Short Communication

Unilateral Polydactylism in a German Holstein-Friesian Calf - A case report

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Abstract

This case report describes the diagnosis and surgical treatment of unilateral polydactylism of unknown origin in a calf. A six-week-old female German Holstein-Friesian calf was referred to the clinic with a hyperflexion of the fetlock and carpal joints of the right forelimb, associated with two surplus digits in the same leg, which was confirmed by radiographic examination. Surgery consisted of an osteotomy of the second metacarpal bone, a disarticulation in the antebrachiocarpal joint of the additional limb combined with an amputation of both odd digits. The follow-up of 12 months revealed a functionally sound heifer showing a good cosmetic outcome.

Keywords: calf, congenital anomaly, polydactylism

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บทคัดย่อ

สภาพนิ้วเกินของขาหน้าขวาในลูกโคพันธุ์ เยอรมัน โฮลสไตน์ ฟรีเชียน: รายงานสัตว์ป่วย

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รายงานสัตว์ป่วยฉบับนี้อธิบายถึงการตรวจวินิจฉัยการรักษาทางศัลยกรรมสภาพนิ้วเกินของขาหน้าขวาที่ไม่ทราบสาเหตุในลูกโค ลูกโคพันธุ์ เยอรมัน โฮลสไตน์ ฟรีเชียน เพศเมีย อายุ 6 สัปดาห์ ที่เข้ารับการรักษา ด้วยอาการการงอเกินของของข้อเท้า ของขาหน้าขวา ร่วมกับมีนิ้วติ่ง ซึ่งทำการวินิจฉัยจากภาพถ่ายรังสี ให้การรักษาโดยการตัดกระดูก ฝ่าเท้าชิ้นที่สอง การจัดข้อต่อ Antebrachiocarpal ของขาทั้งสาม และการกระดูกนิ้วติ่งออก การติดตามผลการรักษาภายในระยะเวลา 12 เดือน ให้ผลเป็นที่น่าพอใจต่อลูกโค

คำสำคัญ: ลูกโค ความผิดปกติแต่กำเนิด สภาพนิ้วเกิน

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Introduction

Polydactylism is a malformation characterized by the presence of one or more additional digits. This anomaly has been described in humans and animals, e.g. birds (Crosta et al., 2002; Grewal and Brar, 1989), cats (Sis et al., 1968), dogs (Hansen et al., 1972), horses (Barber, 1990; Borhoven, 1968; Giofré et al., 2004), lama (Altenbrunner-Martinek et al., 2007[a]) and cattle (Bähr et al., 2003[b]; Johnson et al., 1981; Leipold et al., 1972; Murondoti and Busayi, 2001). Polydactylism is described in cattle in different breeds, e.g. Herford, Holstein-Friesian, Guernsey, Normand, Austrian Fleckvieh and Simmental (Altenbrunner-Martinek et al., 2007[a]; Bähr et al., 2003[a,b]; Mather, 1987; Vermunt et al., 2000). According to literature this malformation occurs solitarily or rarely together with other developmental or inheritable anomalies (Crowe and Swerczek, 1985; Villagomez and Alonso, 1998). Although the frequency of congenital malformations is generally low in cattle, different incidences have been mentioned in the literature; 0.013% to 0.51% for Germany (Bähr and Distl, 2005), 6.26% for the USA (Herschler et al., 1962) and 6.85% for Great Britain (Sellers et al., 1968). The incidence of malformations of the limbs is stated to be 3.85% to 4.85% (Bähr and Distl, 2005).

In this case report the diagnosis of an unilateral polydactylism of unknown origin is described in a calf. Furthermore, surgical amputation of the two odd digits, clinical outcome, physiotherapy and long-term follow-up are described.

Materials and Methods

Case history: A six-week-old female German Holstein-Friesian calf was referred to the Clinic for Ruminants and Swine of Freie the Universität Berlin/Germany, for evaluation of a deformation of the right forelimb associated with supernumerary digits. According to the owner, parturition of the calf was uneventful; there was no sibling and polydactylism was already present at birth.

Clinical examination and diagnostic imaging: On admission the calf appeared in good body condition (67 kg whole body weight). Clinical parameters were normal. The right forelimb showed a hyperflexion of the fetlock and carpal joints and the calf was bearing weight on the dorsal aspect of the fetlock joint. Adspection of both forelimbs revealed an additional distinct foot at the distal aspect of the second metacarpal bone (MC II) and a supplementary limb at the level of the medial aspect of the carpus. Both supernumerary digits had a fully developed claw. A physiologic temperature of the skin could be detected by palpation. Manual extension of the right fetlock and carpal joints was not possible. The claws of the principal digits were normal. The surplus digits were mobile, but not voluntarily movable by the calf. Normal findings were made during adspection and palpation of the left forelimb and both hindlimbs. Radiographic examination of the right metacarpal and antebrachiocarpal region revealed a supplementary digit composed of proximal, middle and distal phalanx taking its origin at the distal aspect of a complete MC II (Figure 1), as well as a surplus digit composed of a carpus, accessory carpal bone, MC, sesamoid bones, proximal, middle and distal phalanx at the distal aspect of a second radius which took its

origin at the principal radius (Figure 2). Amputation of the extra digits was requested by the owner.

General anesthesia: The calf's pre-anesthetic examination, e.g. blood analysis, biochemical values and auscultation of the respiratory system, had normal results. Amoxicillin (Duphamox LA™, 15 mg/kg, SC; FortDodge, Europe), gentamicin (Gentamicin 50™, 4 mg/kg, SC; Medistar, Germany) and meloxicam (Metacam™, 0.5 mg/kg, SC; Boehringer Ingelheim, Germany) were administered 30 min prior to general anesthesia. The calf received ketamine (Ursotamin™ 5 mg/kg, IM; Serumwerk, Germany) and xylazin (Sedaxylan™, 0.1 mg/kg, IM; WDT, Germany) 20 min prior to induction. General anesthesia was induced with a mask using isoflurane (IsoFlo™, Essex Tierarznei, Germany). The calf was intubated with an oro-tracheal tube and was placed in right lateral recumbency. Anesthesia was maintained with isoflurane vaporized in oxygen, using a machine for large animal anesthesia. Patient monitoring included clinical assessment, electrocardiography, direct blood pressure evaluation, spirometry, respiratory gas analysis and arterial blood gas analysis.

Surgical procedure: The right forelimb was prepared aseptically from the elbow down to the claws. A straight incision was made over the medial aspect of the right radius at the level of the additional digit (Figure 3a), starting about 25 cm proximal to the carpus and continuing 10 cm distal to it. The supernumerary limb was circumcised (Figure 3a). The subcutaneous tissue was dissected bluntly. Nerves and vessels were ligated and subsequently cut as far proximal as possible. The supplementary limb was disarticulated at the surplus antebrachiocarpal joint, the distal limb removed and the radial joint surface curetted. The amputated distal part of the digit showed the anatomic landmarks found in a normal digit. A Rédon drain was placed in the wound (Figure 3b). Fascia as well as subcutaneous tissue were sutured with 3-metric polyglactin 910 (Vicryl™; Ethicon, Germany) using a simple continuous suture pattern each. The skin was closed with 3-metric monofilament polypropylene (Dafilon™; Braun Vetcare, Germany) using a simple interrupted vertical mattress suture pattern. An osteotomy of the MC II was performed at its distal part and with an osteotome. The distal MC II and the remaining surplus digits were removed. The wound was sutured in three layers following the same procedure as described above, but no drain was applied in the wound. The cosmetic appearance of both surgical sites was satisfying. A full extension of the right forelimb was possible by manipulation. A full-limb cast was applied to the extended right forelimb. The calf recovered from general anesthesia without complications.

Figure 1: Radiographic view of the metacarpal region of the right forelimb (dorso-palmar view) showed two supplementary distal digits (✱,✱✱) composed of metacarpus and three phalanges.

Figure 2: Radiographic evaluation of the right carpus and mid-radius (latero-medial view) showed a supplementary digit (*) composed of radius, carpus, accessory bone, metacarpus, sesamoid bones and three phalanges.

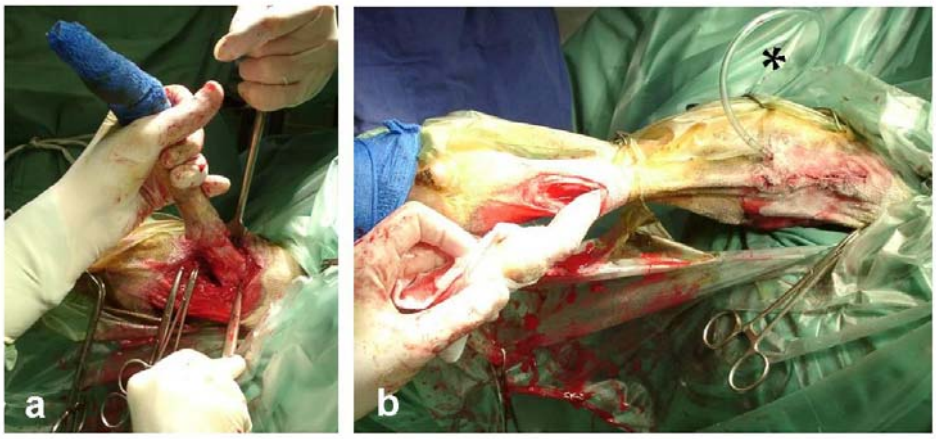

Figure 3: Intra-operative view of the dissection of the proximal (a) and distal (b) supernumerary digit of the right forelimb. A Rédon drainage (*) was included in the proximal wound (b).

Postoperative treatment and short-term follow-up: The postoperative medication consisted of amoxicillin (15 mg/kg, SC, every second day) administered three times, gentamicin (4 mg/kg, SC, SID) for seven days and two applications of metacam (0.5 mg/kg, SC, every second day). The cast was changed at day 6, 9 and 14 *post operationem* and was removed on day 20. The drain was removed at day 6, the sutures at day 16. Full-limb bandages were applied for 8 days following cast-removal and a dorsal extension was glued to both claws of the right forelimb. In total, the calf was confined to a close stable for six weeks.

Physiotherapy: Walking in hand was started at day 21 *post-operationem* for 8 days, followed by an additional training by whole body vibration (WBV; Marquis®VMS, Marquis® Tiermedizintechnik GmbH, Germany, Figure 4). At day 55 post operation the calf was discharged from the clinic. The calf was clinically sound besides a slight carpus valgus formation in the right forelimb (Figure 4).

Figure 4: Calf five weeks after surgery. Full weight bearing of the right forelimb is established. Physiotherapy was completed using whole body

vibration training.

Long-term follow-up: Follow-up information obtained 12 months after surgery revealed a sound heifer. The cosmetic appearance of the right forelimb according to the owner is good.

Results and Discussion

Usually both forelimbs are affected by polydactylism, but -less frequently- a malformation of one or up to all four limbs is described (Johnson et al., 1982). Most polydactylism cases show a surplus digit at the medial aspect of the forelimbs (Mather, 1987). In case of unilateral affection the right forelimb is usually affected (Roberts, 1921), which was found in the calf described in this clinical case report. The affected limb often shows an axial rotation (Altenbrunner-Martinek et al., 2007[a]; Schönfelder et al., 2003).

Polydactylism in cattle can be subdivided into seven types (Type I to VII; Johnson et al., 1982): Bilateral polydactyly of both forelimbs (Type I), i.e. additional MC or phalanges. Unilateral polydactyly of one forelimb or one pelvic limb (Type II), i.e. additional MC or metatarsal bones and phalanges. All four limbs have additional digits (Type III). Bilateral duplication of digits with dimely of the fore- or hindlimb (Type IV), a rare occurrence. Polysyndactyly (Type V). Bilateral incomplete formation of MC II (Type VI). Polydactylism in combination with a malformation-complex (Type VII). A genetic cause is thought to be responsible for polydactylism Type I to VI (Johnson et al., 1982) and Type VII polydactylism is described to be due to environmental factors (Johnson et al., 1982). Furthermore, characteristics of more than one type of polydactylism can be present in one individual (Behrens et al., 1979; Murondoti and Busayi, 2001; Villagomez and Alonso, 1998). The calf described in this present case suffered from a polydactylism Type II. The characterization of polydactyly can further be done by classifying the anomaly as symmetric or asymmetric double malformation (Schönfelder et al., 2003). In this case the calf presented with an asymmetric malformation, characterized by the presence of a completely developed autosite and a smaller, incomplete parasite. Symmetric malformations are known as conjoined twins and are mostly stillborn or have to be euthanized directly after delivery (Schönfelder et al., 2003).

Polydactylism may rarely be caused by external factors like exposure to toxins (Giofré et al., 2004), e.g. Lupinus consentinii and Veratrum californicum (Bähr et al., 2003a), physical forces, e.g. radiation, or chemical agents. An atavistic, i.e. developmental, or a teratogenic, i.e. due to a teratogenic splitting of the basipodial elements, origin has been proposed by some authors (Borhoven, 1968; Marlot and Ilijas, 1967; Stockard, 1930). Another hypothesis discussed is an overaged oocyte with decreased abilities for normal development of the embryo (Schönfelder et al., 2003). Also cholesterol deficiency during pregnancy was found to have a negative influence on the development of the limbs due to interference with the signalling pathways of important morphogenes in rats as a model for human malformation syndromes (Gofflot et al., 2003).

In the described case no cytogenetic analysis (Giofré et al., 2004) was performed. Cow and bull of the described case and their further offspring did not show any signs of polydactylism. Therefore, in the case described the calf's polydactylism cannot directly be attributed to a genetic aberration or to an abnormal development due to external causes.

The diagnosis "polydactylism" is based on clinical examination and diagnostic imaging. A complete radiographic evaluation of the region of the additional digits and adjacent joints, e.g. carpus, is necessary to determine possible osseous abnormalities (Altenbrunner-Martinek et al., 2007[a]) e.g. the presence of surplus carpal bones (Altenbrunner-Martinek et al., 2007[a]; Vermunt et al., 2000). The aim of surgical removal of the extra digits is to improve the well-being of the animal, its cosmetic appearance and to prevent injury of the digit (Schönfelder et al., 2003). However, animals with non-disturbing supernumerary digits or inoperable malformations of the appendicular skeleton and associated joints should not be subjected to surgery (Schönfelder et al., 2003). In the described case the surgical procedure was indicated, because the calf was unable to bear weight on the claws of the right forelimb. Care should be taken to avoid a destabilisation of the corresponding articulations due to the surgical intervention (Barber, 1990). On the other hand, an incomplete removal of supernumerary digits might cause an insufficient cosmetic outcome, lameness or might not improve a persistent lameness. In the above described case, the removal of both additional digits allowed full weight-bearing and full extension of the affected limb. The carpus valgus formation - probably due to the altered strains on the right carpus/radius by the additional digits - improved during the calf's rehabilitation phase.

The rehabilitation program was composed of passive manipulation of the limb, the application of dorsal claw extensions, walking exercise and WBV-training (Trans et al., 2009). The rehabilitation program was well tolerated by the calf and produced a good functional and cosmetic outcome.

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