Case reports of squamous cell carcinoma in cows

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Veterinaria Italiana 2021, **57** (2), 161-168. doi: 10.12834/VetIt.2292.14211.1
Accepted: 29.12.2020 | Available on line: 31.12.2021

Keywords
Neoplasm growth, Cow cancer, Malignant cancer, Eye.

Summary
The aim was to investigate the frequency of squamous cell carcinoma and the outcome after surgical treatment in cows admitted to the clinic between 2012 and 2018. The study included six cows with squamous cell carcinoma (confirmed in 5 cattle and suspected in 1). All cattle underwent clinical examination and additional testing to confirm the diagnosis. Breed, age, gender, localization of neoplasm and treatment were recorded. In a telephone questionnaire owners were asked about survival, culling, integration into the herd after discharge from the clinic, wound healing and neoplasm recurrence. Five ocular squamous cell carcinomas were diagnosed during the study period. Another neoplasm on the dorsolateral thoracic wall of a cow could not be diagnosed with certainty; however, it had characteristics of squamous cell carcinoma. Two cows with ocular squamous cell carcinoma were euthanised. The prognosis and outcome of squamous cell carcinoma depend on early detection of clinical signs, the presence of metastases and the timing of tumour removal. Surgical removal of a squamous cell carcinoma at or near the eye or at other locations of the body appears to have a good prognosis.

Introduction

Reports on neoplasms in cattle are relatively rare compared with other domestic animals. One frequently cited reason is that cattle, similar to other food producing animals, do not reach an age old enough to predispose them to the development of tumours typically seen in horses and companion animals (Russell *et al.* 1976, Klein *et al.* 1984, Stöber 2006).

Squamous cell carcinoma (SSC), particularly the ocular form, has been described in many reports as one of the most common malignant bovine tumours (Russell *et al.* 1976, Köstlin and Jonek 1986, Stewart *et al.* 2006, Tsujita and Plummer 2010). Affected cows typically are seven to eight years of age (Gabriel 2008, Tsujita and Plummer 2010). The aetiology of ocular and periocular SCC in cattle is not entirely clear but breed predisposition, age, nutrition, ultraviolet radiation, non-pigmented eyelids and non-pigmented sclera along the corneal limbus may be involved (Stöber 2006, Tsujita and Plummer 2010). In addition, a hereditary component may be involved in Hereford cattle (Russell *et al.* 1976, Anderson and Badzioch 1991).

Ocular SSC, also referred to as cancer eye, causes significant economic losses in the North American cattle industry (Heeney and Valli 1985, Tsujita and Plummer 2010), and there are several studies of this tumour in various cattle breeds in Europe (Klein *et al.* 1984, Köstlin and Jonek 1986, Hirsbrunner *et al.* 1998, Gabriel 2008, Braun *et al.* 2012, Freick *et al.* 2016).

Ocular SCC can affect all parts of the eye as well as the surrounding tissues. Predilection sites for the tumour include the corneal limbus, the eyelids, the third eyelid and the transition from the cornea to the sclera with varying incidences (Farris and Fraunfelder 1976, Stewart *et al.* 2006). It can occur at a single location or simultaneously at several locations and can persist, regress spontaneously or metastasize (Köstlin and Jonek 1986). Ocular SCC has been classified into 4 groups (Stöber 2006), which are a) conjunctival plaque or keratoma, b) conjunctival or epidermal papilloma, c) non-invasive carcinoma and d) invasive carcinoma. Squamous cell carcinoma is particularly common in cattle breeds with non-pigmented eyes such as Fleckvieh, Simmental or Hereford cattle (Russell *et al.* 1976, Köstlin and Jonek 1986, Gabriel 2008, Schulz and Anderson 2010), in which the yearly incidence of SCC may be as high as 5.9 % (Russell *et al.* 1976). In the Netherlands, the yearly incidence was found to be 0.04 % (Klein *et al.* 1984). This tumour is a common indication for exenteration of the orbit,

also referred to as enucleation (Schulz and Anderson 2010, Chigerwe *et al.* 2017).

Squamous cell carcinoma may also manifest as an oesophageal tumour, particularly in warmer climates or in cattle exposed to poisonous plants such as bracken fern (Faccin *et al.* 2018). In certain parts of the world, the yearly incidence of neoplasia in cattle exposed to poisonous plants can be close to 11% (Pinto *et al.* 2000). There have also been sporadic reports of SCC in other anatomical regions including the reticulum, liver and anal region (Musser *et al.* 1993, Gabriel 2008, Braun *et al.* 2012).

This case series describes the frequency of SCC in bovine patients referred to the clinic from 2012 to 2018 and the outcome of surgical treatment of the tumours. Of all malignant tumours diagnosed in cattle, SCC was the most common. We observed two manifestations of the tumour; the first was ocular SCC, which was diagnosed in five Hereford cows from the same herd, and the second was a neoplasm with features typical of SCC on the right dorsolateral thoracic wall of a German Holstein cow. The clinical findings, treatment protocols and outcomes of these six cases are described.

Materials and methods

The medical records were searched for bovine patients with a histologically confirmed diagnosis of SCC, or with findings highly suggestive of SCC, admitted to the clinic between October 1, 2012 and October 31, 2018. All cattle had undergone clinical examination and additional testing as needed to make a diagnosis. Information that was analysed included breed, age, sex, admission and discharge dates, tumour localisation, type of treatment and results of histological examination. Information about survival, reasons for leaving the herd, integration of the cattle into the herd after discharge, wound complications and tumour recurrence were obtained via telephone interview and added to the medical records.

Case reports – ocular SCC

Cows and history

Five Hereford cows from a pasture-based herd had been referred to the clinic because of tumorous growths of an eye accompanied by ocular discharge. The cows ranged in age from 2.6 to 9.0 years (mean 6.8 years) and at the time of admission had had ocular signs for a few weeks to two months.

Clinical examination

On admission, all cows had a normal demeanour and appetite. Examination of the affected eye and eyelids showed epiphora with reddish ocular discharge, blepharospasm and a firm neoplasm with irregular surfaces, poorly defined borders and a light pink to red surface. Details are shown in Table I.

In two cows (No. 1 and 2), the changes were limited to the eyelids without involvement of the globe, and two other cows (No. 4 and 5) had severe changes involving the bulbar and palpebral conjunctivae and the globe (Figures 1A and 1B). In addition to the changes at the medial canthus, the remaining cow (No. 3) had a 21 × 15 cm subcutaneous swelling that ran from the base of the left ear along the mandibular branch in a caudoventral direction. Oral examination showed a 11 × 12 cm firm mass in the pharyngeal area obstructing the pharyngeal lumen.

Further investigations

The neoplasms were surgically removed, fixed in 4% formaldehyde solution (Oqema, Korschenbroich, Germany) and submitted for examination to the Institute of Veterinary Pathology, Faculty of Veterinary medicine, Leipzig University, Leipzig, Germany (IVP).

Histological examination and diagnosis

The clinical appearance and localisation of the lesions and their occurrence in a herd of Hereford cows were suggestive of ocular and/or periocular SCC. These clinical diagnoses were confirmed in all cases (Table I). Histological examination showed SCCs with moderate to severe infiltrative growth patterns. The prognosis was poor in all cases because of the potential for recurrence and metastasis of the tumours. Cow No. 3 with lesions at the medial canthus, swelling below the ear and along the mandibular branch and pharyngeal obstruction was euthanised immediately after initial examination because metastasis was suspected.

In cows No. 1 and 2 without involvement of the globe, the tumour was resected after sedation of the cows and administration of local anaesthesia. In cows No. 4 and 5 with involvement of the globe, an exenteration was carried out with the cows sedated and the surgical site blocked with local anaesthesia.

Surgical treatment

Tumour excision was performed as published by Köstlin and Jonek (Köstlin and Jonek 1987), and for the orbit exenteration the surgical method by Stöber (Stöber 2006) was used. Before the operation, cows received amoxicillin (Betamox®, 7 mg/kg BM s.c., Bayer Vital GmbH, Leverkusen, Germany) and meloxicam (Metacam®, 0.5 mg/kg BM s.c.,

Table I. *Age, tumour characteristics and initial treatment of 5 Hereford cows with ocular and/or periocular squamous cell carcinoma (SCC).*

Number of cow	Age (years)	Anatomical structures affected	Lesion	Treatment	Tumour recurrence	Histological findings
1	2.6	Medial canthus of right eye	1.5 × 2.5 cm firm, nodular, ulcerated mass attached to skin, small amount of pink serous secretion.	Resection	no	Cornified SCC with moderately infiltrative growth pattern and severe multifocal inflammation, clean margins
2	6.3	Lateral canthus and both eyelids of right eye	1 × 3 cm mass with irregular surface running from lateral canthus medially along lower eyelid; 0.5 cm of lateral part of upper eyelid affected; mass covered with necrotic material	Resection	yes	Cornified and largely well differentiated SCC with moderately to highly infiltrative growth pattern
3	8.5	Medial canthus of left eye, mandibular branch, base of left ear, oral cavity	3 cm bumpy mass at the eye; 21 × 15 cm firm fluctuating mass running from bottom of left ear along mandibular branch caudoventrally; 11 × 12 cm firm mass in pharyngeal area compromising the pharyngeal lumen	Euthanasia	-	Parts of a partially cornified and moderately differentiated SCC with highly infiltrative growth pattern and moderate to severe multifocal inflammation
4	9.0	Medial canthus, third eyelid, conjunctivae of left eye	Haemorrhagic epiphora, mild prolapse of third eyelid and conjunctivae; multiple small fleshy masses, the size of a grain of rice, at the bulbar conjunctiva; periocular hairs reddish-brown and matted	Exenteration	no	Moderately cornified, moderately differentiated, superficially ulcerated SCC with highly infiltrative growth pattern and severe lymphoplasmacytic inflammation
5	7.6	Lateral canthus, conjunctivae, sclera, cornea of left eye	Lateral canthus occupied by 1 × 3.5 × 0.5 cm light pink mass extending across sclera to cornea; 2 × 3 cm light pink to yellow area with neovascularisation on cornea	Exenteration	no	Poorly differentiated SCC, clean margins

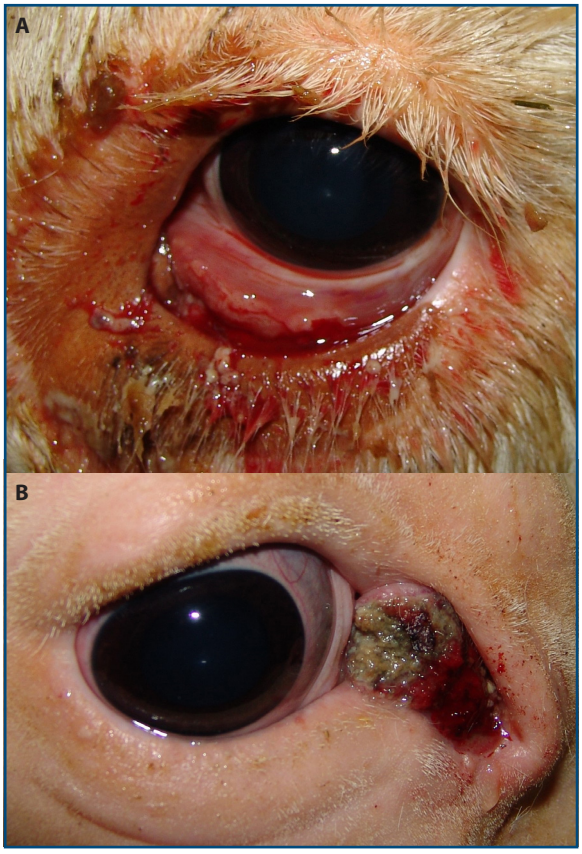

Figure 1. A. *The right eye of a 2.6-year-old Hereford cow (No. 1) with a 1.5 × 2.5 cm firm, nodular, ulcerated tumour at the medial canthus not involving the eyeball.* **B.** *Left eye of a nine-year-old Hereford cow (No. 4) with haemorrhagic ocular discharge, mild prolapse of the third eyelid and multiple small fleshy masses, each the size of a grain of rice, at the bulbar conjunctiva.* The tumour has infiltrated the eyeball.

Boehringer Ingelheim Vetmedica GmbH, Ingelheim, Germany) and were sedated using xylazine hydrochloride (Xylazin® 20 mg/ml, 0.1 to 0.2 mg/kg BM i.m., Serumwerk Bernburg AG, Bernburg, Germany). Ten minutes later, the cows were placed in lateral recumbency on a tilt table (VET PRO®, Rosensteiner GmbH, Steinbach, Austria) with the affected eye uppermost. The skin of the eyelids and the surrounding area was clipped, cleaned and disinfected. For tumour resection, 10 ml of procaine hydrochloride (Procasel-2%®, Selectavet Dr. Otto Fischer GmbH, Weyarn-Holzolling, Germany) was injected subcutaneously along the periphery of the tumour to achieve local anaesthesia, and 5 to 10 min later, the tumour was excised along with some healthy surrounding tissue using a scalpel. Abnormal tissue was fixed in 4% formaldehyde solution and examined histologically. The wound was closed subcutaneously using absorbable monofilament suture material (B. Braun Melsungen AG, Melsungen, Germany) and a continuous suture pattern, and the skin was closed using absorbable suture material in an interrupted mattress suture pattern (Figure 2).

For transpalpebral orbit exenteration, local anaesthesia of the eyelids was first administered by injecting 20 ml of Procasel-2%® subcutaneously from each corner of the eye using a diamond-shaped injection pattern. This was followed by the Peterson retrobulbar eye block in which the ophthalmic nerve was infiltrated with 10 to 20 ml of the same anaesthetic agent. After removal of the globe,

Figure 2. *A 2.6-year-old Hereford cow (No. 1) three weeks after resection of a squamous cell carcinoma at the medial canthus of the left eye.* The wound is dry and healing well.

lacrimal glands and any other affected tissue, a tampon consisting of balled-up gauze soaked with procaine penicillin G (Procain-Penicillin-G® 300 mg/ml, aniMedica GmbH, Senden, Germany) was placed into the orbit, and the eyelids were sutured closed using absorbable suture material in a continuous suture pattern. A small piece of the gauze tampon was left protruding from a small opening at the medial canthus.

After surgery, the cows were discharged from the clinic on the same day, and aftercare was administered at the farm (Figure 3). The owners were instructed to pull and exteriorise 1 to 2 cm of the gauze tampon each day and to remove the entire tampon after about four days. The referring veterinarian continued treatment with antibiotics for five days and with non-steroidal anti-inflammatory drugs for three days. Owners were asked to bring the cows back to the clinic two weeks after discharge for a follow-up examination.

Long-term outcome

As of this writing, three of the four operated cows (No.1, 4, and 5) are still in their original herds. Cow No. 2 underwent orbit exenteration three months after tumour resection because the tumour had recurred. The lesion was initially 1.5 × 2.5 cm and only on the skin of the medial canthus of the right eye. This cow was euthanised three years later by the herd veterinarian based on clinical findings suggestive of metastasis and spread of the tumour to the pharyngeal region.

To summarise, resection of a periocular SCC in one cow and orbit exenteration in two cows with ocular SCC had extended the lifespan of the cows in the absence of tumour recurrence.

Figure 3. *A nine-year-old Hereford cow (No. 4) at the farm of origin after orbital exenteration.* The wound was cared for by the owner.

Case report – neoplasia at the right dorsolateral thoracic wall

Cow and history

A six-year-old German Holstein cow was referred to the clinic because of a large mass on the right dorsolateral thoracic wall that had been growing progressively for six months. The cow was four days in milk and produced 22 kg of milk daily. There had been no prior treatment of the cow.

Clinical examination

On admission, the cow was bright and alert, had slight lordosis, a body condition score of 2.75/5, which was slightly below the expected score at calving, and was not lame. The rectal temperature was 39.2 °C. All other parameters were physiologic. Auscultation and simultaneous percussion on both sides of the abdomen and foreign body tests were negative. Attached to the right dorsolateral thoracic wall was a large mass measuring 51 × 29 × 32 cm that extended from the dorsal midline ventrally to the middle of the thoracic wall and from the 6th to the 12th intercostal space. The surface of the mass appeared lumpy and several prominent blood vessels were seen subcutaneously. The mass had a firm and elastic consistency peripherally and a softer consistency centrally, was warm, not painful and movable against the thoracic wall (Figure 4).

Further investigations

The results of haematological examination of a jugular venous blood sample were in the reference intervals (Moritz *et al.* 2014). Serum biochemical examination showed hypomagnesaemia (0.53 mmol/l, normal

Veterinaria Italiana 2021, **57** (2), 161-168. doi: 10.12834/VetIt.2292.14211.1

Figure 4. *A five-year-old German-Holstein cow viewed from the right side with a 51 × 29 × 32 cm lumpy mass on the right dorsolateral thoracic wall.*

0.90-1.32 mmol/l), potassium deficiency (3.02 mmol/l, normal 3.9-5.2 mmol/l) and hypoalbuminaemia (14.3 g/l, normal 30-39 g/l); the other variables were within the reference intervals. The glutaraldehyde clotting time was normal at > 15 minutes.

Ultrasonographic examination of the mass was carried out in longitudinal and transverse planes in the standing non-sedated cow using a 3.5 MHz convex transducer (MyLabTMOne, Esaote Biomedica Germany GmbH). Multiple hyperechoic septa, blood vessels and heterogeneous tissue with hyperechoic stippling, which was interpreted as calcification, were seen, but there were no flow phenomena. The mass could be delineated from the regular tissue of the thoracic wall.

After the administration of local anaesthesia using procaine hydrochloride, an 8 cm^3 biopsy specimen was excised from the caudoventral part of the mass, fixed in 4% formaldehyde solution and examined histologically at the IVP.

Histological examination and diagnosis

The history of the cow and the clinical appearance of the mass suggested a neoplasia, which was supported by the sonographic evidence of vascularisation and calcification.

The histological examination did not yield a definitive diagnosis. It appeared certain that the mass was neoplastic but its histogenesis could not be determined unequivocally. There were clear characteristics of an epithelial tumour, and the cell morphology and the occurrence of mitotic figures, some of which were atypical, suggested malignancy. Even though there was no evidence of cornification, the most likely tentative diagnosis was SCC.

Surgical treatment

The tumour was removed *in toto* based on the tentative diagnosis of SCC. The cow was placed in a surgical chute and sedated with Xylazine 0.05 mg/kg BM i.m. The mass was prepared aseptically, and 300 ml of local anaesthetic (Pronestesic®, 40 mg/ml procaine hydrochloride and 0.036 mg/ml epinephrine hydrogen tartrate, Veyx-Pharma GmbH) was injected under the mass along its entire periphery. The entire mass, which weighed 23.2 kg including the skin, was then removed surgically. Removal of the mass left a 51 × 49 cm skin wound, the margins of the wound were adapted to the subcutaneous tissue using absorbable suture material in a continuous suture pattern. Blood vessels that bled profusely were ligated, and wound pockets were closed using horizontal mattress sutures. To avoid retraction of the wound edges, multiple stent sutures consisting of horizontal mattress sutures were placed across the wound in a craniocaudal and dorsoventral orientation. To prevent the sutures from cutting into the tissue over the spinous processes or into the skin, the non-resorbable sutures were threaded through pieces of intravenous tubing (B. Braun Melsungen AG, Melsungen, Germany) where indicated (Figure 5A). The wound was covered with drapes soaked in isotonic saline solution to avoid wound desiccation and to promote secondary wound healing.

During hospitalisation, the cow received amoxicillin (Betamox®, 7 mg/kg BM s.c.) for 17 days and nine treatments of meloxicam (Metacam®, 0.5 mg/kg BM s.c.) as required. The wound was cleaned periodically to support healing. Initial wound treatment was daily and consisted of moistening the drapes and then removing them, cleaning the wound with 0.9% sterile sodium chloride solution (isotonic saline solution 0.9%, Serumwerk Bernburg AG) and 0.5% povidone iodine solution (Vet-Sept-Lösung 10%®, AniMedica GmbH), and then covering the wound with a new moist drape. On the fifth day after surgery and for the following 13 days, a polyurethane foam dressing (Ligasano®, Ligamed Medical Produkte GmbH) was used and changed every three days (Figures 5B and 5C). The dressing was moistened before removal, the wound was cleaned with 0.5% povidone iodine, the wound edges were sprayed with an oxytetracycline spray (Engemycin® Spray, MSD Tiergesundheit, Unterschleissheim, Germany) and a new dressing was applied. On day 19 post surgery, the stents were removed and the wound was cleaned with povidone iodine; the entire wound was covered with healthy granulation tissue and was treated with a zinc spray (AniMedica GmbH, Senden, Germany) (Figure 5D). Twenty-four days after surgery, the wound was dry, clean and healing normally (Figure 6), and it was then monitored at less frequent intervals. Three days before releasing the cow, the wound was cleaned thoroughly for the last time with a disinfecting soap.

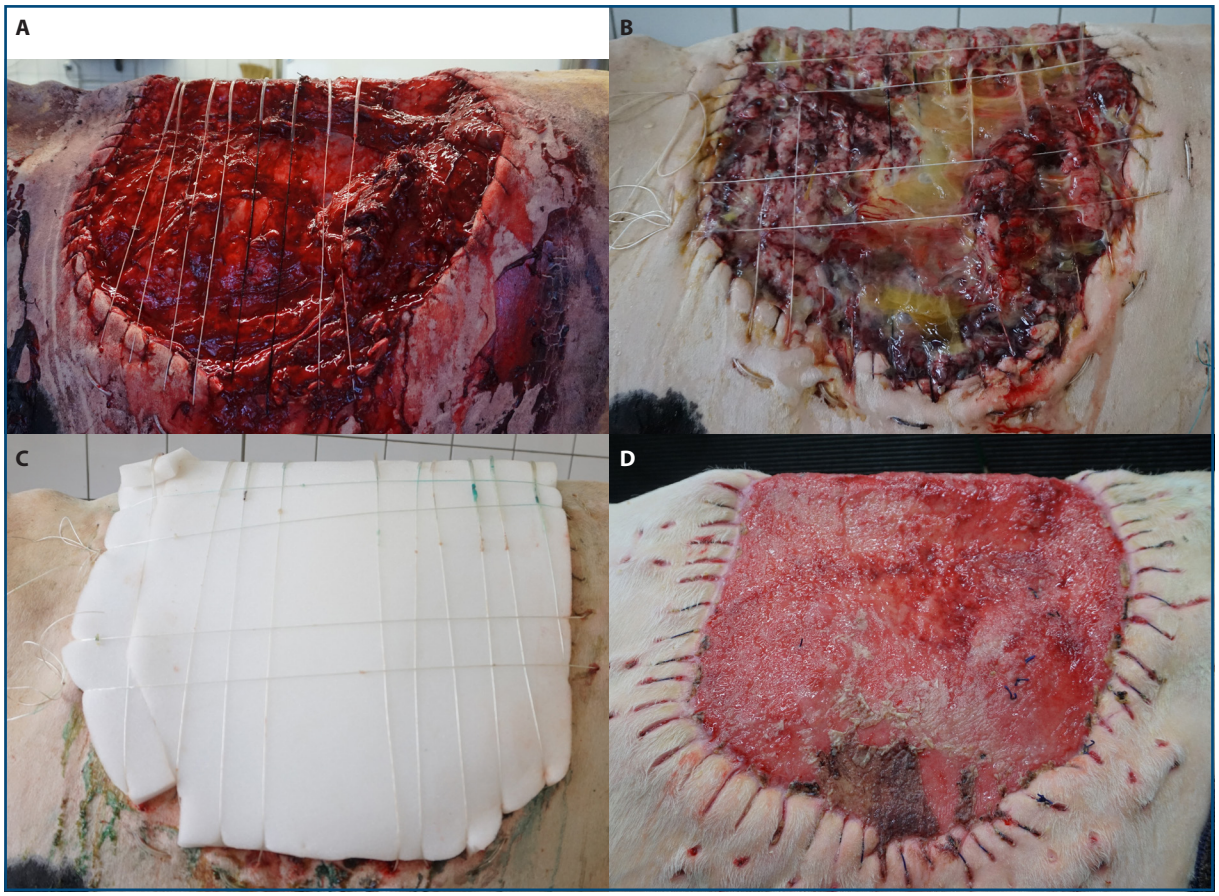

Figure 5. *Right dorsolateral thoracic wall of a five-year-old German-Holstein cow after resection of a neoplasm.* **A.** Immediately after resection the wound measured approximately 51 × 49 cm. The skin and subcutaneous tissues were adapted using a simple continuous suture pattern. To prevent retraction of the wound edges, multiple stent sutures were placed across the wound in a craniocaudal (not yet in place at the time of the picture) and dorsoventral direction. To prevent the sutures from cutting into the tissue over the spinous processes or into the skin, the non-absorbable sutures were threaded through pieces of intravenous tubing. **B.** Five days after resection the wound is partially covered with fibrinous exudate. **C.** Starting on the fifth day, the wound was covered with a polyurethane foam dressing (Ligasano®), which was changed every three days. **D.** The appearance of the wound 19 days after resection and after removal of the stent sutures.

Figure 6. *A five-year-old German-Holstein cow 24 days after resection of a tumor on the right dorsolateral thoracic wall (same cow as in Figures 4 and 5) at the time of discharge from the clinic.*

Outcome

The cow was discharged from the clinic in good health after a hospitalisation period of 67 days. Daily milk production was 35 kg, and integration into the herd of origin was problem-free. A telephone interview with the owner 15 months later revealed that the cow had calved and was still in the herd.

Discussion

Köstlin and Jonek (Köstlin and Jonek 1986) reported an occurrence of 128 cases (2.5%) of ocular SCC in Fleckvieh cows among 5,120 bovine patients admitted over a period of 15 years, which amounted to a yearly incidence of 0.17%. We diagnosed only five cases of ocular SCC in a six-year period and all patients were Hereford cows from the same herd. This suggests a hereditary component as an aetiological factor. The probable reason for the case number discrepancy was that the majority of patients at our clinic were German Holstein cows. The lifespan of a dairy cow is 4.5 to 6 years in the developed world (De Vries and Marcondes 2020), and because age plays a role in the development of ocular SCC, this factor probably contributed to our

low case number. The Hereford cows were from a pasture-based herd and exposure to UV-light likely contributed to the occurrence of the tumour.

The mean age (6.8 years) of the cows with ocular SCC in our study was in agreement with other reports (Köstlin and Jonek 1986, Tsujita and Plummer 2010). However, our youngest patient was 2.6 years old, which was considerably lower than the published mean age.

Schulz and Anderson (Schulz and Anderson 2010) reported that 10 of 53 (19%) cattle developed an orbital infection in the 21-day period after transpalpebral enucleation and removal of the para-orbital structures. These cows were operated in a standing position in a cattle processing area rather than in an operating room. Enucleation in recumbent patients combined with strict aseptic preparation of the surgical area may have contributed to the success rate in our cases. However, the small number of patients does not allow a meaningful comparison.

Lesions on the lower and third eyelids appear to have a greater tendency for metastasis than those at other locations, and the likelihood of metastasis was estimated to be 11% in a slaughterhouse study (Hamir and Parry 1980). At an early stage, the treatment of choice is immediate surgical excision of the tumour along with some healthy surrounding tissue while protecting the eyeball, and in more advanced cases with involvement of eyelids, sclera or the eyeball, the most promising treatment is exenteration of the orbit (Tsujita and Plummer 2010, Stöber 2006). Plaques larger than 0.5 cm should be removed (Stöber 2006). Cryotherapy is an alternative method to resection and can be used for tumours that are smaller than 0.5 cm in diameter and have well-defined margins. None of our patients had tumours small enough for removal with cryotherapy. This method is not suitable in cases with suspected metastasis or lesions on the globe itself (Tsujita and Plummer 2010).

In a study done by Welker and colleagues (Welker *et al.* 1991) twelve of fourteen cattle that had undergone tumour resection did not have recurrence of the tumour within six months. Another study showed that four of eleven cattle without metastasis to the retropharyngeal and subparotid lymph nodes, which had undergone resection, had tumour recurrence (Klein *et al.* 1984).

In two of the five cows in the present study, the tumour had metastasised. In one cow (No. 3), this was evident at the initial examination, and the cow was immediately euthanised because eating and respiration were compromised. The other cow (No. 2) that had undergone resection of a tumour at the medial canthus and then exenteration of the orbit three months later because of tumour recurrence, was euthanised three years later because recurrence was again suspected based on possible metastasis to the pharyngeal area. This shows that even small lesions that do not involve the globe can metastasise. Nevertheless, tumour resection is a valid treatment option as long as the globe is not affected, which was supported by one of our two cases that did not have tumour recurrence.

The case considering the tumour on the right dorsolateral thoracic wall was the first description of such a neoplasm in this location and of such dimensions, with a positive long term outcome after surgery. To our knowledge no similar cases have been published (pubmed, November 2020: tumour, cow, thoracic wall, surgery). SCCs mostly develop on mucocutaneous junctions of the eye and the vulva in cattle and rarely develop on the skin as in this case (Hewicker-Trautwein *et al.* 2007). As SCCs grow slowly in most cases and have the potential to metastasize, it is important to diagnose and treat such tumours in the early stages before metastasising. In this case, the clinical findings indicated a neoplastic process, as the tumour was solid and not sensitive to palpation. The cow showed neither evidence of a haematoma nor inflammation according to the laboratory results. The sonographic findings supported the clinical suspicion of a tumour, as they indicated neither an abscess, a phlegmon nor a haematoma. SCC was found to be the most likely diagnosis, based on the histological examination of a biopsy.

Furthermore, a resection of such large tumours in field conditions could pose a challenge in the aftercare of the wound. Tumours with increased volume could affect mobility of the animal negatively depending on its location such as on the limbs, neck or axillary region and cause discomfort or pain. During the general examination of the cow lordosis was detected, which is a distinct indication of discomfort. The pain or discomfort caused either directly from the tumour or through mechanical impairment could have a negative effect on the feed intake, which in turn could cause a reduced milk yield. After surgery, lordosis disappeared and the body condition score improved. Daily milk yield increased from 22 kg on admission to 35 kg at discharge 67 days postoperatively, but this may have also been an effect of lactation stage. As of this writing 15 months after surgery, recurrence did not occur in the cow with the thoracic wall tumour.

In a follow-up telephone survey, Köstlin and Jonek (Köstlin and Jonek 1986) determined that 31 of 54 animals were slaughtered after surgical treatment of ocular SCC. Of these cattle, ten were slaughtered because of recurrence of the tumour approximately six months postoperatively and five others because of impaired wound healing approximately five

months postoperatively. Five of these cattle were considered unfit for human consumption. Cattle that are sent to slaughter without resection of ocular SCC or other masses, such as the thoracic wall tumour, may be totally or partially condemned.

Conclusions

The prognosis of ocular and periocular SCC in cattle depends on the severity of the clinical signs caused by the tumour, on the anatomical structures affected and on the stage of the tumour. Tumour resection of a periocular SCC without involvement of the eyeball is a valid treatment option, but orbit exenteration is indicated when the globe is involved. Particular large tumours and ones in certain locations, such as the eye, compromise the cow's wellbeing. Therefore, cows with tumours should be considered for surgery, since even large tumours have a good chance of healing if excised in total and aftercare is performed properly. For economic and animal welfare reasons, tumours that are amenable to resection should be removed as expeditiously as possible.

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