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Tetraphyllidean Cysticerci in the Peritoneal Cavity of the Common Dolphin

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ABSTRACT: Cysticerci of the cestodes *Monorygma grimaldii* and *Phyllobothrium delphini* were encountered during necropsy of an adult common dolphin (*Delphinus delphis*) found dead on the southeastern coast of Australia. *Monorygma grimaldii* cysticerci were found within highly organized retroperitoneal cysts, whereas *P. delphini* cysticerci in the subcutaneous blubber did not occupy specialized structures. There was a localized lymphoplasmacytic host response to the presence of cysticerci of both species, but *M. grimaldii* provoked a more severe suppurative response than *P. delphini*. The systematics and life history of both parasites are incompletely known, but sharks postulated as the potential definitive hosts are found in the region. A unique cysticercus of *M. grimaldii* was found lying free in the peritoneal cavity of this dolphin. Two rare records of *M. grimaldii* cysticerci in pinnipeds from the literature include one case of aberrant migration to the testis.

Key words: Common dolphin, *Delphinus delphis*, *Monorygma grimaldii*, pathology, *Phyllobothrium delphini*, tetraphyllidean cysticerci.

Encysted larvae of tetraphyllidean cestodes have been reported from a number of cetacean and pinniped hosts (Dollfus, 1964), including dolphins from Australian waters (McColl and Obendorf, 1982). Their nomenclature has been reviewed (Dollfus, 1964), but the systematics and life history traits of these parasites are incompletely understood (Testa and Dailey, 1977). In the present study, cysticerci of *Monorygma grimaldii* (Cestoda: Tetraphyllidea) were examined live and fixed *in situ*, and a cysticercus of this species found lying free in the abdomen is described for the first time. These specimens are compared with those of *Phyllobothrium delphini* (Cestoda: Tetraphyllidea) from the same host.

A young adult lactating female common dolphin (*Delphinus delphis*) was found dead on 29 October 1993 at Barwon Heads (Victoria, Australia; 144°30′E, 38°18′S). At necropsy, approximately 50 cysticerci of *M. grimaldii* were encountered, mainly as nests of 5 to 10 retroperitoneal cysts 25 to 40 mm in diameter on the abdominal wall (Fig. 1), in the broad ligaments of the uterus, and in the lateral ligaments of the bladder. Three cysts were isolated in the muscle of the ventral abdominal wall. One cysticercus was free in the peritoneal cavity adjacent to the mesocolon (Fig. 2).

Each cyst usually contained a single motile cysticercus (Fig. 3), with a fleshy bladder enclosing a filamentous process tangled in a small amount of serous or turbid fluid. Occasionally, two cysticerci were found occupying a single cyst, or two adjacent communicating cysts with an incomplete septum. One cyst contained a single cysticercus which had a pronounced median constriction so that it appeared to be two bullae joined by an isthmus of tissue. The cysticercus lying free in the abdomen was approximately 300 mm long with its bladder wall attenuated to translucency. After removal to 0.9% saline, it slowly contracted into an irregular bilobed form approximately 40 mm long.

Encysted parasites fixed *in situ* in 10% buffered formalin were embedded in paraffin, and sections cut at 2 to 5 μm were stained with haematoxylin and eosin (H&E). Cysticerci were fixed satisfactorily in 10% buffered formalin or in hot 70% ethanol.

Specimens of *M. grimaldii* have been deposited in the Australian Helminth Collection at the South Australian Museum, Adelaide under collection numbers AHC 26380 - 26384. Histological sections have been deposited in the National Registry of

FIGURE 1. Nest of encysted *Monorygma grimaldii* cysticerci in a common dolphin.

FIGURE 2. Cysticercus of *Monorygma grimaldii* lying free in the peritoneal cavity of a common dolphin. Bar = 5 cm.

Non-domestic Animal Pathology at Taronga Zoo, Sydney under accession number W1359/93. The skull of the host has been deposited in the Museum of Victoria, Melbourne under the registration number C29365.

Histologically, in encysted cysticerci a superficial investment of peritoneum overlay a richly vascularized, lamellated fibrous capsule 0.6 to 1.2 mm thick (Fig. 4). A heavy host plasmacytic infiltrate with infrequent eosinophils amongst the internal lamellae of the capsule was replaced by neutrophils and macrophages near the interface with the parasite, and the bladder tegument was bathed in necrotic neutrophils and proteinaceous fluid. The tegument was 20 μm thick, with a ruffled external border and a 30 μm thick bilayer of fine supporting fibres. It was superficial to an epidermal cell layer (Chitwood and Lichtenfels, 1972) 40 μm thick. A broad zone of parenchyma contained scattered calcareous corpuscles, prominent excretory ducts, and a band of diffuse slips of parenchymal muscle. The internal boundary of the bladder was poorly defined by a condensation of attenuated parenchymal cells. The tegument invaginated at one pole of the bladder to form the inverted, filamentous neck 50 to 200 mm long, and 300 μm in diameter (Fig. 4), terminating in a simple scolex.

Death of the cysticercus in one cyst examined in H&E section was evidenced by pallid staining of the bladder, loss of the epidermal cell layer and calcareous corpuscles, increased vacuolation of the parenchyma, and flooding of the central cavity of the bladder by proteinaceous material with precipitated calcium. The host's lymphoplasmacytic and neutrophilic response had breached the tegument. Baker (1992) described fibrous nodules with central caseation after the death of *M. grimaldii* cysticerci in *D. delphis* and striped dolphins *Stenella coeruleoalba*.

FIGURE 3. Live cysticerci of *Monorygma grimaldii* from a common dolphin in 0.9% saline.

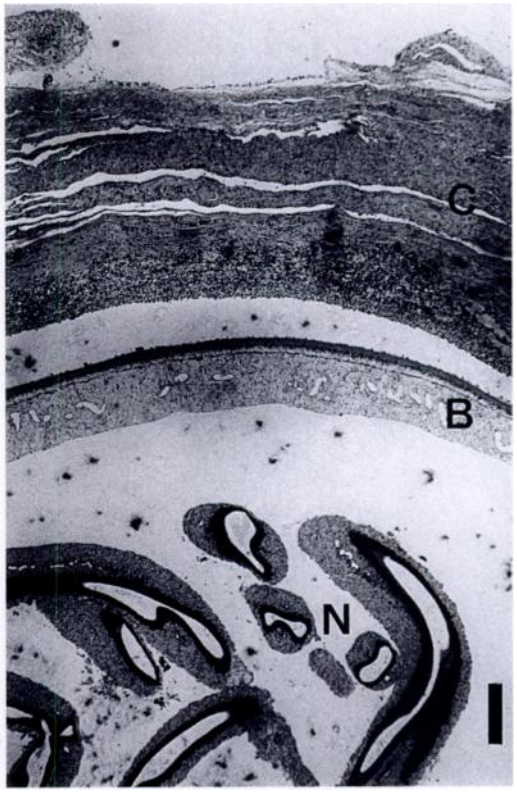

FIGURE 4. *Monorygma grimaldii* encysted in a common dolphin, showing fibrous tissue capsule (C), bladder (B), and neck (N). H&E. Bar = 250 μm.

Approximately 30 cysticerci of *P. delphini* were distributed in the ventral abdominal subcutaneous blubber, concentrated around the anogenital fold. Grossly, a distinct cyst structure confining the cysticercus was not seen. However, histology revealed a modest fibrous capsule 200 μm thick nested among the collagenous trabeculae of the subcutis, containing a parenchymatous cysticercus 6 to 10 mm in diameter (Fig. 5). There was a dense local lymphoplasmacytic and mononuclear infiltrate, but the suppurative component present in the *M. grimaldii* cysts was almost absent. The cysticerci of *P. delphini* had broadly the same tissue organization as the *M. grimaldii* cysticerci described above, except that the invaginated neck was a short robust structure bearing a large and elaborate scolex at its termination.

Two types of cestode larvae are described in the present study, distinguished by their morphology, the sites of encystment and the cyst structure. Delyamure's (1955) artificial key to cestode larvae parasitizing marine mammals distinguishes larvae in the genus *Monorygma* as having a scolex with oval bothridia situated at the top of a long filament, and larvae in the genus *Phyllobothrium* as having very plicate bothridia situated at the top of a short neck. These respective features were observed in the present material.

The adults of *M. grimaldii* and of *P. delphini* are unknown (Williams, 1968), although the scolex of *M. grimaldii* is similar to *M. perfectum* or *M. elegans* (Baylis, 1919), and the scolex of *P. delphini* is similar to *P. tumidum* (Johnston and Mawson, 1939). The specialised cyst structure of *M. grimaldii* may facilitate transmission of the cysticercus by protecting it from the me-

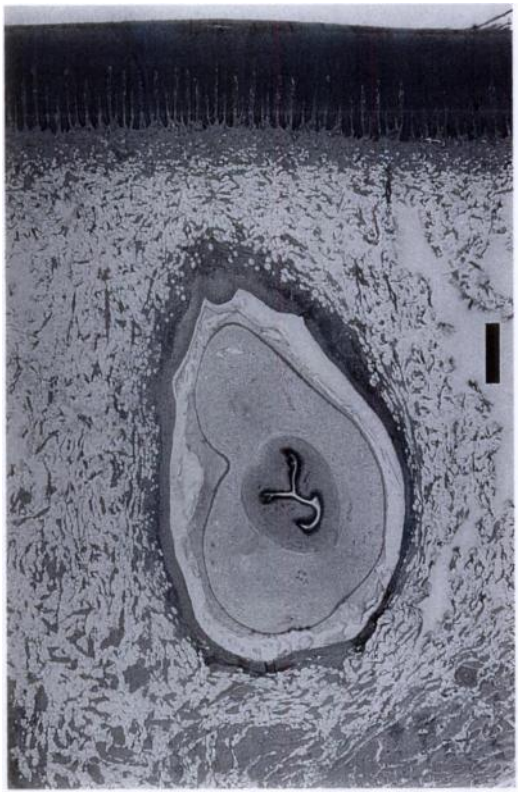

FIGURE 5. *Phyllobothrium delphini* encysted in the subcutaneous blubber of a common dolphin. H&E. Bar = 1 mm.

chanical hazard of ingestion by a predatory shark such as the great white shark (*Carcharodon carcharias*). Alternatively, if the definitive host is a scavenger such as the tiger shark (*Galeocerdo cuvier*), it may preserve the cysticercus during any delay between death of the dolphin and its ingestion. Baylis (1919) noted survival of encysted *M. grimaldii* at least 11 days after the death of their host. *Phyllobothrium delphini* cysticerci also are available to these large lamnid and carcharhinid elasmobranchs, but their subcutaneous site of encystment makes them peculiarly available to cookie cutter sharks (*Isistius brasiliensis*). These potential definitive hosts of tetraphyllidean cestodes (Williams, 1968) prey on dolphins in southeastern Australian waters (Last and Stevens, 1994).

The *M. grimaldii* cysticercus lying free in the peritoneal cavity of this dolphin is unexplained. Escape from a ruptured cyst was excluded since all the cysts were intact. The communicating cysts, two cysticerci occupying a single cyst, and the incompletely bisected cysticercus also present in this host may represent aberrant development of *M. grimaldii*. Alternatively, they may represent transitional stages of multiplication in the dolphin intermediate host. The formation of nests of *M. grimaldii* cysts could support the latter conjecture, or it may simply reflect migratory predilection. Linton (1905) described four cysticerci occupying discrete cysts contained within a single large cyst and interpreted this to be the result of the cysts of four separate larvae coalescing as they grew. Bester (1989), in the first report of a *M. grimaldii* cysticercus in a pinniped, recorded aberrant migration to the testis of a subantarctic fur seal (*Arctocephalus tropicalis*). Morgan et al. (1978) described two cysts attached to the peritoneal wall of a southern elephant seal (*Mirounga leonina*). The larvae within were identified as *P. delphini*, although the illustration of the lesion, and the description of "a single tapeworm larva of considerable length in each cyst" are suggestive of *M. grimaldii*. The latter specimens could not be located to confirm their identity. *Phyllobothrium delphini* and *M. grimaldii* were not encountered in seven bottlenosed dolphins (*Tursiops truncatus*) which stranded on the coast of Victoria (Australia) between 1991 and 1994 (R. J. de B. Norman, unpubl. observ.). Anomalous findings should be interpreted conservatively because the life history and usual hosts of these cestodes are poorly understood.

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