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TITLE: Differential diagnoses, investigation, and management of a periocular swelling close to the nasolacrimal duct in a horse – A case report of Dacryops

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1 Differential diagnoses, investigation and management of a periocular swelling close
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23 Running Title: Dacryops in a horse

24

25 **Abstract:**

26 *Objective:* To describe the differential diagnoses, investigation and management of a
27 periocular swelling close to the nasolacrimal duct in a horse that was consistent with a
28 nasolacrimal duct dacryops (lacrimal cyst).

29 *Animal studied:* A 16 year old gelding, Connemara cross.

30 *Procedures:* The horse presented with a history of a periocular swelling rostro-ventro-
31 medial to the right eye that had been sampled by the referring veterinary surgeon. A
32 cystic lesion was diagnosed following standing computed tomography. Surgical
33 removal of the cystic lesion was performed and the tissue was submitted for
34 histopathologic and immunohistochemical examination.

35 *Results:* Surgical removal of the cyst was curative and there was no recurrence of
36 clinical signs 7 months later. There was a small amount of mineralized material in the
37 center of the cyst. Histopathologic and immunohistochemical examination confirmed
38 a nasolacrimal duct cyst.

39 *Conclusion:* Dacryops can form in horses as well as other species and appears to have
40 a favorable outcome if surgically removed.

41

42 Key Words: nasolacrimal system, cyst, equine, dacryops, computed tomography,
43 histopathology

44 Word count: 154

45

46 **Introduction:**

47 Dacryops, or lacrimal cysts are fluid filled distensions of the lacrimal system and have
48 been reported in the dog (1), red-eared slider (2) and people (3). It has also been
49 described in different locations such as the lacrimal gland (4), ventromedial
50 conjunctiva(5), and nasolacrimal duct itself(1). Histopathological examination of the
51 tissue reveals an epithelial lining of stratified squamous origin(6). Mineral deposits
52 have been reported within the nasolacrimal system in dogs(6) and horses(7). The
53 canine deposit was reported to be calcium carbonate composition in the dog(6) and
54 was a mixture of, mainly carbonate hydroxyapatite, and a small amount of sodium
55 chloride halite in the horse(7). To the authors' knowledge this is the first reported case
56 of dacryops in the nasolacrimal system of a horse.

57 **Case report:**

58 A 16-year-old Connemara cross gelding presented to the Royal Veterinary College,
59 Equine Referral Hospital with a two month history of swelling located rostro-ventro-
60 medial to the right eye. Fluid-like material had been aspirated by the referring
61 veterinarian two months prior to referral. Cytologic evaluation was consistent with
62 neutrophilic inflammation.

63 A complete ophthalmic examination revealed that both eyes were comfortable and
64 visual. The menace response was present in both eyes and all reflexes were present.
65 Schirmer Tear Test – 1 readings were 18mm/min in each eye. All ocular media were
66 clear and funduscopy was consistent with a healthy equine fundus. Intraocular
67 pressures were 25mmHg in both eyes (Tonovet® Tiolat, Helsinki, Finland).
68 Fluorescein (Minims, Bausch & Lomb House, Surrey, UK) was negative in both eyes
69 and the Jones Test was positive bilaterally. The nasolacrimal ducts were irrigated in a

70 retrograde direction and with ease. Following aspiration by the referring veterinarian,
71 the swelling immediately resolved and was not evident of referral examination. At
72 this time differential diagnoses included: Nasolacrimal duct cyst (congenital or
73 acquired), cyst unrelated to the nasolacrimal duct, foreign body granuloma, suture
74 exostosis, and neoplasia. Potential further diagnostics included plain radiography,
75 plain computed tomography (CT) or dacryorhinocystography with either radiography
76 or CT. After discussion with the owner, further diagnostic imaging was performed to
77 assess for any structural changes that may have been present in light of the apparent
78 resolution of the swelling. CT was the imaging modality of choice due to a superior
79 anatomical understanding of where any pathology lies and avoidance of
80 superimposition of structures. At this stage contrast dacryorhinocystography was not
81 considered due to normal irrigation of the nasolacrimal duct and lack of evidence of
82 swelling.

83 The patient was sedated using intravenous (IV) acepromazine maleate (Novartis,
84 Surrey, UK, 0.05mg/kg), detomidine hydrochloride (Domosedan, Orion Corporation,
85 Espoo, Finland, 10µg/kg) and butorphanol tartrate (Zoetis, London, UK, 0.1mg/kg). A
86 standing computed tomography (CT) scan was performed with a 16 slice scanner (GE
87 LightSpeed Pro 16, GE Medical Systems, Berkshire, UK) using 1.25mm thick slices
88 and a 1.25mm interslice gap, 120kVp and 200mA with a tube rotation time of 0.5
89 seconds. CT images of the head were reviewed in a bone and soft tissue window and
90 revealed a single focal 5mm spherical area of gas attenuation within soft tissue
91 surrounded by a thin bone attenuating rim overlying the lateral aspect of the right
92 lacrimal bone immediately rostral to the orbit and adjacent to the right nasolacrimal
93 duct. On a multiplanar reconstruction (MPR) of the CT images there was a suggestion
94 of a complete defect within the lacrimal bone, which could not be clearly appreciated

95 on transverse images. Concurrent dental disease was identified, with the crown and
96 rostral roots of the 106 tooth being absent and there was a single, clearly marginated
97 vertically orientated hypoattenuating line within the caudal half of the remaining
98 portion of the 106. There was a single roughly diagonal hypoattenuating line within
99 the right maxillary bone overlying the buccal rostral aspect of the 106 alveolus, and
100 an apparent communication from the oral cavity to the alveolar bone in the rostral
101 aspect of the socket of 106 (Figure 1).

102 Due to the mass no longer being present on examination, and the CT findings being
103 inconclusive, the horse was discharged from the hospital and no medication was
104 prescribed, with instructions for the owner to arrange a reexamination if clinical signs
105 recurred.

106 The patient re-presented eight months later with a recurrence of the swelling, rostro-
107 ventro-medial to the right eye (Figure 2).

108 The second ophthalmic examination revealed that both eyes were visual and
109 comfortable and that all reflexes and responses were present and as expected. There
110 was a firm swelling, approximately 4 cm in diameter, situated in the medial canthus of
111 the right eye. The location of the swelling was in close apposition to the right
112 nasolacrimal system. All other aspects of the ophthalmic examination were
113 unremarkable. The Jones test was positive in the left eye and negative in the right eye.

114 Nasolacrimal irrigation was not possible on the right from either direction and no
115 change was appreciated in swelling size and was possible with ease on the left side.

116

117 The patient was sedated using the same protocol as stated above, for repeat standing
118 CT. This revealed that immediately rostral to the right eye there was a focal uniformly

119 soft-tissue attenuating swelling (mean attenuation of 23HU) overlying a smoothly
120 marginated and focally thickened contour of the right lacrimal bone. Further rostral to
121 this area the soft tissue swelling enlarged and there was a concave appearance of the
122 lacrimal bone. The right nasolacrimal duct was normal in size, but had a thickened
123 wall adjacent to the endosteal surface of the lacrimal bone and appeared to
124 communicate with the swelling at a level close to the medial canthus of the eye
125 (Figure 3). These CT findings were consistent with a cyst.

126 Possible treatment options for this case included: medical management with a
127 sclerosing agent such as polidocanol or surgical removal. Options were discussed with
128 the owner and surgery was chosen.

129 Intravenous premedication consisted of 0.04 mg/kg of acepromazine IV, xylazine
130 (Chanazine; Chanelle Animal Health, UK) 0.5 mg/kg IV and flunixin meglumine IV
131 (Finadyne, MSD Milton Keynes, UK 2.2mg/kg IV); followed by IV induction with
132 ketamine (Ketaset, Zoetis, UK) at 2.2 mg/kg in combination with midazolam
133 (Hypnovel; Roche, UK) at 0.04 mg/kg mixed in the same syringe. A thiopentone
134 bolus (Link Pharmaceuticals Ltd, UK) of 1 mg/kg IV was required to achieve
135 endotracheal intubation. Once the airway was secured, isoflurane (IsoFlo®; Abbott
136 Animal Health, UK) vaporized in medical air and oxygen mixture (fraction inspired
137 of oxygen of 60%) was administered via a large animal circle system (Mallard
138 Medical Inc., CA, USA). The patient was positioned in left lateral recumbency.

139 Prophylactic antibiotics consisted on IV penicillin (Crystapen, MSD Milton Keynes,
140 UK) and gentamicin (Dechra, Shrewsbury, UK) before the surgery.

141 The area around the eye and the nares were prepared with 1:10 dilution of povidone
142 iodine solution, and anterograde cannulation of the nasolacrimal duct was attempted
143 with USP 0 ethilon (Ethicon, Norderstedt, Germany), however this was not possible.
144 An incision was made with a no.11 scalpel blade over the cyst, and scissors were used
145 to bluntly dissect the tissue around the cyst (Figure 4). During the blunt dissection, the
146 cyst ruptured at the site next to the lacrimal bone. Some of the fluid that released was
147 sampled with a charcoal swab, and another sample of the fluid was placed in an
148 EDTA tube. The cyst capsule was removed and placed into 10% neutral-buffered
149 formalin for histopathologic examination.

150 The nasal opening of the nasolacrimal duct was cannulated with a size 6 urinary
151 catheter. Sterile sodium chloride (Vetevex, Shrewsbury, UK) was irrigated in a
152 retrograde direction, and was seen to exit the upper and lower puncti of the right eye.
153 There was no exit of fluid at the site of the cyst, indicating the nasolacrimal duct was
154 intact. The nasolacrimal duct and the cyst were closely associated, however appeared
155 not to be directly communicating.

156 The subcutaneous layer was closed with USP 2-0 polyglactin 910 (Vicryl, Ethicon,
157 Norderstedt, Germany) in a simple continuous pattern.

158 USP 2-0 polyglactin 910 (Vicryl, Ethicon, Norderstedt, Germany) was used to place
159 intradermal sutures, and USP 2-0 ethilon (Ethicon, Norderstedt, Germany) was used
160 to suture the skin with a simple interrupted pattern.

161 The day following surgery, antibiotic treatment was changed to oral trimethoprim
162 sulphonamides (Noradine, Norbrooks, Northhampton, UK, twice daily for 10 days)
163 and nonsteroidal anti-inflammatory treatment changed to phenylbutazone
164 (Equipalazone, Dechara, Shrewsbury, UK, twice daily for 2 days then once daily for 5
165 days) orally.

166 The patient was discharged the day after surgery. The wound was assessed by the
167 referring veterinary surgeon and the sutures were removed without complication two
168 weeks postoperatively. Seven months post operatively the owner reported that there
169 was no recurrence of the swelling.

170 Histopathologic examination of the resected tissue revealed dense collagenous and
171 vascular connective tissue with a partially collapsed, central cystic space, lined by a
172 single layer of attenuated epithelium (Figure 5). Within the surrounding fibrous
173 connective tissue there were scattered smaller cystic spaces often lacking an epithelial
174 lining and containing scant mucinous material. These were surrounded by numerous
175 clear acicular (cholesterol) clefts, areas of hemorrhage and aggregates of macrophages
176 containing hemosiderin. There were multifocal small aggregates of lymphocytes and
177 plasma cells within the tissue. The structure was diagnosed as a focal lacrimal duct
178 cyst with mild lymphoplasmacytic cellulitis and acute and chronic hemorrhage.

179 Immunohistochemical staining for pancytokeratin AE1/3 (Dako, Ely, United
180 Kingdom) and alpha smooth muscle actin (α -SMA, Leica, Milton Keynes, United
181 Kingdom) was performed using a BondMax Autostainer (Leica). Both assays used a
182 standard Leica protocol with heat-induced antigen retrieval and the Bond Polymer
183 Refine Detection system (Leica) and with pancytokeratin at 1:100 and α -SMA at
184 1:250 concentration. The cyst lining cells were strongly positive for pancytokeratin,
185 confirming an epithelial origin, and a subset of spindloid cells, immediately deep to
186 the epithelium were strongly positive for alpha smooth muscle actin, confirming a
187 myoepithelial origin (Figures 6 and 7). No bacteria were isolated after 48 hours
188 incubation, aerobically or anaerobically or after selective culture.

189 Analysis of the mineral material found within the cystic lesion was not performed.
190

191 **Discussion:**

192 The presentation of this case is similar to that of previously reported in dogs (1,6).
193 The etiology of dacryops still remains unknown and some authors have described that
194 it could be congenital(8), related to trauma(5), or secondary to chronic
195 dacryocystitis(9). This horse was not young, and given the progression during the 8-
196 month period between evaluations, the authors theorize that the aetiology was
197 unlikely congenital, and more likely to be either traumatic or inflammatory in origin,
198 e.g. recurrent subclinical dacryocystitis. In the human literature it is theorized that
199 periductal inflammation or trauma can stimulate hypersecretion (10). This can lead to
200 cyst formation due to weakening of the ductal and subsequent dilatation (10). Another
201 theory in dogs is ectopic lacrimal tissue causing or predisposing an individual to
202 dacryops (11). In this case an acquired nasolacrimal cyst was felt to be the most likely
203 diagnosis in light of the clinical presentation, immunohistochemical examination and
204 that no lacrimal tissue was demonstrated on histopathological examination. At the
205 time of surgery it appeared that the nasolacrimal duct remained intact, however it is
206 possible if there was an area of stenosis, fibrosis or narrowing of the cyst opening,
207 which could have prevented the fluid from leaking.

208 Smooth muscle actin immunostaining has been performed in dogs to confirm the
209 diagnosis of dacryops (1). This procedure stains myoepithelial cells in the lining of
210 the cyst. In this case, immunostaining was performed and supported the clinical
211 diagnosis for a dacryops.

212 The lacrimal system has been previously evaluated with computed tomographic
213 dacryocystography(12,13). In horses, magnetic resonance imaging has also been used
214 to identify the cross sectional anatomy of the lacrimal system (14). Computed

215 Tomography dacryorhinocystography was not performed due to the technical
216 difficulties experienced specific to this individual patient. In this horse, even non-
217 contrast enhanced CT acquisition was very challenging due to an uncooperative
218 temperament. Despite the appropriate administration of sedatives, it was felt that for
219 safety of staff and equipment that dacryorhinocystography was not an appropriate
220 option. The authors do however recognize that CT dacryorhinocystography would
221 have been beneficial to the optimal diagnostic investigation of this case and that in the
222 general equine population this is a relatively straightforward diagnostic technique. In
223 this case it is likely that CT dacryorhinocystography would have demonstrated
224 communication from the nasolacrimal duct with the lesion preoperatively, and it is a
225 vital tool in the investigation of periocular swelling. Despite this limitation, non-
226 contrast enhanced CT provided adequate information regarding the anatomical
227 location and attenuation characteristics to suggest that a cystic lesion was the cause.

228 The first computed tomographic examination of this patient was inconclusive because
229 of recent aspiration of cyst contents, reducing visibility and anatomic identification of
230 the cyst directly. It is recognized that CT dacryorhinocystography would have been
231 helpful, however as described above due to patient specific factors this was not
232 possible. It is likely that the second CT was more diagnostic because the cystic cavity
233 had refilled with fluid, making more detailed anatomic localization of the lesion
234 possible. The described CT abnormalities regarding the 106 tooth root (thought to be
235 most likely a primary dental disease) were felt to be an unrelated finding.

236 Surgical removal of these lesions is usually curative(1,4,5,6,9) and this appeared to be
237 the same in this case. A longer follow up period and a larger sample size would be
238 needed to demonstrate this definitively. Surgical removal is vital as these cysts are

239 unlikely to spontaneously regress. Without surgery, these cysts lead to eyelid
240 conformational abnormalities such as entropion, and occlusion of the nasolacrimal
241 duct and resulting chronic epiphora (10).

242 Mineral analysis of the deposits would have been interesting to report if they were
243 similar to the previously reported equine and canine cases. It is unlikely, however,
244 that this would have changed the outcome for this patient.

245 **Conclusion:**

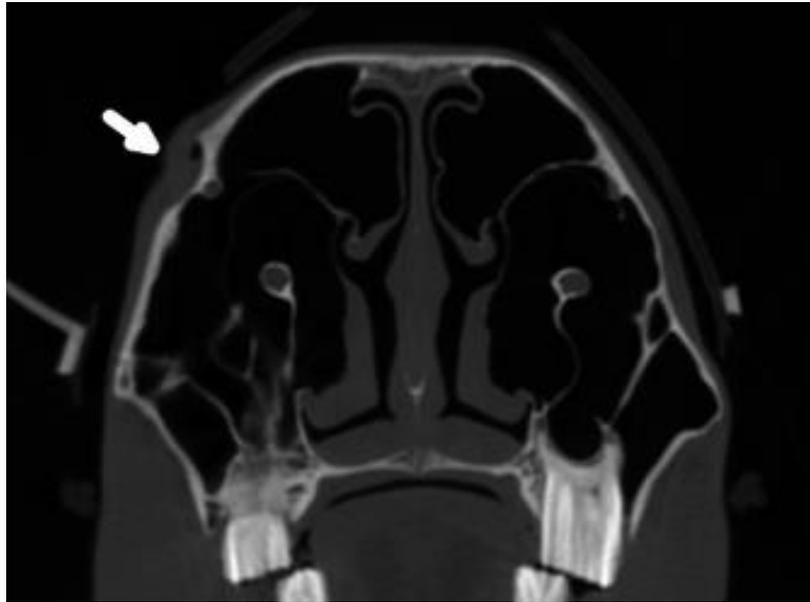
246 Cystic lesions of the lacrimal system can occur in different species and to the authors'
247 knowledge this is the first reported case of dacryops in a horse. It is important to
248 consider this as a differential diagnosis in periocular and nasolacrimal swellings in
249 order to give appropriate guidance and prognosis to referring veterinary surgeons and
250 the owners. Advanced diagnostic imaging and histopathological examination is
251 paramount to a rapid and correct diagnosis.

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255 **Figure 1:** Transvers CT image showing the first CT performed, revealing a soft tissue
256 attenuating region lateral to the right lacrimal bone (arrow) with a single gas bubble
257 within this lesion.
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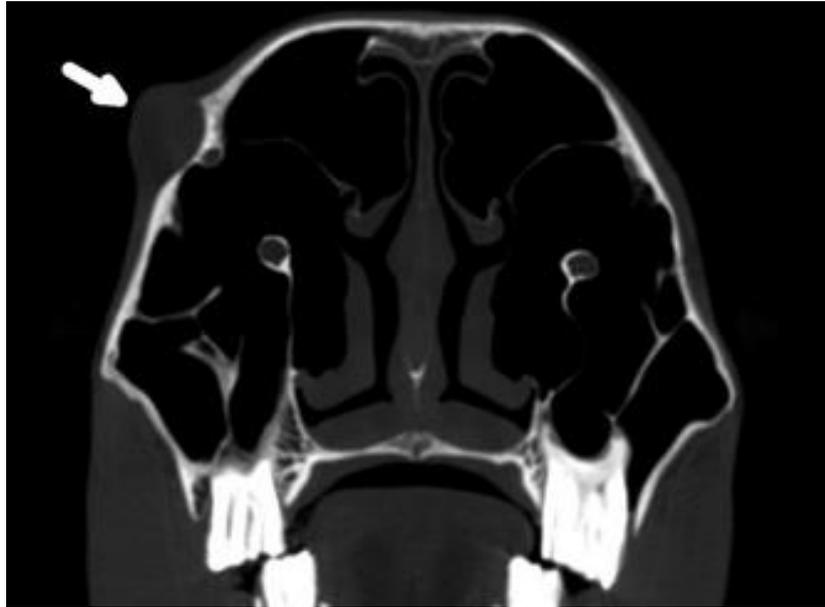
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Figure 2: Photograph of the horse preoperatively showing the mass at the
rostromedial aspect of the right eye.



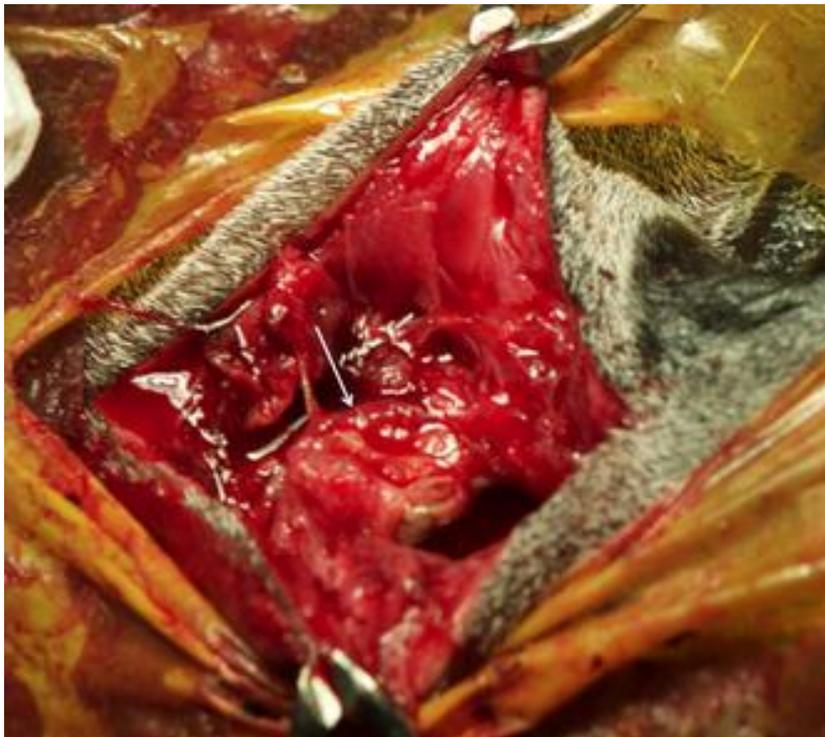
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268 **Figure 3:** Transverse CT image showing the cystic lesion (arrow) lateral to the right
269 lacrimal bone, which was enlarged as compared to the previous CT examination.
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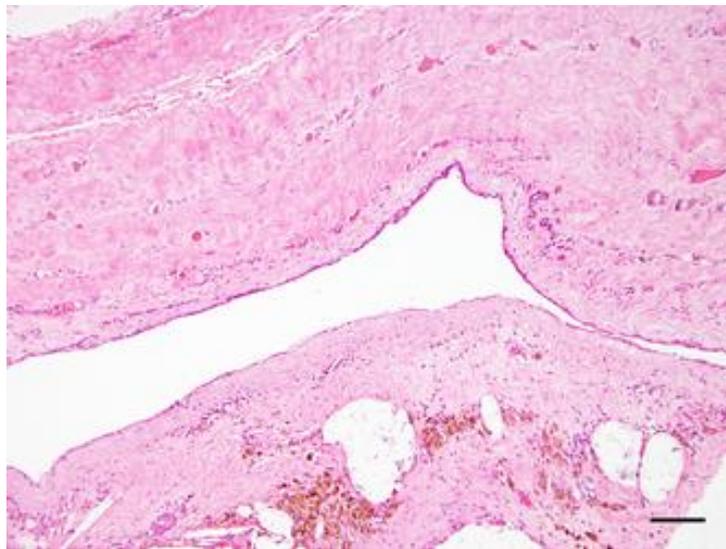
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Figure 4: Intraoperative photograph of the cyst (arrow).



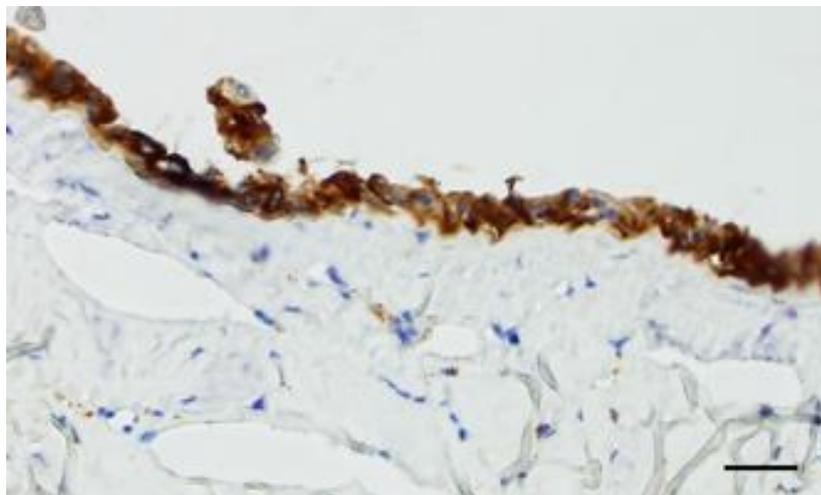
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278 **Figure 5:** Light microscopy image showing a thick-walled cystic structure, with an
279 attenuated epithelial lining, and multifocal haemorrhage and haemosiderin.
280 Magnification is $\times 100$, bar = 250 micrometers.
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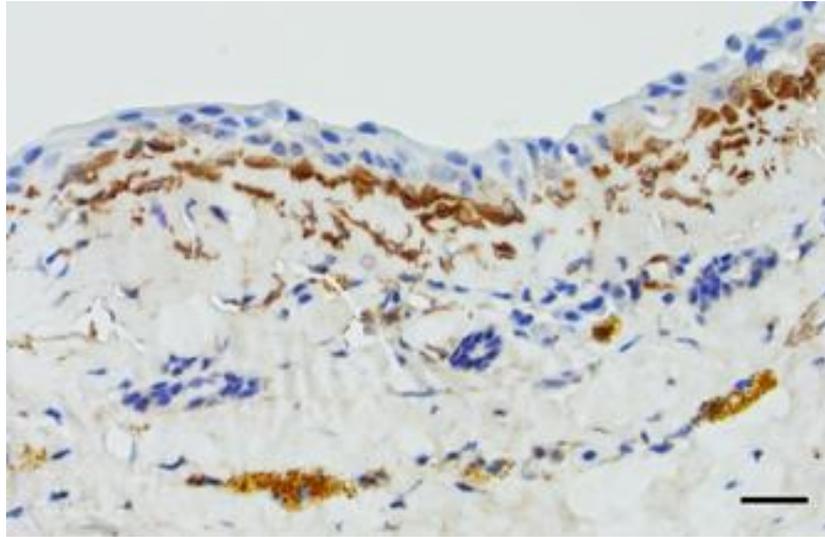
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Figure 6: Immunohistochemical staining with pancytokeratin AE1/3 showing the
epithelial lining of the cyst. Magnification is $\times 400$, bar = 50 micrometers.



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291 **Figure 7:** Immunohistochemical staining with alpha smooth muscle actin showing the
292 myoepithelial cells. Magnification is $\times 400$, bar = 50 micrometers.
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