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CLINICAL STUDY

Ulcerative stomatitis associated with yellow bristle grass in New Zealand dairy cows

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ABSTRACT

Case history: A line of 25 cull cows were all found to have ulcerative lesions of the tongue at post-mortem inspection in a New Zealand slaughter plant. A further 9 of 10 cows inspected at the farm of origin had similar oral lesions. There were no other clinical signs or indicators of ill-health observed at ante-mortem inspection in the abattoir or on the farm. The cows had been fed baleage for 3 weeks prior to slaughter, made from pasture in paddocks heavily contaminated with yellow bristle grass (*Setaria pumila*).

Clinical findings: There was extensive and deep transverse linear ulceration in the lingual fossa immediately rostral to the torus linguae. At histological examination, full-thickness ulceration of the stratified squamous epithelium was observed with a bed of disorganised collagenous tissue and extensive mixed inflammatory infiltrate extending into the sub-epithelial connective tissue and skeletal muscle. Barbed plant fragments were embedded in both the superficial and deeper areas of inflammation. Detailed examination of the baleage also found that yellow bristle grass seedheads were present.

Diagnosis: Based on the presence of barbed plant material in the tongue and yellow bristle grass seeds in the baleage, a diagnosis of ulcerative stomatitis associated with yellow bristle grass was made.

Clinical relevance: Clinicians should be aware of the potential for hay or baleage contaminated with yellow bristle grass to cause oral lesions in cattle.

Abbreviations: FMD: Foot and mouth disease; IIV: Initial Investigating Veterinarian; MPI: Ministry for Primary Industries; YBG: Yellow bristle grass

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KEYWORDS
Cattle; ulcerative stomatitis; foot and mouth disease (FMD); yellow bristle grass

Introduction

Passive surveillance is an important component of the animal health surveillance system to detect and report new organisms in New Zealand (Froud *et al*. 2008). Sections 44 and 46 of the Biosecurity Act (Anonymous 1993) place a legal obligation on everyone in New Zealand to report suspected exotic diseases to the Ministry for Primary Industries (MPI). Given the dire implications for New Zealand's economy if a highly contagious exotic disease such as foot and mouth disease (FMD) gained entry (Sanson 1994), all reports of ruminants with suspicious oral lesions are responded to promptly by MPI and with a standardised protocol (O'Connell 2020). The main differential diagnoses for vesicular lesions in cattle are FMD and vesicular stomatitis, which are clinically indistinguishable (Parkinson *et al*. 2010).

This case describes an investigation triggered when 25 Jersey cows with oral lesions were discovered at post-mortem inspection in a New Zealand slaughter plant.

Case history

On the morning of 28 April 2023, an MPI Verification Services veterinarian, based at a Waikato meat export premises, phoned the MPI exotic pest and disease hotline to report tongue lesions observed at post-mortem inspection of cull dairy cows. A line of 25 mixed age Jersey cows had been consigned to the export premises from a Bay of Plenty dairy farm. When observed on arrival the previous evening by a Verification Services veterinarian and again at ante-mortem inspection on 28 April, no clinical issues were noted.

However, at post-mortem inspection, all cows had unusual lesions on the dorsal lingual surface at the base of the tongue. These lesions were typically comprised of focally extensive and deep linear lingual areas of ulceration with a transverse orientation and were in the lingual fossa immediately rostral to the torus linguae. The ulcers ranged in size from 60–80 mm in length and 10–20 mm in

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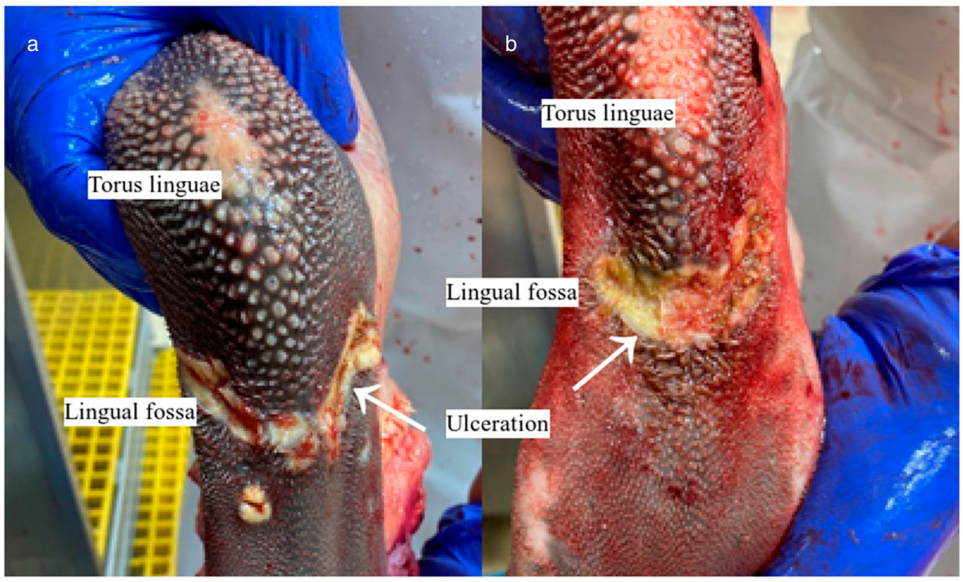

Figure 1. (a,b) Excised tongues from two cows immediately after slaughter affected with oral lesions after ingestion of yellow bristle grass (*Setaria pumila*) showing characteristic gross lesions of deep transverse linear ulceration on the dorsal lingual surface immediately rostral to the torus linguae (photo credit: Jacolette Jansen (MPI Verification Services) and AsureQuality Meat Inspection Services).

width; most were 10–15 mm deep. Areas of ulceration were generally well-demarcated from the adjacent lingual mucosal surface and were pale yellow in colour with multifocal red areas (Figure 1). Grossly, no plant material could be seen in the ulcerations. Aside from these tongue lesions, there were no lesions elsewhere in the oral cavities, nor were any lesions identified on inspection of the rumen pillars, teats, and interdigital spaces.

Although exotic vesicular disease in this case was assessed by the duty incursion investigator to be highly unlikely, the high morbidity and the unusual lesions justified activating the Initial Investigating Veterinarian (IIV) system (O'Connell 2020). This nominated an IIV from a national database of 30 veterinarians with additional training in the clinical signs and epidemiology of exotic diseases, to visit the farm and collect further relevant clinical and epidemiological information from the farm, support the exclusion of exotic disease, and test the IIV system in doing so. Furthermore, given the high morbidity and unusual appearance of the lesions, a determination of the cause was considered desirable.

That afternoon, following briefing and instruction from the duty incursion investigator, the IIV, along with the farm veterinarian, visited the farm of origin. There were no other species or classes of stock present aside from 125 cows on the dairy platform. There was nothing in the herd health history in the previous month, or indeed over the course of the lactation, to indicate a vesicular disease incursion. Five cows had been lame over the lactation with one in the previous month. One cow had been drooling a week prior and it had responded to antibiotic treatment. The herd was coming up to dry-off and milk production was tailing off as expected.

Clinical findings

The herd was observed from a distance and no clinical cases could be identified. Ten mixed-age cows were yarded for clinical examination. Of the ten cows, nine had similar oral lesions to those observed at the slaughter plant (Figure 2(a,b)). However, there were no other clinical signs or indicators of ill-health. At this stage, the IIV discussed his findings with the duty incursion investigator who, based on the clinical picture and epidemiology, stood the investigation down for exotic disease incursion.

Subsequently, MPI incursion investigators worked with the farm veterinarian to pursue an endemic diagnosis. Given the location of the lesions and a gross appearance suggestive of sub-acute trauma, some sort of oral insult was suspected. The history excluded the possibility of a drench gun (or similar) injury.

Instead, the farmer suggested that yellow bristle grass (YBG; *Setaria pumila*) could be a contributing cause of the lesions. The farm reportedly had suffered from a particularly bad year for YBG in the pasture. Having failed to control the YBG before the appearance of seed heads, the farmer, following advice from a colleague, had made baleage from the affected paddocks. Feeding this YBG-containing baleage had commenced 3 weeks prior to the discovery of the tongue lesions at slaughter. A farm walk revealed remaining evidence of YBG infestation in several paddocks (Figure 2(C)) and on examination of the baleage itself, characteristic seed heads of YBG

Figure 2. Images of tongue lesions observed in live animals (a, b), and images of yellow bristle grass (*Setaria pumila*) in the pasture (c) and in the baleage (d) on the farm from which the affected cows originated (photo credits: a and b, Harry Taylor, c and d, Dan Schluter).

were found (Figure 2(D)). The MPI Plant Health and Environment Laboratory (Tamaki, Auckland), subsequently confirmed the plant as YBG.

Pathological findings

For histopathological investigation, tongues from two affected cows, removed at the time of slaughter at the abattoir, were sectioned and fixed in 10% neutral buffered formalin, routinely processed, paraffin-embedded, sectioned at 5 µm and stained with H&E, Gram stain, and Grocott's methenamine silver stain. Grocott's methenamine silver stain is commonly used to identify fungal elements in tissue sections, staining the fungi brown to black and the background pale green (Adhya 2019).

Histologically, lesions typically comprised full-thickness ulceration of the stratified squamous epithelium with overlying serocellular crusts of necrotic cellular debris admixed with fibrin, large abundant neutrophils, and a mixed bacterial flora. Beneath the ulcerated surface and extending into the adjacent sub-epithelial connective tissue and skeletal muscle was a bed of disorganised collagenous tissue with an extensive mixed inflammatory infiltrate that predominantly comprised neutrophils and macrophages admixed with lower numbers of lymphocytes and plasma cells, with moderate numbers of eosinophils present in the peripheral aspects of the lesion. Aggregates of abundant neutrophils surrounded numerous fragments of embedded plant material (Figure 3(a)); several fragments of plant material appeared to have visible barbs projecting out from the fragment surface (Figure 3(b,c)). Plant fragments were present in both the superficial and deeper areas of inflammation; in superficial regions, fragments of plant material were often located within islands of dysplastic keratinocytes and admixed with mixed bacteria. The adjacent intact epithelium also showed moderate dysplasia and hyperplasia with abundant neutrophils. Grocott's methenamine silver stain did not reveal fungal elements within the lesions and viral inclusions were not observed.

Discussion

Yellow bristle grass is a tufted, multi-tillered upright annual that grows 25–45 cm high (James and Rahman 2009) and has become a significant problem for livestock farmers, particularly in Taranaki, Waikato, South Auckland, and the Bay of Plenty. It has a flattened leaf sheath, which is often red or purple at the base. The leaves are flat, soft, twisted, slightly rough at the edges and hairless except for a few long hairs at the base. In open pasture the first leaves often grow parallel to the ground. There are no auricles at the junction of the leaf blade and sheath and the ligule consists of a fringe of hairs 0.5–1.5 mm long (James 2013). It is an extremely aggressive annual plant which spreads

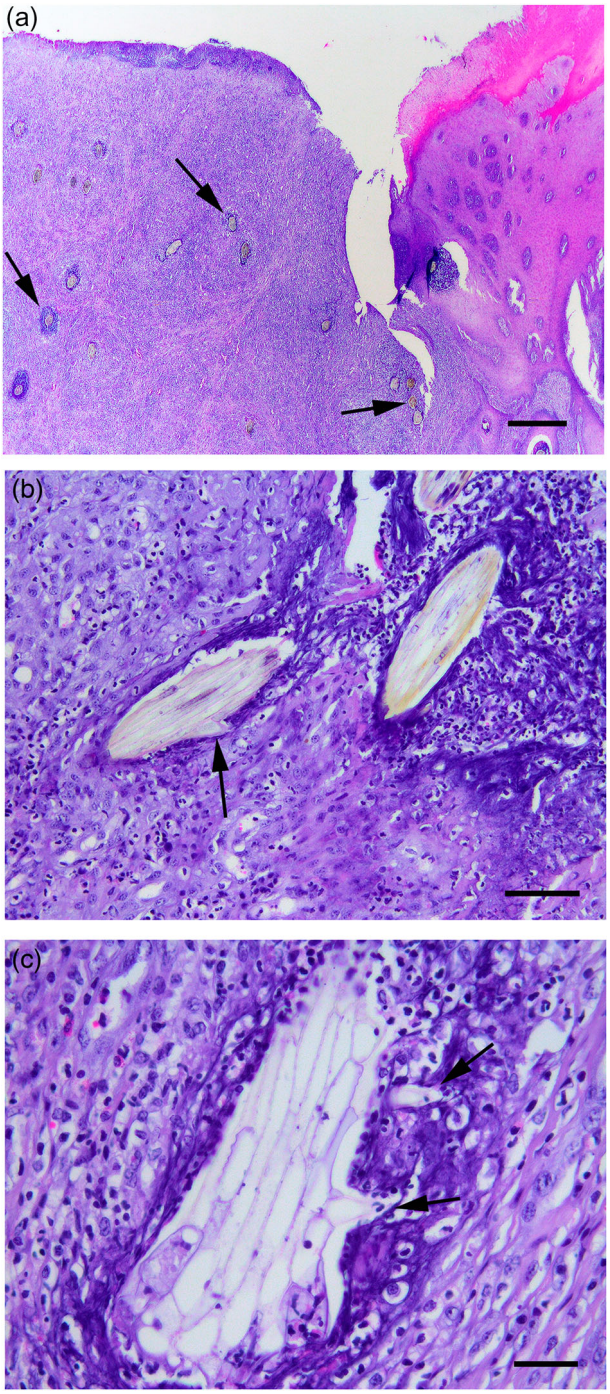

Figure 3. Photomicrographs of a section from the dorsal tongue of a cow affected with oral lesions after ingestion of yellow bristle grass (*Setaria pumila*). (a) Full-thickness ulceration of the stratified squamous epithelium of the dorsal surface of the tongue with loss of the epithelium and deeper tissues by an extensive mixed inflammatory infiltrate predominantly comprising neutrophils and macrophages in which multiple plant fragments (arrows) are embedded (H&E; bar = 32 mm). (b and c) Embedded plant material often appears to have visible barbs (arrows) projecting out from the fragment surface (H&E; bar = 50 µm (b) and bar = 25 µm (c)).

rapidly through pasture (Tozer *et al*. 2012). Germination is normally from mid-November to February when soil temperatures are greater than 20°C (James *et al*. 2009) leading to reduced pasture quality in late summer and autumn. Since cows avoid grazing it when in seed, this leads to low pasture utilisation (James 2013), and a massive seed set resulting in rapid spread. YBG was first recorded in New Zealand in 1905 (Lamoureaux and Bourdôt 2014) but did not become a problem weed in pasture until the early twenty-first century (James *et al*. 2009). Bristle grass is named for the seed head, which is a cylindrical spike, 2.5–10 cm long, with many densely packed spikelets, each containing a single seed. Every spikelet is surrounded by five to ten barbed bristles, 5–8 mm long which are initially green but later turn golden-brown, giving YBG its characteristic name. A single bristle grass plant can have 60–90 seed heads although most other *Setaria* species, e.g. knot-root bristle grass (*S. gracilis*) and rough bristle grass (*S. verticillata*), have fewer bristles on their seed heads than YBG.

Cattle and horses usually avoid grazing the YBG once the seed heads emerge, due to irritation of the oral cavity from the barbs on the bristles of the seed head (Fava *et al*. 2000). However, there are several reports of ulcerative stomatitis in horses after consuming hay contaminated with prairie foxtail (*S. geniculata*) seed heads (Turnquist *et al*. 2001; Johnson *et al*. 2012), in cattle and horses fed hay contaminated with YBG seed heads (Bankowski *et al*. 1956), and in cattle fed hay contaminated with YBG seed heads (Fava *et al*. 2000).

While it is possible that the plant fragments present within the lingual lesions found here could have been secondary invaders and causes of inflammation following initial primary mucosal damage due to another unknown cause, this is considered unlikely in these cases. Causes of mucosal damage to the tongue in these cattle other than YBG ingestion appeared unlikely based on the absence of recent drench gun use or exposure to caustic substances, while trauma due to ingestion of a sharp foreign body would be unusual in such a high proportion of a herd. It is therefore considered that the most likely cause of the ulcerative and inflammatory lesions in this case was exposure of the whole herd to baleage containing fragments of the barbed YBG. The presence of apparent surface barbs on several plant fragments on histology is also considered supportive of this interpretation.

The bovine torus linguae has two types of papillae: the flattened lenticular papillae and the pointed conical papillae, and it is the pointed conical papillae that would likely trap the barbs of the YBG seed head. Furthermore, during swallowing the torus linguae moves backwards and forwards which has the effect of opening and closing the lingual fossa, possibly forcing any seed heads trapped in the lingual fossa deep into the mucosa of the tongue leading to infection and foreign body reaction.

There were no reports of ill health in the animals examined on the farm these cattle originated from, despite almost 100% prevalence of tongue lesions. This agrees with Turnquist *et al*. (2001) who found no

signs of systemic illness or anorexia in 20 horses with oral lesions after consuming hay contaminated with prairie foxtail (*S. geniculata*) seed heads and Bankowski *et al*. (1956) who only reported salivation in cattle and horses fed hay contaminated with YBG seed heads. As well as lingual lesions, horses are more likely to have periodontal gingivitis, gingival ulceration, and ulceration of the mucocutaneous junction (Turnquist *et al*. 2001; Johnson *et al*. 2012). This likely reflects the difference in feeding behaviour between cattle and horses.

It is likely given the lack of clinical signs associated with these lesions and the rapid spread of YBG in New Zealand grazing pastures, that these lesions are more common than we know. The authors would be interested in hearing from veterinarians who may have seen similar lesions.

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Disclosure statement

No potential conflict of interest was reported by the author(s).

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