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Trichinella spiralis in walruses from the Thule district, North Greenland, and possible routes of transmission

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Abstract

Examined samples of muscle tissue from 126 Atlantic walruses, *Odobenus rosmarus rosmarus* (L.), collected in the Thule district, North Greenland (1975, 77 and 78), for *Trichinella spiralis*.

Two adult males were found to be infected with *Trichinella spiralis* (prevalence of 1.6 %).

It is suggested that the walrus in the Thule district contracts trichinosis from scavenging on carcasses of polar bears or/and sled dogs.

Introduction

The parasite *Trichinella spiralis* in the walrus (*Odobenus rosmarus* Linnaeus) is a potential threat to the Inuit health. An epidemic disease in 1947 among the Inuit of central West Greenland was caused by the eating of trichinous walrus meat (Thorborg et al. 1948; Roth 1949). Since then, trichinous walruses have been reported from different arctic areas

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(e. g. Roth and Madsen 1953; Rausch et al. 1956; Brown et al. 1949; Kuitunen 1954; Thorshaug and Rosted 1956; Fay 1960; Madsen 1961; Kozlov 1971; Thing et al. 1976; Margolis et al. 1979).

In the Thule district, North Greenland, the walrus is a cornerstone in the subsistence catch and trichinous walruses do occasionally cause trichinosis in humans. In the fall 1977 a woman and two children were severely sick of trichinosis after having eaten raw walrus meat which was insufficiently frozen.

The Inuit of Grise Fjord at Ellesmere Island, Canada, take a limited number of walruses from the same population (Bowler 1976, fide Reeves 1978).

Materials and methods

Samples of diaphragma, the masseter and the intercostal muscles from 126 walruses (64 males, 59 females and 3 with no sex recorded) in the Thule district were collected in 1975, 1977 and 1978 (Fig. 1). The total sample represents about 60 % of the Inuit annual subsistence catch of walrus on the stretch, Saunders Island (Agpat, 76°30′N) to Cape Inglefield (Anoritooq, 78°30′N) in the period 24 April until 28 July. The samples were kept frozen at minus 12 °C until examination in the laboratory where 15–20 g muscle from each individual were examined in a trichinoscope and by digestion (Henriksen 1978).

The ages of 106 walruses caught in 1977 and 1978 were determined from growth layers in the cement of the lower cheek teeth as described in Mansfield (1958) and Krylov (1965). No teeth for age determination were obtained from 20 walruses in 1975 (reported in Thing et al. 1976). However, an approximate age has been determined for these specimens by comparison of: 1. nosetail length and 2. tusk length and circumference, with age-dependent growth curves established on measurement results of walruses of known age collected in 1977 and 1978.

Results

Trichinella spiralis was detected in two adult males. One was killed 28 May 1975 off Neqe in Murchison Sound. According to tusk and body dimensions this male was about 12 years old and in good condition. No larvae were detected in the trichinoscope, but 1–2 larvae per gram muscle tissue were found after digestion, this indicating a low infection level. The other infected walrus was a 20-year-old, apparently healthy, male killed 6 June 1978 off the northeastern point of Northumberland Island (Kiataq). This animal was infected with about 50 *Trichinella* larvae per gram muscle tissue, indicating a moderate infection level.

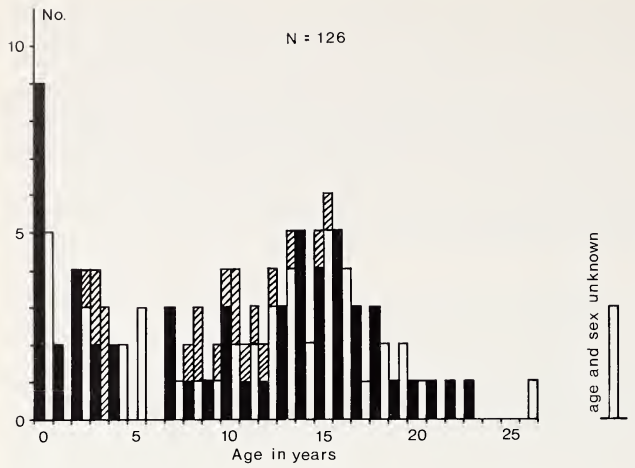
The results of the present study are shown in the Table together with the results of other studies for comparative purposes. In this study the overall infection prevalence in the walrus from the Thule district is 1.6 %. Including the 74 walruses recorded in Madsen (1961) the infection prevalence in the Thule area is 1.0 %.

Although there is no criterion for determining whether a walrus is trichinous or not, from physical appearance alone, it should be mentioned that the infected male taken in 1978 had an abnormal hump on its shoulders. By a superficial inspection this hump consisted of normal-looking somatic muscle tissue and blubber.

In the fall 1977 three persons in the Thule district became severely sick of trichinosis after having eaten infected meat from an old bull which had been caught at Northumberland Island. Judged from the skull of this walrus it was estimated to be at least 20 years old.

Discussion

The finding of *Trichinella spiralis* in the walrus and other marine mammals is puzzling. The walrus is an inshore bottom-feeder whose main diet consists primarily of bivalve molluscs. Occasionally an insignificant number of fish and decapod crustaceans are also found in the



Age composition of the combined sample of walruses analyzed for *Trichinella spiralis* (1975, 1977 and 1977), Thule district North Greenland. Black columns = males; White columns = females; Cross hatched columns = animals with age determined from tusk and body measures

Table

Prevalence of *Trichinella spiralis* among walruses *(Odobenus rosmarus)* in different arctic areas

Area	No. examined	No. infected	% infected	Source
Alaska	104[1]	1	1.0	Rausch et al. (1956); Fay (1960)
Eastern Canada	401[1]	17	4.2	Brown et al. (1949); Kuitunen (1954)
The Svalbard Area	74[1]	7	9.5	Thorshaug and Rosted (1956)
Greenland				
East Greenland	1[1]	0	0.0	Madsen (1961)
Upernavik (NW. Greenl.)	18[1]	0	0.0	
Egedesminde (W. Greenl.)	271[1]	5	1.8	
Frederikshåb (W. Greenl.)	10[1]	0	0.0	
Thule district (N. Greenl.)				
(1961)	74[1]	0	0.0	Madsen (1961)
1975	24[2]	1	4.2	Thing et al. (1976); this study
1977	49[2]	0	0.0	This study
1978	53[2]	1	1.9	This study

[1] Trichinoscopical detection. – [2] Trichinoscopical detection and digestion.

stomach (Dunbar 1949; Vibe 1950; Mansfield 1958; Fay and Lowry 1981). Because *Trichinella* is absent from these food items different alternative routes of infection in the walrus have been proposed. Vibe (1950), Rausch et al. (1956) and Fay (1967) suggested that *Trichinella* is transferred from carcasses of polar bears and sled dogs to marine mammals, with amphipods serving as „intermediate hosts". The transfer of *Trichinella* via amphipods (Fay 1967) and via fish (Kozlov 1971) has been experimentally demonstrated. Although the ringed seal (*Phoca hispida* Schreber) feeds extensively on amphipods and other crustaceans (e.g. McLaren 1958), only 0.06 % (one of 1775 examined) *Trichinella* infected ringed seals have been found in Greenland (Madsen 1961) and 0,7 % (two of 300 examined) in Alaska (Fay 1960). These findings indicate that transfer of *Trichinella* via amphipods to marine mammals is very unusual and may be even more unlikely in the case of the walrus, which does not feed on crustaceans to any extent. Fay (1960), underlining the occasional carnivorous habits of the walrus, suggested that walruses might be infected

from bearded seals (*Erignathus barbatus* Erxleben) and ringed seals. The walrus kills seals during periods of famine, and there are several reports of walruses with remnants of seals in the stomach (e.g. Johansen 1910; Degerbøl and Freuchen 1935; Vibe 1950; Loughrey 1959; Fay 1960). Manning (1960) drew attention to the low frequency of seals infected with *Trichinella* and suggested that a polar bear-walrus-polar bear cycle could not be ruled out. It is most likely that the walrus is infected when scavenging on polar bear carcasses, as suggested by Manning (1960) or on polar bear and sled dog carcasses (Vibe 1950). In the Thule district 20 % of the polar bears (3 of 15 examined) was found to be infected with *Trichinella* and 91 % (38 of 42 examined) of the sled dogs was also infected (Madsen 1961).

Kozlov (1971) was also of the opinion that the main source of *Trichinella* infection in pinnipeds and whales is carcasses of terrestrial and marine mammals.

In the Thule district the Inuit kill diseased and old sled dogs and leave them on the ice in the tidal zone before ice break-up in June-July (Vibe 1950 and own information). This activity is designed to eliminate the necessity of feeding surplus dogs during the open water period. About 200–300 dogs of a total of about 1500–1600 sled dogs in the Thule district are disposed in this manner every year. If the walrus contracts trichinosis when scavenging on polar bear and dog carcasses this route of infection could also explain why trichinous bearded seals have been found, as reported by Madsen (1961). The bearded seal is also a bottomfeeder (Vibe 1950) which has never been reported to prey on other seals, to our knowledge.

The average annual catch of walruses in the Thule district is about 200 animals of which about 53 % are males (own information). Thus, probably three to four trichinous walruses are taken in the district annually. The yield of the annual walrus catch is about 80 tons of meat, blubber and hide. While most of the yield is used for dog food an unknown proportion is eaten by humans. In the case of the walrus the epidemiological risk to humans is theoretically large because walrus meat is distributed to many households in the communities in contrast to the meat of other pinnipeds and of the polar bear. About 77 % of the annual catch of walrus is taken in the period from May until October (own information) where temperatures in the Thule district are often about or above freezing point which increases the risk of walrus meat being infectious.

Temperatures in household freezers are not low enough to reduce infectivity of arctic *Trichinella* ssp. (Anon. 1981). For example, portions of infected meat of the Alaskan black bear (*Ursus americanus* Pallas) held at minus 15 °C for up to 35 days showed no loss of infectivity for laboratory animals (Anon. 1979, fide Anon. 1981).

Thus, walrus meat must be cooked thoroughly, which according to Ransom and Schwarts (1919) means that all parts of the meat must be raised to 58 °C (137 F) in order to kill the encysted *Trichinella* larvae. In the Thule district the walrus meat is boiled on kerozene burners, and at least when on hunting trips the Inuit often eat the meat while parts of it are only half done. Furthermore, raw walrus meat which previously has been frozen for a variable period is also eaten.

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Zusammenfassung

Trichinella spiralis in Walrossen aus dem Thule-Gebiet, Nordgrönland, und mögliche Wege der Übertragung

Fleischproben von 126 Atlantischen Walrossen, *Odobenus rosmarus rosmarus* (L.) aus dem Thule-Gebiet, Nordgrönland (1975, 1977 und 1978), sind auf Befall durch den Parasiten *Trichinella spiralis* analysiert geworden.

Zwei erwachsene Bullen waren mit *Trichinella spiralis* infiziert (Häufigkeit 1,6 %).

Es wird angenommen, daß das Walroß aus dem Thule-Gebiet durch Fressen von Eisbären- und/oder Hundekadavern infiziert wird.

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WISSENSCHAFTLICHE KURZMITTEILUNGEN

Der Einfluß der Domestikation auf die Riechleistung der Hausmaus *(Mus musculus)*

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Eingang des Ms. 6. 1. 1982

Domestizierte Tiere unterscheiden sich von ihren freilebenden Wildformen nicht nur durch Veränderungen im äußeren Erscheinungsbild (Größe, Fellfärbung, Schädelform etc.), sondern auch durch die Kapazität ihrer Hirnschädel. Darwin (1859) wies erstmals auf dieses Phänomen hin; inzwischen wird die Abnahme der Hirngröße als ein Charakteristikum der Domestikation angesehen (Herre und Röhrs 1973). Nieder evoluierte Gehirne, wie die der Nager, weisen dabei mit bis zu 9 % (Laborratte: 8,3 %; Kruska 1975b) jedoch weit geringere Gewichtsverluste auf als in der Evolution höher stehende (Hausschwein: 33 %; Kruska 1970). Eine Ausnahme macht die Labormaus, bei der sich im Vergleich mit der westlichen Hausmaus keinerlei Hirngrößenunterschiede ergaben (Nord 1963).

Veränderungen des Hirngewichtes sagen jedoch nicht unbedingt etwas über die Leistungsfähigkeit einzelner Funktionsbereiche aus, da Teilstrukturen wesentlich stärkere Umwandlungen aufweisen können als das Gesamtsystem. So besitzt z. B. die Laborratte, trotz einer Gesamthirngewichtsabnahme von 8,3 %, einen um 4,5 % größeren Bulbus olfactorius und ein um 11,2 % vergrößertes Tuberculum olfactorium als die Wanderratte (Kruska 1975a).

Elektrophysiologische Untersuchungen am olfaktorischen System der wilden Hausmaus und der Labormaus sollten klären, ob bei dieser Art, die als einzige keinerlei Abweichungen im Hirngewicht aufweist, Divergenzen in der Leistungsfähigkeit des olfaktorischen Systems auftreten.

Als Versuchstiere dienten adulte Männchen der wilden Hausmaus (Wildfänge und F 1). Mit Hilfe fest implantierter Elektroden (Methode: Schmidt 1978) wurden neurale olfakto-

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