The observed abnormalities are related by the authors to a high grade of homozygosity of the animal.

[Dept. of Animal Anatomy, Warsaw Agric. Univ., Nowoursynowska 166, 02-776 Warsaw (SP, FK) and Dept. of Animal and Human Anatomy, Agric. and Teachers Univ., Żytnia 17, 08-110 Siedlce (MW), Poland].

The examined material was the cadaver of a male calf aged 49 days of *Bison bonasus* (Linnaeus, 1758); "Pomian", Pedigree No 1304, born in the reserve of the Białowieża National Park on Nov. 15, 1960. His mother was "Polatucha" (832) and his father was "Ponury" (902) belonging both to the lowland bison of Białowieża. The calf was in a good general condition but had to be eliminated because of congenital blindness on Jan. 3 1961. The body was kept in formalin till 1964 when the dimensions of it were measured and certain internal organs were taken for preparatory procedures (Pytel, 1969).

The pedigree books of the European bison (Żabiński, 1947—61) show that the parents of "Pomian" were consanguineous having five forebears in common — three males: "Poganin" (716), "Plisch" (229) and "Plebejer" (45) and two females: "Plakette" (49) and "Planta" (42). The inbreeding coefficient calculated by Wright's formula (1921) was in the case of "Pomian" $F=0.389$.

A vein was found lying below the vertebral column to the right from the descending aorta. It was a major blood vessel, its diameter at the height of the Th_8 vertebra was 17 mm, and it passed through the diaphragm not through the aortic hiatus but between the costal part

of the diaphragm and right crus of its lumbar part. The abdominal segment of this vein was dilated spindle-like at the height of the L_{1-3} vertebrae (Fig. 1—1). The following bilateral blood vessels were reaching this segment of the vein: the deep circumflex iliac vein (Fig. 1—4) which was met more distally by the testicular vein, the renal vein (Fig. 1—6) and the lumbar veins (Fig. 1—5). The thoracic part of the vein was joined by dorsal intercostal veins (Fig. 1—7) — the right ones from vein VIII to III, the left ones IX and VIII, and two trunk veins (Fig. 1—7), right and left, situated on both sides of the vein and joining both its dorsal surface at the height of the Th_8 vertebra. Before joining the vein both these trunk veins received the dorsal intercostal veins — the right trunk vein was joined by the dorsal intercostal veins from XIII to IX,

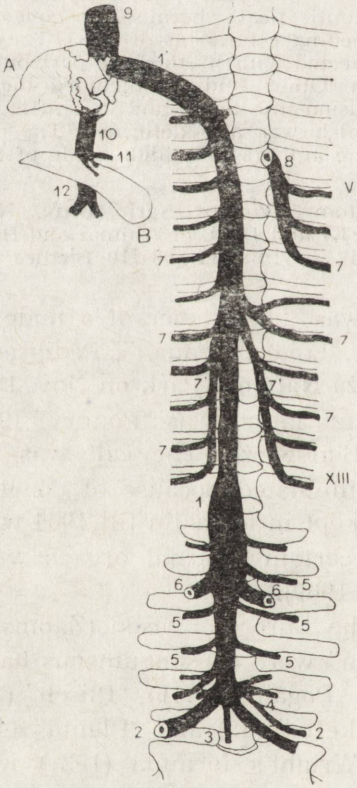

Fig. 1. Schematic drawing of the main veins view from the ventral side. 1 — *caudal vena cava* (abdominal part), 1' — right azygos vein, 2 — common iliac vein, 3 — middle sacral vein, 4 — deep iliac circumflex vein, 5 — lumbar veins, 6 — renal vein, 7 — dorsal intercostal veins, 7' — their common trun, 8 — left azygos vein, 9 — *cranial vena cava*, 10 — *caudal vena cava* (thoracic part), 11 — cranial phrenic vein, 12 — portal vein, A — heart, B — liver, V—XIII — ribs.

and the left trunk vein by the intercostal veins from XIII to X. The IX left dorsal intercostal vein was joind by the VIII left dorsal intercostal vein.

Besides that, the animal had the thoracic part of the caudal *vena cava* (Fig. 1.—10). This vessel appeared on the phrenic surface of the liver and was formed by several hepatic veins. This part of the caudal *vena cava* was joined by cranial phrenic veins (Fig. 1.—11) and passed then on to the heart in a pleural fold. On the surface of the liver the groove for caudal *vena cava* was absent.

The left azygos vein (Fig. 1.—8) was in the animal a short and poorly developed vessel joined by only three (VII, VI and V) left dorsal intercostal veins. It ended in the coronary sinus of the right atrium. The cranial *vena cava* (Fig. 1.—9) showed no abnormalities and its diameter was 20 mm at the site where it joined the coronary sinus.

The lumen of the arterial brachiocephalic trunk contained a septum separating at its whole length the blood reaching the left subclavian artery from the blood flowing into the common trunk of the carotid arteries and the right subclavian artery.

These vascular anomalies were associated with changes in the structure and situation of other organs. The spleen was enlarged (336 g or 0.69% of the total body mass) and was lying nearly completely on the visceral surface of the rumen (Fig. 2—A). The ventral extremity of the spleen was divided into three lobes, one of which was reached by aberrant vessels and nerves.

The structure of the rumen differed from the normal one, its ventral sac was shortened and the caudoventral sac was not developed (Fig. 2—b"). The cranial part of the duodenum was long and had two segments.

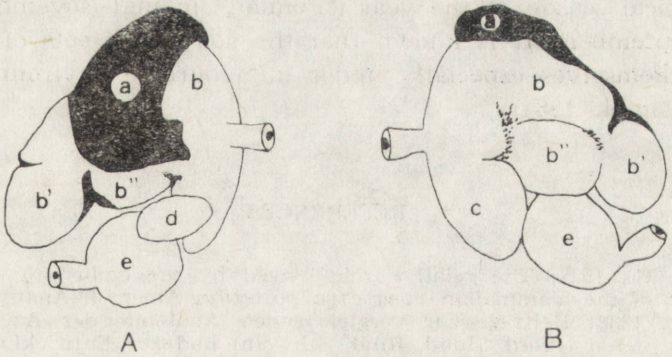

Fig. 2. Spleen and stomach view from the right side (A), and left side (B). a — spleen, b ⊢ dorsal sac of the rumen, b' — its caudodorsal blind sac, b" — ventral sac of the rumen, c — *reticulum*, d — *omasum*, e — *abomasum*.

The first was running from the pylorus in the craniodorsal direction obliquely to the liver. Here, it formed the second segment which swept abruptly in the ventral direction and formed a characteristic loop on the surface of the liver. The loop was lying with the gall bladder in a special incisure of the liver. The short descending part of the duodenum was lying obliquely in the caudodorsal direction.

On the basis of the data on the development of the system of the caudal cardinal vein (Butler, 1927; Grau, 1933; Vollmerhaus, 1964), the strongly developed venous vessel in this animal (Fig. 1.—1,1') may be regarded as representing the persistent postcardial parts of the right caudal cardinal veins. During normal development these veins arise from the caudal *vena cava* (without its hepatic part) and the right azygos vein. In the reported case of developmental anomalies the abdominal and thoracic parts of the caudal *vena cava* failed to form a connection, while the right azygos vein was in the animal a direct continuation of the abdominal part of the caudal *vena cava* in the direction towards the heart, and it was exceptionally strongly developed. In the normal European bison this is a small vessel, while the left azygos vein is the main vessel receiving the dorsal intercostal veins (Węgrzyn, 1966, 1978).

The congenital anomalies of various organs in this animal might have been connected with the high homozygosity of "Pomian". Another offspring of the same pair ("Polatucha" and "Ponury"), the male "Podół" (1226) died on the first day of life. Autopsy demonstrated, among other findings, *hypoplasia* of *cranium, hydrocephalus* and wry neck (Onopiuk, 1984). In the new established population of the European bison in Białowieża a correlation was demonstrated between the degree of inbreeding of the animals and their perinatal and juvenile mortality (Slatis, 1960). Another fact which deserves mentioning, is that both calves were born in an atypical season of the year ("Pomian" in mid-November, "Podół" in late September). It is known that the adverse effects of inbreeding manifest themselves especially under unfavourable environmental conditions (Onopiuk, 1984).

REFERENCES

Butler E. G., 1927: The relative role played by the embryonic veins in the development of the mammalian *vena cava posterior.* Amer. J. Anat., *39:* 267—353. — Grau H., 1933: Bejträge zur vergleichenden Anatomie der Azygosvenen bei unseren Haustieren (Pferd, Hund, Rind, Schwein) und zur Entwicklungsgeschichte der Azygosvenen des Rindes. Z. Anat. Entwicklgesch., *100:* 119—148; 295—330. — Onopiuk W., 1984: Historia, warunki utrzymania i analiza wpływu inbredu na rozród i długość życia żubrów w Białowieży. Diss. SGGW-AR. Warszawa. — Pytel S. M., 1969: Morphology of digestive tract of the European bison. Acta theriol., *14:* 349—402. — Slatis H. M., 1960: An analysis of inbreeding in the

European bison. Genetics, *45:* 275—287. — Vollmerhaus B., 1964: Gefässarchitektonische Untersuchungen am Geschlechtsapparat des weiblichen Hausrindes (*Bos primigenius* f. *taurus*, L., 1758). Zbl. Vet. Med., Reihe A, *11:* 538—596. — Węgrzyn M., 1966: Układ krwionośny żubra — *Bison bonasus* (L.). Diss. SGGW-AR. Warszawa. — Węgrzyn M., 1978: Układ naczyniowy żylny żubra, *Bison bonasus* (Linnaeus, 1758). Zesz. Nauk. SGGW-AR. Ser. Rozprawy nauk., *108:* 1—107. Warszawa. — Wright S., 1921: System of mating. Genetics, *6:* 111—178. — Żabiński J., (Ed.) 1947—1961: Pedigree book of the European bison. PWN. 1—237. Warszawa.

Received 15 May 1987, Accepted 4 November 1987.