PATHOLOGICAL CHANGES IN KIDNEYS OF INTENSIVELY BRED BROOK TROUT (SALVELINUS FONTINALIS MITCHILL, 1815)

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Abstract


Description is given of histopathological changes in kidneys of juvenile and generative brook trout (Salvelinus fontinalis Mitchill, 1815) under conditions of intensive rearing and feeding with granulated food mixture and meat scraps. Epithelial cells of renal tubuli showed necrosis and dystrophic calcification with subsequent giant cell granulomatous reaction and formation of stones consisting of brushite \( \text{CaH}(\text{PO}_4)_2 \cdot 2\text{H}_2\text{O} \), as proved by roentgenometric analysis. An unknown detrimental substance is taken into consideration as pathogenetical agent.

Salvelinus fontinalis, visceral granulomatosis, necrotizing nephrosis, nephrocalcinosis, nephrolithiasis, brushite.

Connected with intensive breeding of Salmonids, there is a rising number of cases reported as nephrocalcinosis (Besse, Kinkelin and Levaditi 1968), visceral granulomatosis (Dunbar and Herman 1971), and necrotizing nephrosis (Vitovec, Vladik and Červinka 1974).

In Salmo gairdneri suffering from nephrocalcinosis, white deposits of tricalciumphosphate were described. They were oriented towards the walls of tubuli and surrounded by resorptive granulomas. Corynebacteria were isolated from some of the affected kidneys. The authors tend to consider metabolic calcinosis as the ethiological factor. The disease appeared when sea fish was replaced by pelleted food.

Visceral granulomatosis in Salvelinus fontinalis, in addition to typical changes on visceral organs, is characterized by granulomas and tubular degeneration resulting in lithiasis in the caudal part of kidneys. The authors, in agreement with Wood and Yasutake (1956) in Dunbar and Herman (1971), failed to isolate any infective agent. They concluded that the disease is an inflammatory reaction to irritating chemical substances in food.

With necrotizing nephrosis in Salvelinus fontinalis, dystrophic calcification of desquamated epithelia was described together with a secondary granulomatous reaction to foreign bodies. No grampositive immobile diplobacilli were isolated. Sulfonamides were taken into consideration as etiological factor.

The present report is limited to description of the culminating pathological process in the kidney of Salvelinus fontinalis and the resulting grave nephrolithiasis.

Materials and Methods

Post-mortem examination was performed in one generation (4+) brook trout (Salvelinus fontinalis Mitchill, 1815) of 440 mm length and 1200 g mass, and one juvenile (1+) brook trout of 180 mm and 75 g, fed with pelleted food mixture of inland provenience and with meat scraps.

The kidney tissue was fixed in 10% neutral formol, decalcified in 0.5 M Chelaton III solution at pH 7—8, and, embedded in paraffin wax. Slides were stained by hematoxyline-eosine, the PAS method, Masson's green trichromium, for reticuline by Gomori's, for calcium by Kossa's, for iron by Perls' and for microbes by Gram's method.
Physico-chemical analyses of concrements were carried out on the diffractometer Chirana GON-3 with a characteristic CoK-alfa radiation, at 28 kV voltage, 14 mA current intensity, 1° per minute goniometer rotations and 600 mm registration shift.

Photographs of the superficial structure of concrements were taken, after coating with gold, by the scanning microscope Jeol, JSM-50 A.

Results

The most striking post-mortem finding in the adult fish were protuberancies of a light colour protruding below the renal capsula particularly on the caudal, enlarged part of the kidney (Fig. 1).

After cutting the kidney with a grating noise of the knife, a large number of concrements was removed from the kidney tissue. They had the size from sand particle to 5 mm, were of hard consistency, irregular shape and white to faintly yellowish colour (Fig. 2). No alterations were observed in the rest of the organs.

Microscopical examination of the kidney showed enormously dilated tubular spaces, transformed here and there to cystic formations littered with cylindric, mostly desquamated epithelium (Fig. 5). A layer of mesenchymal cells was below the epithelium, and, a fibrous basophilic mass was inside the dilated tubules. In some of them, granulomatous inflammatory reaction with foreign body giant cells could be observed (Fig. 6, 7).

In the juvenile fish, there were different greyish mutually communicating strips on the kidney, resembling marble (Fig. 8). Microscopically, there was an apparent

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*) I am obliged to Dr. J. Králík, School of Mining and Metallurgy, Ostrava, for the analysis and photographs of concrements by the scanning microscope.

Fig. 1.
Enlargement of the caudal part of kidney with numerous concrements in the adult brook trout.

Fig. 2.
Renal concrements.
Fig. 3.
Brushite crystal on the surface of concrement. Magnification 115×.

Fig. 4.
Brushite crystal on the surface of concrement. Magnification 345×.
Fig. 5.
Enormously enlarged renal tubules in decalcified renal tissue. Inflammatory granulomatous reaction evident in the tubules. HE, 65×.

general reduction of renal tubules. They were of irregular shape, enlarged, deformed and showed a distinctly thickened wall. The tubules were filled with dystrophically altered epithelial cells. In the amassed cells were large deposits of calcium salts. Granulation developed around their crystals and filled partly or totally the tubules. In the granulation tissue, histiocytes rich in eosinophilic plasma predominated. There was a minor admixture of fibroblasts, while foreign body polynuclear cells occurred sporadically (Fig. 9, 10, 12). At intervals, thin diaphragms of renal mesenchyma with evident fibroproductive alterations penetrated and formed partitions inside the renal tubuli (Fig. 11). Apart from the altered tubules, there were also tubules with normal epithelium, filled with granular eosinophilic masses. In some areas of the kidney, interstitium showed fibrous alterations of the haemopoietic tissue where decreased pigmentation could be observed. The eosinophilic mass in the tubules as well as the minute grains in the histiocytes of granulomas were stained by the PAS method.

The chemical analysis of concrements was based mainly on the results of diffraction of the roentgenometric examination. Maxima were satisfactorily relevant to tabellar values for brushite (calciumhydrogenphosphate CaH(PO$_4$)$._2$ H$_2$O, with the exception of the comparatively intensive reflexion of 2.143 d-value which is not listed in Schneider’s tables, but is to be found in the atlas (1974). Microscopical examination showed tubular crystals of brushite (monoclinical system) with evidently good fissility (010), reminding of gypsum (Fig. 3, 4).
The described morphological alterations in kidneys of both post-mortem examined fish are identical with the changes reported by Vitovec, Vladičk and Červinka (1974) in necrotising nephrosis. The histopathological picture corresponds to findings described with visceral granulomatosis in Salvelinus fontinalis (Dunbar and Herman 1971) and partly also with nephrocalcinosis in Salmo gairdneri (Besse, Kinkelin and Levaditi, 1968). Similarly as Vitovec et al. (1974), we proved no grampositive diplobacilli in histological sections, while Vladík et al. (1974), succeeded in cultivating them from altered kidneys.

Considering the character of alterations and the failure to find any infective agent (Wood and Yasutake, see Dunbar and Herman 1971), intoxication by some unknown food component seems to be the more probable etiological factor. A detrimental effect of sulphonamides, however, was reliably excluded by scanning performed earlier.

Fig. 7.
Margin of granulomatous process with histiocytes and foreign body giant cells (g). Decalcified kidney, HE, magnification 270×.

Fig. 8.
Altered kidney from juvenile brook trout. Macroscopically intact part in foreground (h).
Patologicke zmény na ledvině sivena amerického (Salvelinus fontinalis Mitchill, 1815) v intenzivním chovu

V práci jsou popsány histopatologické změny v ledvinách juvenilního a gene-
račního sivena amerického (Salvelinus fontinalis Mitchill, 1815) z podmínek
intenzivního odchovu při výživě granulovanou krmnou směsí s masitými odpady.
Byla nalezena nekróza buněk epitelu ledviných kanálků a jejich dystrofická
kalcifikace s následnou obrovskobuněčnou granulomatosní reakcí a dále tvorba
kamenů složených z brushitu (kalciumhydrogenfosfát CaH(PO₄)₂·2H₂O), jak
prokázala rentgenometrická analýza. V etiopathogenezi se uvažuje o možném
toxickém působení neznámé škodliviny v krmivu.
Fig. 12.
Amorphous mass containing calcium surrounded by giant cell reaction and its fibrotic transformation. (g = foreign body giant cell). Kossa, magnification 90x.

References

VÍTOVEC, J. — VLADÍK, P. — ČERVENKA, S.:nekrotizujicí nefróza s granulomy a četnými