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ORIGINAL PAPER

Cryptorchidism in the sub-Antarctic fur seal *Arctocephalus tropicalis*

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Abstract
The prevalence of cryptorchidism, a condition when one or more testes failed to move to their proper position(s), was evaluated for sub-Antarctic fur seals from Gough Island, South Atlantic. The reproductive tracts of male fur seals ($n = 123$) were examined and reproductive organs measured in a previous study. Only one fur seal, a 5-year-old sexually mature male, had one inguinal testis on the right side, and a small abdominal one situated below the kidney on the same side. A matching contralateral testis could not be located, neither in the scrotum or inguinal canal nor within the abdominal cavity. Amongst pinnipeds, cryptorchids rarely occurred in northern fur seals (0.01% to 0.02% prevalence), harbour seals (undetermined prevalence) and in sub-Antarctic fur seals (0.8% prevalence). Inconsequential on a population level, the rare instances of cryptorchidism in seals are interesting curiosities.

Keywords Fur seals · Reproduction · Ipsilateral testes · Testicular descent · Sexual maturity

Introduction

The male reproductive tracts of marine mammals, though fundamentally the same as in 'typical' mammals, have varied positional relationships (Reynolds and Rommel 2018). A detailed summary of the male reproductive system in pinnipeds appears in Harrison (1969) and Laws and Sinha (1993). The phocid ('earless') seals have paired, testicond (ascrotal) testes, while in the otariid ('eared') seals (fur seals and sea lions) paired testes become scrotal from their usual inguinal position at elevated body temperatures (Reynolds and Rommel 2018). In the inguinal position, the otariid testes are situated as in the phocids, i.e. in the groin external to the abdominal muscles, but covered by a superficial muscle (Laws and Sinha 1993). The pinniped testes are therefore para-abdominal (Reynolds and Rommel 2018).

Cryptorchidism is a condition found in male mammals when one or more testes has not moved to its proper position, and which impacts the health and survival of such individuals (Amann and Veeramachaneni 2018). Ontogenically, the testes originate in the body cavity behind the peritoneum at the medial sides of the developing kidneys, from where it migrates downward. Testicular descent usually occurs some months prior to birth in phocids, but only after birth, and sometimes not until the 3rd or 4th year, in otariids (Harrison 1969). In domesticated dogs, for example, cryptorchidism may be unilateral or bilateral, but unilateral cryptorchidism is most common, with the right testis more commonly affected (Dunn et al. 1968; Yates et al. 2003).

This paper reports on (a) cryptorchidism in the sub-Antarctic fur seal (SAFS) from Gough Island, (b) the prevalence of this anomaly in pinniped populations, and (c) the possible negative effects of such a condition at the population level.

Methods

(a) Males of all ages were shot ($n = 123$) between November 1977 and October 1978, their reproductive tracts examined in situ, and then dissected out and measured to enable a study on male reproduction in the species (Bester 1990). Mean value and standard deviation were calculated for testes mass and size. Ages of sampled individuals were estimated from incremental lines (growth layer groups) in the dentine of tooth sections (Bester 1990).
(b) Antarctic seal literature within the Mammal Research Institute (MRI) collection, as well as those sourced

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from the University of Pretoria's Merensky library, was scrutinized for reference to cryptorchidism in pinnipeds. A Google Scholar internet search was done using various key words, some of which are included in the listing after the abstract (above).

Results and discussion

The left testis and epididymis of the adult male sub-Antarctic fur seal are significantly heavier than the right testis and epididymis (Bester 1990). Amongst all the *A. tropicalis* males ($n = 123$) that were examined, only a 5-year-old had one inguinal testis on the right side (17.4 g, epididymis included) and a small one (2.0 g, epididymis included) situated in the abdomen below the kidney on the same side (Fig. 1). The animal had reached sexual maturity (puberty) which is typical for males between 3–4 years of age in sub-Antarctic (Bester 1990) and Antarctic fur seals (McCann and Doidge 1987). A testis with associated epididymis could not be located on the contralateral side (Bester 1990), neither in the scrotum or inguinal canal nor within the abdominal cavity.

The mass of the right inguinal testis (and associated epididymis) was on par with those of other sexually mature, non-cryptorchid 5-year-olds examined at Gough Island (mean = 11.7 ± 3.75 g; range 6.6–19.5 g; $n = 8$). The undescended ipsilateral testis and epididymis, located below the right kidney, weighed ~ sixfold less than the mean mass of the inguinal testes of the other 5-year-olds. The dimensions of the descended right testis in the cryptorchid were not measured, but the mean length of the inguinal testes of the other 5-year-olds ($n = 8$) was 4.4 ± 0.18 cm (range 3.37–5.2 cm). The presence of ipsilateral testes (this study), also occur in triorchidism, the rare presence of three testes, in individual mammals (Uğuz et al. 2017).

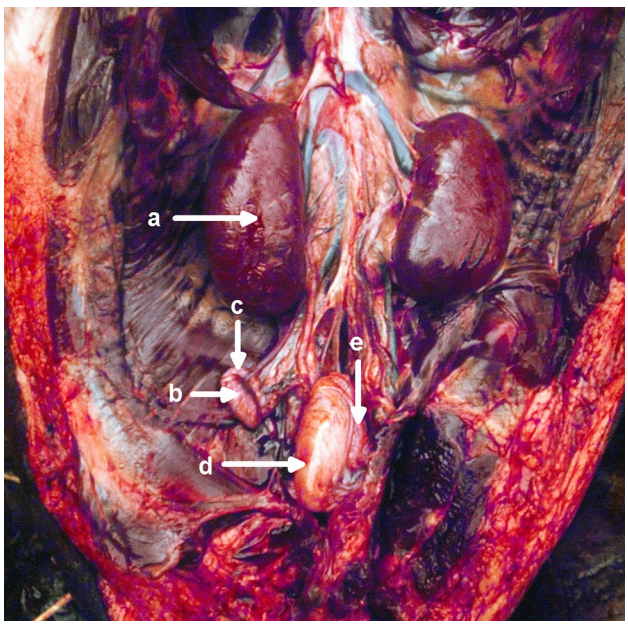

Fig. 1 Photograph of the abdominal cavity (intestines, bladder and prostate removed) of a 5-year-old male sub-Antarctic fur seal at Gough Island, showing (a) the right kidney, (b) an undescended, abdominal testis, and (c) its associated epididymis. The ipsilateral descended testis (d), expressed from its inguinal canal, and its epididymis (e) appear more centrally, lower down. No scale is available, but the mean length of the right inguinal testis in other 5-year-olds is 4.4 cm

Amongst otariid males, undescended testes (bilateral) occurred in five northern fur seals *Callorhinus ursinus* (Scheffer 1951). A literature search failed to uncover reported cryptorchidism in any other pinniped, apart from the unilateral cryptorchidism observed in two young phocid harbour seals, *Phoca vitulina* (Harrison 1969). Cryptorchidism in pinnipeds is not mentioned in recent authoritative summaries of their reproductive anatomy (Orbach 2018; Reynolds and Rommel 2018).

For want of relevant pinniped data, a comparison between domesticated dogs (family Canidae) and fur seals (family Otariidae), both of which are grouped within the suborder Caniformia, seems appropriate. Cryptorchidism occurs in dogs at 0.8% (Priester et al. 1970) to 9.7% (Reif and Brodey 1969), is estimated at 0.8% in sub-Antarctic fur seals (this study) and 0.01% to 0.02% in adult male northern fur seals (Scheffer 1951, 1962).

The absence of a testis contralateral to the existing ones in the 5-year-old sub-Antarctic fur seal (this study) is similar to monorchidism in domesticated dogs. Monorchidism is a rare developmental condition in which the affected individual only develops one testis (not to be confused with unilateral cryptorchidism). Therefore, the affected individual does not develop a testis contralateral to the existing one(s) as in the present study, perhaps due to testicular regression syndrome (TRS), or 'vanishing testis' (Pirgon and Dündar 2012). TRS is a condition which is considered to be due to the disappearance in foetal life of an initially normal testis (Hegarty et al. 2006).

Conclusion

The occurrence of two ipsilateral testes in a sub-Antarctic fur seal, the one inguinal and within the size (mass) range for conspecific 5-year-olds, and another non-inguinal (non-scrotal) testis, some ninefold smaller (in mass), is exceptional. The observed absence of a contralateral testis is probably a result of an issue during foetal development such as in monorchidism. Due to the extremely low presence of cryptorchidism in seals, a condition that has health and survival implications, it is of no consequence on a population level

in fur seals. Rather, the rare instances of cryptorchidism in seals are interesting curiosities.

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Author contributions I (MNB) planned the original research, collected the samples, processed it, and wrote and reviewed the manuscript.

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Data availability The original datasheets on which the relevant data were recorded will be available upon request.

Declarations

Conflict of interest MNB declares no conflict of interest.

Ethical approval Field procedures in 1977/78 were approved by the Director-General, SADT, under advice from the South African Scientific Committee for Antarctic Research, pursuant to the provisions of the South African Sea Bird and Seals Protection Act, 1973 (Act 46 of 1973), and the Convention for the Conservation of Antarctic Seals of 1972. No formal animal ethics committee existed at the University of Pretoria in 1977.

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