MORE ABOUT WEEVER FISH AND THEIR TOXIC STINGS

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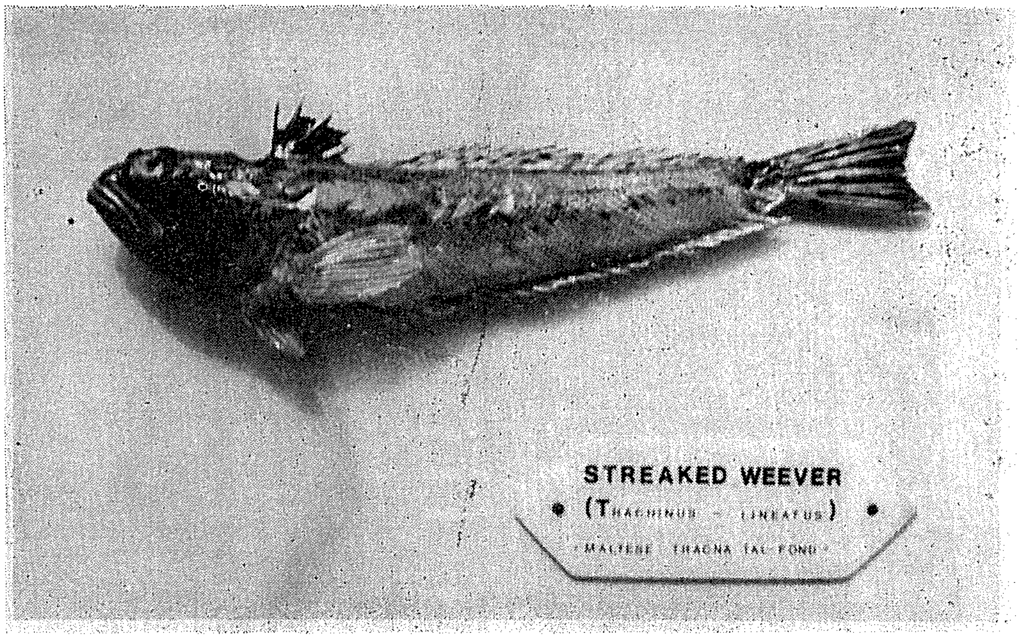
This paper is meant to follow that on weever fish stings which appeared in this periodical in Dec. 1973. In that paper the immediate and complete relief obtained in ten patients by means of local Lignocaine infiltration in the proximity of the puncture site of weever stings was described. Since that paper was written three other cases have been similarly treated and these will be described further on. An attempt has also been made in the last few months to review most of the scientific literature available on weever fishes and their toxicological properties.

Nomenclature

Weever fish can be found in the Mediterranean, the East Atlantic coast, around the British Isles and Ireland, in southern Norway and Sweden, and in Denmark particularly in the Kattegat area where weever fishing is lucrative, yielding a profit of almost half a mllion Danish kroner a year. Weevers are consumed as fillets but are also in great demand as mink fodder on account of their suitable fatty content: (Skeie 1962a). In view of their wide distribution along the various European coasts weevers are known by many vernacular names: weever, adderpike, bishop, dragon fish, otterpike, stangster, stingbull (English), vive, avive, aragna (French), fjärsing, fjäsing (Danish), drakena (Greek), pietermann, arend, stekelvisch (Dutch), Petermannchen, Drachenfisch, Ragno (German), fibersing, foersing (Swedish), tracina, ragno, draco (Italian), traconia (Turkish), draganja, zanja (Yugoslavian). Ancient Latin names include araneus, draco and tragine. (Fig. I).



Some Historical Notes

The toxicological nature and painful effects of weever fish stings have been remarked upon by ancient classical writers. Pliny, in his "De Venenatis Marinus" says that "draco marinus" and "araneus" have on their back and opercula, spines capable of inflicting dangerous venomous wounds. Aelian ascribes poisonous properties to the dorsal spines of weevers. In "Haliutica", a poem on fishing by Oppian, one reads; "Cruel spines defend some fishes, as the goby fond of sands and rocks, the Scorpion, Dragons and Dog fish from their prickly mail, well named the spinous; These in puncture sharp a fatal poison from their spines inject." Dioscorides (*circa* 50 A.D.) in "The Greek Herbalist" (edited by Gunther 1934), under the subject Drakon thalassios tells us that, "The Sea Dragon, being opened and soe applyed is a cure for ye hurt donne by his prickles." Galenus has also discussed a mode of treatment for weever stings.

More recently Allman (1840) was probably the first to give an anatomical description of the opercular (gill cover) apparatus of weevers. Byerley (1849) demonstrated both opercular and dorsal venom glands. Parker (1888) provided a histological description of the venom glands. Evans (1906, 1907, 1910) wrote a note on the treatment of weever stings. Halstead (1957) has discussed in considerable detail weever fish stings and their medical management. He reported the case report of a patient who had been attacked by a weever and stung in the neck, which sting caused a severe anaphylactic reaction and swelling in the neck leading to respiratory difficulty. The patient however, recovered fully after ten days intensive hospital care. Perhaps the most interesting work in this field was carried out by Skeie (1962) for the Danish State Serum Institute. Skeie has not only managed to extract the weever toxin but purified and analysed it, made toxicity determinations and extensive immunological observations on various experimental animals.

Weever fish Toxin

Much of what is known about the nature of weever toxin (venom) is due to Skeie's extensive laboratory experiments. Earlier crude and poorly successful attempts at observing the toxic effects of weever stings had been carried out by Schmidt (1874). He observed the effects after inserting small bits of opercular gland tissue in the cut skin of frogs. His results were equivocal. Gressin (1884) obtained the venom by pressing fresh opercular glands. He described the fluid thus obtained as "clear, with a slightly bluish tint in its fresh state but opalescent and less liquid in fish which had been dead for a few hours." This extract was noticed to be coagulated by strong acids, by bases and on heating. Pohl (1893) found that the toxin can be rendered non-poisonous by the addition of alcohol, ether or chloroform and also that dried stings loose their toxicity within 24 hours. Phisalix (1899) made glycerine extracts after crushing opercular and dorsal stings in a mortar. The extract was then injected into the thigh of guinea pigs and the effects of swelling, inflammation and subsequent death of the animals were noticed. Briot (1902) made various observations of the effects of the weever venom in experimental animals as well as in vitro experiments with red blood cells. He found that the venom had haemolytic effects. Evans (1910) made similar observations. Evans obtained the toxin by removing it with a sterile syringe direct from the grooves of the spines. After injecting the toxin in cats he recorded the effects on blood pressure and respiration. A marked fall in blood pressure leading to eventual death of the animals was noticed. Briot was the first to evaluate the immunological characteristics of Trachinus venom. He showed that the venom acted in rabbits as an antigen. He was able to immunize a rabbit actively by giving it two diluted sublethal inoculations of weever venom. Animals so immunized could then tolerate doses of full strength venom four times greater than the lethal amount effective in control animals. The main disadvantage in the various experiments mentioned above, was the fact, that no stable preparation of well defined toxicity had been available. Skeie however found a method of extracting weever toxin by a 'micromethod' tech-

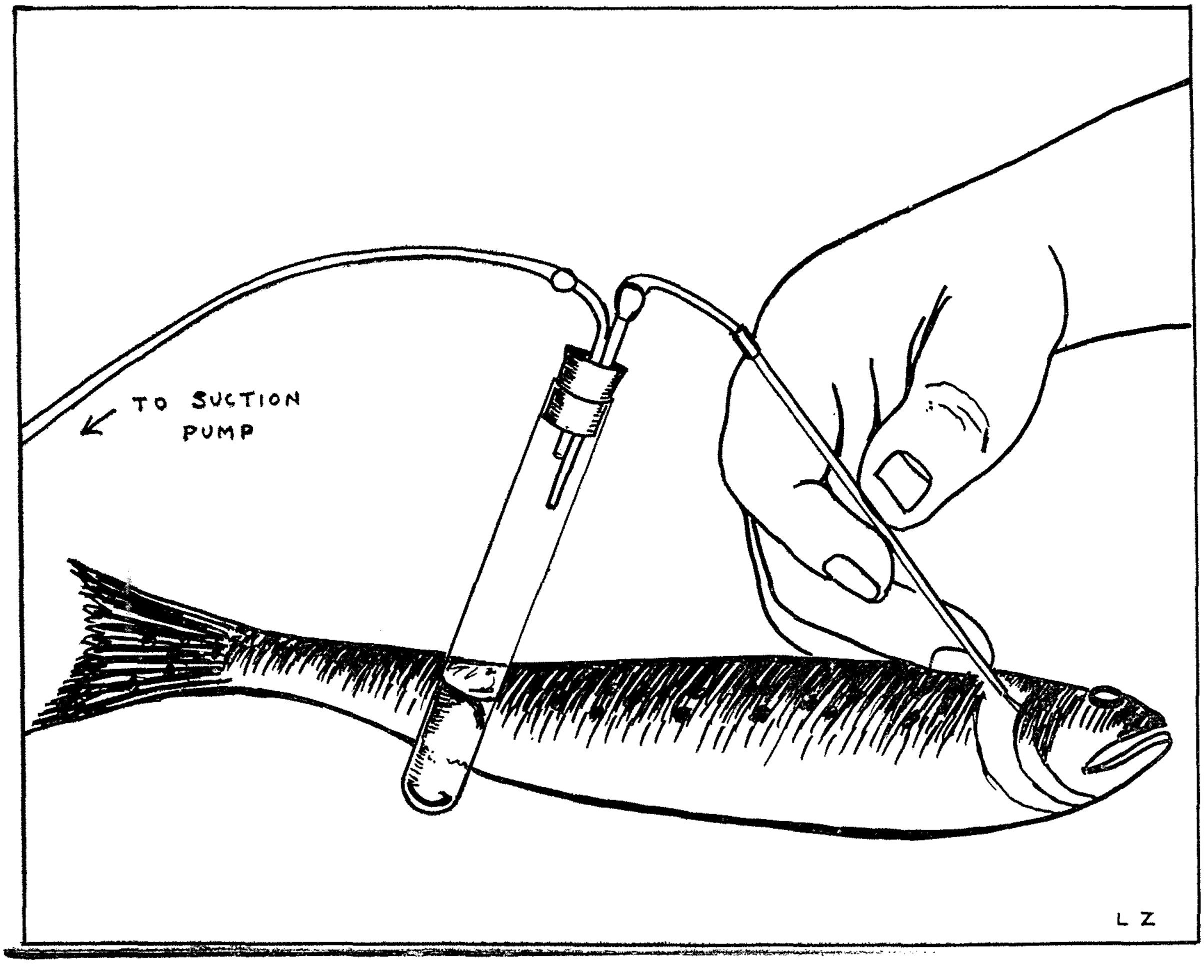


Fig. 2

nique applying suction to narrow tubes and collecting the toxin in a test tube. (Fig. 2). Opercular spines yielded more toxin than first dorsal ray spines and the average amount obtained per fish was only about 0.15 ml. The raw toxin obtained was then centrifuged to separate solid sediment and fragments. This left a clear solution of slightly increased viscosity with a pH of 7.1. Quantitive titration of the toxin and potency determinations were carried out. It was found that even a small amount representing 0.0004 ml of undiluted toxin was lethal to mice. Smaller dilutions produced local reactions of inflammatory redness and even ischaemia and skin necrosis when injected subcutaneously in mice. The toxin was found to consist of a number of different proteins and these were of varying venom-like activity. Some protein fractions were even innocuous. The toxin was found to contain hyaluronidase in a concentration of 38,600 I.U. per ml. Electrocardiographic studies were carried out after injecting different doses of venom in cats and rabbits. Lead II was recorded. Smaller doses produced sinus arrhythmia, higher doses showed marked ischaemic changes with ST depression, and lethal doses quickly produced ventricular flutter and death. There was a corresponding lowering of blood pressure and increased respiration. This shows that besides being neurotoxic the venom is also cardiotoxic. Autopsies on animals showed stasis in the lungs and liver, frothy blood-stained discharge in the respiratory system and haemorrhagic sub-pleural discoloration.

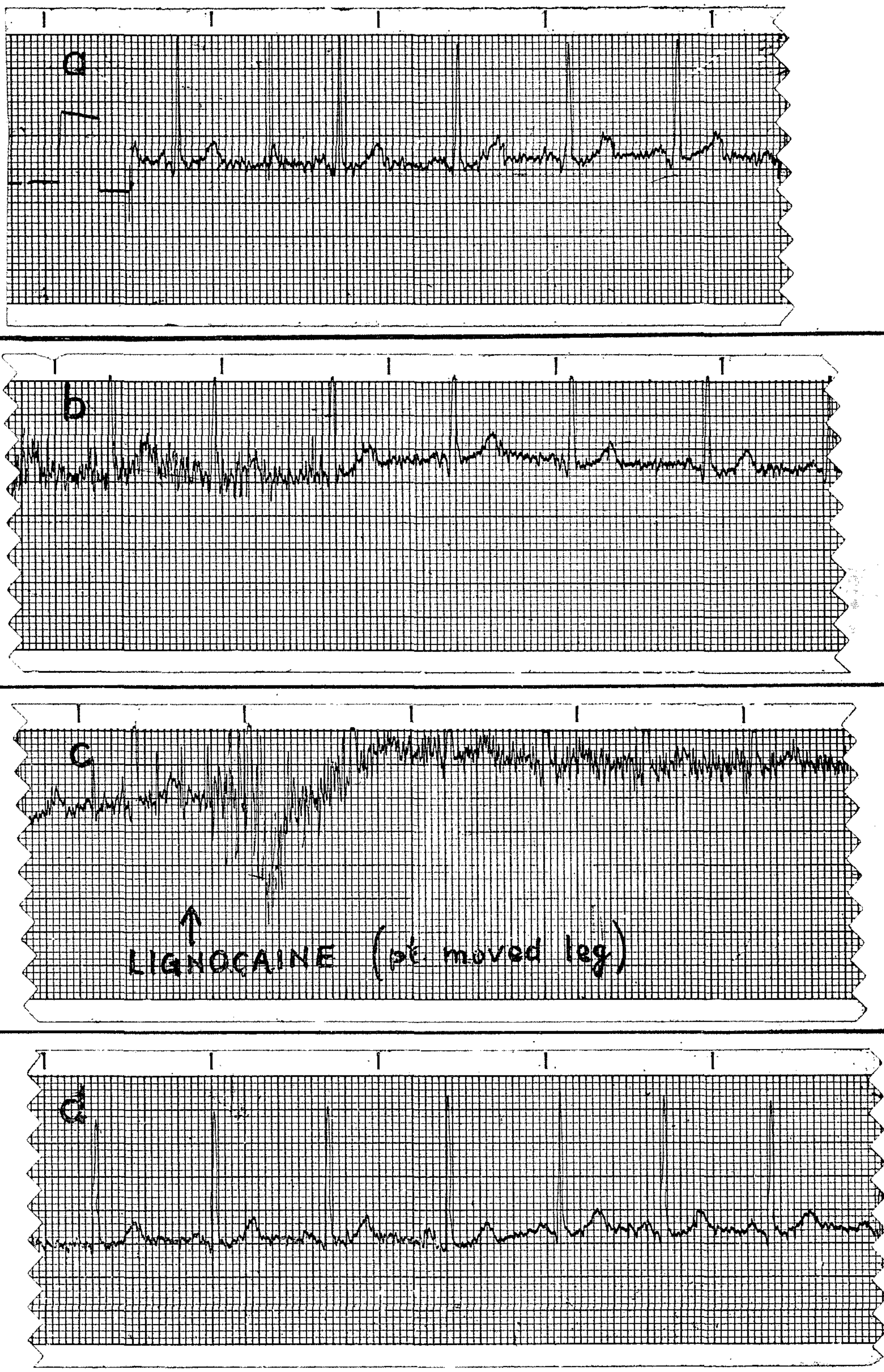


Fig. 3 Case 13

The heart was always full on the right side and the left ventricle contained no blood. At times the heart was considerably dilated.

Skeie also carried out, extensive immunization experiments on animals to examine the antigenicity of weever venom. He found it possible to detoxicate venom without loss of antigenicity. In principle it was found quite possible to produce a vaccine or perhaps an anti-serum against weever intoxication, but great practical difficulties are encountered in obtaining a sufficient amount of toxin. It was estimated that about 3,000 weever fish would be required for the production of enough vaccine for one person (Skeie, 1966).

Symptoms and Signs

Besides the intense pain at the site of the sting which characteristically spreads proximally (cf. hyaluronidase) and the inflammatory redness and swelling (foreign protein reaction), weever sting victims quite often complain of pain across their chest. Originally this symptom was not given much importance. It was attributed to the patient's extreme fright and fear of death knowing that he is suffering from some form of poisoning. There is no doubt, however, that this is in fact true typical cardiac ischaemic pain. A sting inflicted directly into a victim's vein can be very serious indeed, if not immediately fatal. This possibility should be kept in mind when healthy young good swimmers drown in relatively calm waters for no apparent reason.

Further Case Reports

Case 11. 28/10/74. J.U. a five year old boy was stung on the plantar aspect of the right big toe. There was a definite hard gritty sensation at the puncture site. The boy was extremely restless and crying with severe pain. He stopped crying immediately 1 ml of 2% Lignocaine was injected near the puncture site. A sharp sting was then quite easily removed. This was about 8 mm long and consisted of hard white translucent dentine structure; its shape was consistent with the terminal portion of a weever's opercular spine. This is the first time I have found a sting in situ. The boy made a full and uneventful recovery.

Case 12. 13/5/74. S.M. a 14 year old boy was stung in the plantar aspect of the left middle toe. In this case three puncture wounds could be seen in a row at a distance of about 6 mm from each other. This injury would be consistent with stepping directly on the fish's erected first dorsal ray spines whilst the rest of the fish is lying buried in the sand when spawning. Immediate, complete and full recovery was obtained after infiltrating 2 ml of 2% Lignocaine around the puncture wounds.

Case 13. 3/6/74. C.D.S. was a 29 year old lady seen 20 minutes after the accident. She had been stung in the middle plantar aspect of her left foot. With the help of an assistant we managed to apply the four leads of an electrocardiographic machine and Lead II was recorded immediately before, during and after Lignocaine injection at the puncture site. Part of the tracings can be seen in fig. 3 which show sinus arrhythmia but no definite ST changes. Similar changes have been recorded in cats and rabbits by Skeie (1962) after experimental toxin inoculation. This leaves little doubt that weever toxin affects the human heart as well, and the precordial pain experienced by victims during the acute episode is in fact cardiac pain. Immediate and complete relief was achieved in this patient by infiltrating 2 ml of 2% Lignocaine near the puncture wound.

Lignocaine

Other synonyms are xylocaine and lidocaine. The immediate and complete relief achieved by infiltrating Lignocaine hydrochloride near the puncture wounds of weever sting victims has led me to believe that it has the effect of completely eradicating the venomous potency of the toxin. The most probable explanation for this is the fact that Lignocaine HCl is an acid with a pH of 5.0. The weever toxin has a pH of 7.1. It has been variously established that the toxin is coagulated and loses its potency in in vitro experiments by the addition of acids. In this respect other acid injections might also be effective, but lignocaine has the added advantage of allowing for local incisions to be comfortably made if required, say to romove remnants of spines (cf. case 11). Besides, in view of the proved cardiac arrhythmias which occur following weever toxin poisoning, its effect in helping to correct this state of affairs constitutes a further indication. It should remain the treatment of choice and it would be extremely difficult to find a better alternative. It must be stressed that the sooner lignocaine is injected the better.

Acknowledgements

My thanks are due to Nurse Maria Muscat of Rabat without whose assistance treating patient C.D.S. and at the same time recording an E.C.G. would have been impossible; Mrs. S. Salmento and Mr. T.R. Mercier of Pensyvania, USA for their help in obtaining photocopies of Bruce W. Halstead's papers on weever stings and Mr. M. Aarkrogh, Secretary, Statens Seruminstitute, Copenhagen for supplying me with reprints of Dr. E. Skeie's papers.

References

ALLMAN, G.J. (1840): On the stinging property of the lesser weever fish (Trachinus vipera). Ann. Mag. Nat. Hist., *6*, 161.

BRIOT, A. (1902): Sur l-action du venin de la vive (Trachinus draco) Jour. Physiol. Path. Gen., *6*, 271.

BYERLEY, I. (1849): On the Trachinus draco, or otter pike, sting fish or weever. Proc. Lit. Philos. Soc. Liverpool, *5*, 156.

EVANS, H.M. (1906): Note on the treatment of weever sting. Brit. Med. J., *2*, 23.

EVANS, H.M. (1907). Observations of the poisoned spines of the weever fish. Brit. Med. J., *1*, 73.

EVANS, H.M. (1910): Further studies in haemolysis by weever venom. Brit. Med. J., *1*, 982.

GRESSIN, L. (1884): Contribution a l'etude de l-appariel a venin chez les poissons du genre Vive. Thesis. Fac. Med. Paris.

GUNTHER, R.T., Editor (1934): Materia Medica. The Greek Herbalist. Translated by J. Goodyear (1655). Oxford Univ. Press.

HALSTEAD, B.W. (1957): Weever Stings and their medical management. U.S. Armed Forces Med. J., *8*, 1441.

PARKER, W.N. (1888): On the poison organs of Trachinus. Proc. Zool. Soc. London, *3*, 359.

PHISALIX, C. (1899): Experiences sur le venin des vives (Trachinus vipera et Tr. draco). Bull. Mus. Hist. Nat. Paris, *5*, 256.

POHL, J. (1893): Bietrag zur Lehre von den Fischgiften. Prag. Med. Wschr., *18*, 31.

SCHMIDT, F.T. (1874): Om fjarsingens stik og giftredskaber. Nord. Med. Arkiv., 6.

SKEIE, E. (1962): Weeverfish Toxin. Acta Path. et Microb. Scandin. *55*, 166. and *56*, 229.

SKEIE, E. (1962a): The venom organs of the weeverfish. Med. fra Dan. Fiskeri - og Havund. Copenhagen, *3*, 327.

SKEIE, E. (1966): Weeverfish stings. Danish Medical Bulletin. August, 119.