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Two cases of asymmetrical conjoined twins in wild mammals from the Netherlands

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Case reports of conjoined twins ('Siamese twins') in wild mammals are very scarce. Most published reports of conjoined twinning concern cases in man or in domestic mammals. In this article two cases of asymmetrical conjoined twinning in wild mammals are described: an omphalopagus parasiticus in a black rat *Rattus rattus* and a pygopagus parasiticus in a European hedgehog *Erinaceus europaeus*. The omphalopagus and pygopagus are the first published cases of parasitic conjoined twinning in wild mammals.

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INTRODUCTION

Conjoined twins ('Siamese twins') are well known in man, in domestic and laboratory mammals, domestic and wild birds and in wild and captive-bred reptiles, amphibians and fishes, but are very rarely described in wild mammals. The precise incidence is unknown, most likely due to high prenatal and antenatal mortality. Almost all known cases of conjoined twins in wild mammals concern unborn embryos and foetuses found during dissection of the pregnant dead female. The aim of this article is to describe two postnatal cases of asymmetrical conjoined twins in wild mammals.

MATERIAL

Case I Black rat *Rattus rattus*

A subadult male pair of conjoined twins of a black rat *Rattus rattus* (LINNAEUS, 1758) was collected at St. Michielsgestel, province of Noord Brabant, The Netherlands, in January

1940. The specimen was subsequently sent to the National Museum of Natural History, Leiden, where it was preserved in alcohol 70% and stored in the collection (catalogue number RMNH 4149). The jar with the conjoined twins was rediscovered in the summer of 2000 and the present author recognised an omphalopagus parasiticus conjoined twin.

The autosite is an adult, full-grown male. The head-body length is 131.0 mm, the tail length 155.5 mm. The autosite is normal in appearance and proportions. The parasite is also male, and consists of a 55 mm long posterior part of the body with pelvis and two lower limbs. Two rudimentary structures resembling a front leg with one finger and another separate finger are present above the bridge connecting the autosite and the parasite. Anus and tail are missing, the penis lacks the urethra, the scrotum was empty (Fig. 1). Roentgenograms showed a normal skeleton of the autosite and the presence of the pelvic bones, lower limb-bones and rudimentary upper limb-bones in the parasite. During the dissection of the parasite,



Figure 1 *Omphalopagus parasiticus* in a black rat *Rattus rattus* from St Michelsgestel, The Netherlands, January 1940 (RMNH cat.nr 4149). [photo: H. van Middelkoop]

some remains of intestines and fatty tissue were found. No kidneys were present.

Case 2 European hedgehog

Erinaceus europaeus

A juvenile female pair of conjoined twins of a European hedgehog *Erinaceus europaeus* LINNAEUS, 1758 was brought in alive at an animal rescue centre at Gouda, province of Zuid Holland, the Netherlands, in October 2002. It died the following day. Eventually the hedgehog reached the Natural History Museum Rotterdam, the Netherlands, where the specimen was preserved in alcohol and was given catalogue number NMR 9990-002079.

The specimen (Fig. 2). could be recognised as pygopagus parasiticus conjoined twins. The autosite is a juvenile female. The head-body length is 192 mm. The autosite is normal in appearance and proportions. The parasite exists of a 35 mm long posterior part of the body with pelvis and two lower limbs. The pelage of the parasite consists of circa 25 spines and long brown hairs usually found laterally in a normal hedgehog. Anus and tail are missing; the vulva lacks the urethra During the dissection of the parasite some remains of intestines and fatty tissue were found. No kidneys were present.

DISCUSSION

Conjoined twins can be separated in symmetrical and asymmetrical (internal and external parasitic) twins. Symmetrical conjoined twins concern two equal conjoined parts (the 'classic Siamese twins'). External parasitic conjoined twins are unequal, asymmetrical conjoined twins in which one (the autosite) is nearly or completely normal, while the other (the parasite) is incomplete, and attached to and dependent on the autosite. In man, external parasitic conjoined twinning is very rare. In the United States the incidence is estimated at about one or two cases per one million births (Knowles 1987; Steele *et al.* 1992). Gupta *et al.* (2001) give an incidence of one in 50.000 to 100.000 live births. Among 1037 conjoined twins, Spencer (2001) found 157 (15%) para-

sitic ones. There are no estimates for the various species of domestic mammals (Otlanga-Owiti *et al.* 1997).

Conjoined twins are always conjoined in one of only eight sites (Spencer 2001, 2003) and are named after the site of union: thoracopagus (united ventrally at the chest); omphalopagus (united ventrally at the abdomen); cephalopagus (united ventrally at head and chest); ischiopagus (united ventrally at the pelvis); parapagus (united laterally [dicephalus; one body, two heads or diprosopus; one body, two faces]); craniopagus (united at the heads); pygopagus (united caudally) and rachipagus (united dorsally at the spine). Symmetrical and asymmetrical conjoined twins are usually united at the same sites.

Parasitic conjoined twins are, as symmetrical conjoined twins, monozygotic. Logroño *et al.* (1997) described a case of omphalopagus parasiticus; based on DNA extraction from formalin-fixed, paraffin-processed tissue taken from the parasite, they concluded that the twin-pair were dizygotic fused twins. Their statement is however, unproven and at best hypothetical (Machin 1998). Steele *et al.* (1992) proved that their set of parasitic twins was monozygotic, chromosomally and otherwise genetically identical, within the discriminatory power of the employed technology.

In domestic mammals, parasitic twins are most often described in sheep (Leipold *et al.* 1972, Dennis 1975, Hiraga & Dennis 1989), cattle (Abt *et al.* 1962, Leipold *et al.* 1972, Hiraga & Dennis 1989), domestic pig (Benesch 1957, Selby *et al.* 1973, Partlow *et al.* 1993) and laboratory animals such as rat and rabbit (Szabo 1989). Some remarkable cases in domestic mammals are described and illustrated in classic historical literature, such as in the beautifully illustrated monographs by the veterinary teratologist E.F. Gurlt (1832, 1877) and in other works by Geoffroy Saint-Hilaire (1836), Vrolik (1849) and Schwalbe (1907). These cases concern cattle, goat, sheep and pig, and also domestic cat and dog.

The black rat described here (case 1) can be identified as an omphalopagus parasiticus, an



Figure 2. *Pygopagus parasiticus* in an European hedgehog *Erinaceus europaeus* from Gouda, The Netherlands, October 2002 (NMR 9990-002079). **A** ventral view; **B** lateral view; **C** detail of lower body in ventral view (arrow indicates the vulva of the parasite) with the parasite; **D** lower body in dorsal view. [photo: C.W. Moeliker]

asymmetrical conjoined twin united ventrally high at the abdomen. The described European hedgehog (case 2) can be identified as a *pygopagus parasiticus*.

The typical omphalopagus parasiticus most often has both upper and/or lower limbs occu-

pying the lower chest and/or upper abdomen of the autosite, above the shared umbilicus (Spencer 2003). A typical case in a lamb *Ovis aries* is shown in Figure 3. Normal or rudimentary genitalia are present in most cases concerning the lower limbs, many with gonads



Figure 3 *Omphalopagus parasiticus* in a lamb *Ovis aries* from Heeze, The Netherlands, April 2004 (NMR 9990-002078). [photo: C.W. Moeliker]

and kidneys. A patent anus is seldomly found in the parasite.

Omphalopagus parasiticus (sometimes also called heteropagus or epigastricus) are well known in man from several classic historical cases, such as Lazarus-Johannes Baptista Collerado, who was born in 1617 and probably died in 1646. Later, several cases have been described and illustrated in the classic works on descriptive teratology in the 19th century (e.g. Wirtensohn 1825, Förster 1865, Ahlfeld 1880, Guinard 1893). The 20th century cases of *omphalopagus parasiticus* in man concern case reports on (successfully) surgically separated newborns (Schwalbe 1907, Sarrelangue & Potter 1946, Poradowska *et al.* 1969, Nasta *et al.* 1986, O'Neill *et al.* 1988, Biswas *et al.* 1992, Chadha *et al.* 1993, Soundrarajan *et al.* 1994, Cywes *et al.* 1997, Logroño *et al.* 1997,

Mir *et al.* 1998, Chun *et al.* 1999, Karnak *et al.* 1999, Raynal *et al.* 2001, Gupta *et al.* 2001, Tongsin *et al.* 2003, Chen & Choe 2003), but also some newly discovered living adult cases (Soundrarajan *et al.* 1994, Saha & Dewan 1995).

In the *pygopagus parasiticus* (dipygus; caudal duplication) supernumerary structures are found on the ventral aspect of the lower trunk, usually with a bony attachment in the gap of an autosite diastases pubis (Spencer 2003). *Pygopagus parasiticus* typically have one to four limbs, often only the two lower, as in the described hedgehog. All the parasites have some remnant of a lower intestinal tract and a genito-urinary tract. A recent case of *pygopagus parasiticus* in an adult goat is thoroughly described by Otiangá-Owiti *et al.* (1997).

The aetiology of asymmetrical conjoined

twins remains enigmatic. The parasitic twin is the remains of a defective twin embryo incapable of independent survival and development but with sufficient attachment to the autosite with vascularisation of some remaining anatomical structures. Several reports on chromosomal abnormality in such twins suggest a genetically imperfect embryo that develops into a defective conjoined foetus. Parasitic asymmetrical twins are most probably the result of secondary deterioration or death of one embryo in primary symmetrical conjoined (fused) twins. Also important is the fact that a functional heart or brain is rarely found, suggesting that the aetiology of deterioration or death of the parasite is primarily a cardiac malformation, with secondary disruption in the development of the brain and parts of the body

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- I am not aware of any published cases of external parasitic twinning in any wild mammal species. The present cases could therefore be regarded as the first described cases of omphalopagus parasiticus and pygopagus parasiticus in wild mammals.

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