LIPOID PNEUMONIA IN THE RED FOX (Vulpes vulpes)

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Abstract - Eight red foxes (Vulpes vulpes) out of 182 examined animals, either found dead or shot in Cuneo and Vercelli provinces (Italy) during 1993, showed pulmonary lesions characteristic of lipoid pneumonia. Histological examination showed an infiltration by vacuolated macrophages, containing sudanophilic material. Associated lesions were represented by bronchitis, localized emphysema and peribronchiolar aggregates of lymphoid nodules. The concomitant localized inflammatory process might be responsible for post-obstructive lipoid pneumonia.

1. Introduction
Although the red fox (Vulpes vulpes) is the most abundant and widely distributed predator species in Italy, little is known about its pulmonary pathology. Lipoid pneumonia, a selected lesion of the lung, characterized by subpleural white plaques consisting of accumulations of vacuolated macrophages, has been recognized in cats (Dungworth 1985; Chalifoux and Morin 1987), dogs and mink (Corcoran et al. 1992), opossums (Brown 1988), rats (Beaver et al. 1963; Corrin and King 1969; Flodh et al. 1974; Weller 1985), mice (Emi et al. 1985) and man (Verbeken et al. 1989; Wolfson et al. 1989), though it does not appear to have been reported in foxes. The cause of the disease is still unclear, but it is probably consequent to bronchial obstruction, inhalation of dust or disturbance of lipid metabolism (Brown, 1988). Based on clinical and pathological findings, three types of lipoid pneumonia have been described in wild and domestic species and in man: exogenous, endogenous and post-obstructive lipoid pneumonia (Corcoran et al. 1992). This paper reports on several cases of lipoid pneumonia found in red foxes, submitted during 1993 for pathological investigations at the Department of Animal Pathology of the University of Turin (Italy).

2. Materials and methods
Necropsies were performed on 182 red foxes either found dead or shot in Cuneo and Vercelli provinces (Italy) during 1993. Whole animals, usually refrigerated or frozen, were submitted. Sex, age, origin, date and diagnostic findings were recorded. Samples of tissues were fixed in 10% buffered formalin, paraffin embedded, cut at 4 μm, stained with haematoxylin and eosin, and observed by light microscopy. Part of the same tissues were snap frozen, cut at 4 μm and stained with Sudan IV for detection of lipids.

Fig. 1 - Red fox, lung, lipoid pneumonia: subpleural plaques disseminated in the dorsal region of the diaphragmatic lobe

Fig. 2 - Red fox, lung: higher magnification of Fig. 1, showing multiple foci of lipoid pneumonia and surrounding emphysema
3. Results
Out of 182 animals, 8 (4.4%) showed pulmonary lesions characterized by multiple subpleural plaques, disseminated or often coalescent, in the dorsal region of the diaphragmatic lobe (Fig. 1-3). The lesions appeared soft, raised under the pleural surface, white or grey in colour. The section surface of the plaques appeared solid, white or grey, surrounded by congested pulmonary parenchyma. Nodules, showing the same characteristics, were also disseminated in the cut surface of the diaphragmatic lobes in all specimens. Histological examination of subpleural lesions showed a massive infiltration by vacuolated macrophages (Fig. 4, 5), often localized around bronchioles and vessels, causing disruption of the surrounding pulmonary parenchyma (Fig. 6, 7). Bronchiolar as well as alveolar lumina in affected areas appeared obliterated by the massive macrophagic infiltration. Lymphoid nodules and hypertrophy of vascular musculature were often present.

4. Conclusions
Lipoid pneumonia, previously reported in cat, dog, opossum, mink, rat, mouse and man, has never been observed in foxes; our report is therefore the first in this species.

Of the three types of lipoid pneumonia until now described, only the exogenous form is consequent to inadvertent inhalation of lipidic substances (i.e. oil). In both endogenous and post-obstructive endogenous lipoid pneumonia, the accumulated lipids are believed to be derived from endogenous sources, possibly in consequence of the obstruction of airways (e.g. by an inflammatory process) (Dungworth 1985;
Weller 1985), exposure to dust (Corrin and King 1969; Lee et al. 1985) and vitamin deficient diets (Beaver et al. 1963). Either production of large quantities of surfactant and subsequent phagocytosis by macrophages (Lee et al. 1985), or altered lipid metabolism (Flodh et al. 1974) may result in lipid accumulation in tissues. The etiology of the cases described in the present study has not been fully elucidated, though a concomitant localized inflammatory process, which might be responsible for post-obstructive lipoid pneumonia, has been observed. No signs of inhalation of fat substances were detected. An interesting subject for further verification is represented by the rapid mobilization of body fat, as described in mink (Corcoran et al. 1992), where the lung could conceivably act as a route for excretion of lipids. Environmental factors (i.e. food availability) or concomitant diseases may therefore interact in the pathogenesis of the described lesions.

REFERENCES
CORRIN, B. & E. KING (1969) - Experimental endoge-


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**Fig. 11** - Red fox, lung: a bronchiolar lumen heavily infiltrated by inflammatory cells, surrounded by thickening of alveolar septa and emphysema, in the pulmonary parenchyma surrounding a focus of lipoid pneumonia (H. & E., x100).