





Case Report

Follicular thyroid carcinoma in a domestic pigeon (*Columba livia*)

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Abstract

A 10-year-old female domestic pigeon (*Columba livia*), presented with marked depression, hyporexia, and scant green droppings for approximately two weeks, according to the owners. On general physical examination, a nodule was detected in the subcutaneous tissue at the level of the crop. Due to the bird's poor prognosis, euthanasia was performed. At necropsy, an oval mass was found in the subcutaneous tissue of the ventral region of the distal third of the neck, located above the crop and adjacent to the trachea. The mass measured 3.5 x 2.2 x 1.5 cm, was light brown, had a slightly irregular and firm consistency, and on cut section showed small cavitations. The tissue was

27 submitted to the Departamento de Patología, Facultad de Medicina Veterinaria y Zootecnia, UNAM,
28 for histological evaluation, where it was diagnosed as follicular thyroid carcinoma. In birds, thyroid
29 neoplasms have been reported as incidental findings, and their prognosis is usually poor. Antemortem
30 diagnosis is difficult because birds often exhibit nonspecific clinical signs; therefore, in most cases,
31 the definitive diagnosis is made *postmortem*. Although papillary thyroid adenomas have previously
32 been reported in pigeons, the aim of the present study is to report the first case of follicular thyroid
33 carcinoma in a domestic pigeon.

34

35 **Keywords:** neoplasia, carcinoma, thyroid, pigeon

36

37 **Introduction**

38

39 Primary neoplasms of the thyroid gland have been reported as incidental findings in different
40 avian species. Thyroid adenomas and carcinomas derived from follicular cells (thyrocytes) have been
41 reported in pigeons (*Columba livia*) (28), budgerigars (*Melopsittacus undulatus*) (4, 14, 21), African
42 grey parrots (*Psittacus erithacus*), yellow-crowned amazons (*Amazona ochrocephala*), blue-fronted
43 amazons (*Amazona aestiva*) (5, 10), common and green pheasants (*Phasianus versicolor*, *Phasianus*
44 *colchicus*) (13, 17), a scarlet macaw (*Ara macao*) (27), an Andean goose (*Chloephaga melanoptera*)
45 (12), a carrion crow (*Corvus corone*) (30), a bald eagle (*Haliaeetus leucocephalus*) (3), a saker falcon
46 (*Falco cherrug*) (23), a wild barred owl (*Strix varia*) (6), and psittacine birds of the family *Cacatuidae*
47 (20, 29).

48 These neoplasms cause enlargement of the thyroid gland, which may result in respiratory
49 disturbances, regurgitation, or changes in vocalization in some birds due to compression of the trachea
50 and esophagus, although clinical signs may be nonspecific or absent before death. (10, 18). In birds,
51 adenomas have been described as soft, smooth, red to violaceous nodules, whereas carcinomas are
52 commonly multinodular, firm, white or gray, and poorly demarcated (20, 29). Although a higher

53 incidence of thyroid neoplasia has been observed, psittacine birds such as budgerigars and cockatoos
54 (20, 29), there is limited information in birds regarding predisposing factors according to taxonomy,
55 age, sex, or environmental factors involved, possibly due to the diversity of avian species and the low
56 number of reported cases (10).

57 Because the available literature on malignant thyroid tumors in birds is limited, the aim of the
58 present study is to report the first case of follicular thyroid carcinoma in a domestic pigeon.

59

60 **Case description**

61

62 A 10-year-old female domestic pigeon (*Columba livia*), that lived with its owners and was fed
63 a mixed diet based on cereals, legumes, and oilseeds, with water provided *ad libitum*, was presented
64 for veterinary consultation due to weakness, lethargy, hyporexia, and scant green droppings for
65 approximately two weeks. On physical examination, poor body condition (1/5) and a movable
66 subcutaneous nodule on the ventral aspect of the neck were noted. Due to the patient's poor condition,
67 the owners elected euthanasia, followed by necropsy.

68

69 *Macroscopic evaluation*

70 During necropsy, an oval mass was found within the subcutaneous tissue of the ventral region
71 of the distal third of the neck, above the crop and adjacent to the trachea. It measured 3.5 x 2.2 x 1.5
72 cm, was yellowish-white had a slightly irregular surface and firm consistency, extended to the
73 thoracic inlet, completely replaced the thyroid gland bilaterally, and compressed the trachea and
74 esophagus (Fig. 1). On cut section, it showed small cavitations delineated by solid yellowish-white
75 tissue and areas of hemorrhage (Fig. 2). This was the only finding reported at necropsy. The mass
76 was fixed in 10% buffered formalin for 14 days and submitted to the Department of Pathology,
77 Faculty of Veterinary Medicine and Animal Science, National Autonomous University of Mexico,

78 for routine histologic processing. Sections 4 μ m thick were prepared, stained with hematoxylin and
79 eosin (H&E), and examined microscopically.

80

81 *Histopathological evaluation*

82 Histologic examination revealed a neoplasm partially encapsulated by fibrous connective
83 tissue that completely replaced the normal thyroid tissue. The neoplasm was composed predominantly
84 of cells forming follicles of variable size, with occasional papillae, embedded in a delicate fibrous
85 stroma (Fig. 3). The cells lining the follicular structures were cuboidal to columnar, with a moderate
86 amount of pale eosinophilic cytoplasm and pleomorphic, round to oval, basophilic nuclei containing
87 finely granular chromatin; some nuclei were hyperchromatic and had prominent nucleoli. Mitoses
88 were infrequent (0-1 per high-power field) (Fig. 4). Some follicles contained scant amorphous
89 eosinophilic material (colloid) within the lumen (Fig. 5). In addition, there were small foci of necrosis
90 and hemorrhage, with aggregates of heterophils and the presence of neoplastic cells in some areas of
91 the capsule. The histologic diagnosis was follicular thyroid carcinoma.

92

93 *Immunohistochemistry*

94 Histologic sections of the neoplastic tissue were analyzed by immunohistochemistry (IHC).
95 For heat- induced epitope retrieval (HIER), Diva Decloaker 20X was used in a pressure cooker
96 (Decloaking Chamber) for 10 minutes (Biocare Medical, CA, USA). The available antibodies used
97 were pancytokeratin (AE1/AE3) (mouse monoclonal, Biocare Medical, CA, USA.; dilution 1:100)
98 and thyroglobulin (mouse monoclonal, clone 2H11/6E1, Bio SE, CA, USA; ready to use [RTU]). As
99 negative controls, the primary antibodies were excluded for the reaction; for positive controls,
100 sections of chicken intestine (pancytokeratin) and equine thyroid (thyroglobulin) were used. For
101 detection and visualization, peroxidase-conjugated secondary antibodies and diaminobenzidine were
102 used (Reveal Detection System Polyvalent HRP DAB, Spring Bioscience, CA, USA). The analyzed
103 sections of the neoplastic tissue showed no immunoreactivity for either marker.

104

105 **Discussion**

106

107 Thyroid tumors have been reported more frequently in companion birds, particularly in
108 budgerigars and cockatoos, with adenomas being the most common type (14, 20, 29). However, in
109 domestic, companion, and ornamental birds, there are fewer reports than in dogs, cats, and horses (2,
110 7, 11, 22, 25, 31). Most thyroid tumors are malignant in dogs (8, 22, 31) and benign in cats and horses
111 (1, 7, 15, 22). The low frequency of thyroid tumors reported in birds may be due to lower species
112 predisposition or underdiagnosis, either because clinical signs may be nonspecific or go unnoticed,
113 or because birds die suddenly and a *postmortem* examination is not requested; therefore, such cases
114 are not recorded (10, 13).

115 In both mammals and birds, the main differential diagnoses for follicular cell thyroid
116 carcinomas that should be considered are adenoma and hyperplasia or goiter (16). In this regard, in a
117 retrospective study, bilateral papillary adenomas were diagnosed in the thyroid lobes of 5 out of 83
118 (6%) pigeons (28). In dogs, thyroid adenomas are usually bilateral, whereas in birds, they are usually
119 unilateral, with well-defined fibrous capsules, and are smaller than adenocarcinomas, which, when
120 large, distort the affected glands and may be more easily palpated on clinical examination than
121 adenomas. The cells composing thyroid adenomas are well differentiated and resemble normal cells
122 (16, 22). Based on the histologic growth patterns, thyroid adenomas in birds have been classified as
123 follicular, papillary, and cystic (20, 29).

124 Thyroid carcinomas in dogs are usually unilateral, although they may also be bilateral, and in
125 birds, they may affect one or both thyroid lobes (16, 22). As in the present case, they may be partially
126 encapsulated or encapsulated, and the neoplastic cells often invade the capsule. They may also invade
127 blood vessels, adjacent tissues, or give rise to metastases, none of which were detected in the present
128 case. Histologically, they are more cellular and show a greater degree of pleomorphism and atypia
129 than adenomas, as well as areas of necrosis and hemorrhage near the central regions (22). According

130 to the predominant histologic growth pattern used in mammals, carcinomas derived from thyroid
131 follicles are classified into follicular, papillary, compact cell (solid), cystic, or mixed subtypes, a
132 classification that has also been used in birds (22). The follicular pattern has been reported as the
133 most common histologic pattern of thyroid carcinomas in birds, whereas only a few cases have
134 corresponded to the papillary pattern (5, 10, 13, 29). In the present case, most tumor cells were also
135 arranged in a follicular pattern, although with rare papillary formations.

136 In birds, follicular cell-derived thyroid carcinomas may be non-secretory for serum T3, T4,
137 and thyroglobulin (18); however, there is one report of a thyroglobulin-producing thyroid carcinoma
138 in a wild barred owl (*Strix varia*) (6). On microscopic examination, another neoplasm that should be
139 differentiated because of its location and histologic similarity is medullary thyroid carcinoma
140 (parafollicular, C-cell, carcinoma), which produces calcitonin (2, 8). Likewise, differential diagnosis
141 should include parathyroid carcinoma producing PTH; however, unlike dogs, such carcinomas have
142 not been described in birds (29).

143 In the present case, we conclude that the histological characteristics of the neoplasm, such as
144 the presence of thyroid follicles of different sizes and irregular shapes, pleomorphic nuclei with
145 prominent nucleoli, areas of necrosis, and mainly the invasion of the capsule by neoplastic cells, were
146 the findings considered for the diagnosis of follicular thyroid carcinoma.

147 The use of IHC has been helpful in determining the cellular origin of thyroid neoplasms in
148 dogs and other species (2, 8, 9). In some birds, thyroid carcinoma has been diagnosed by correlating
149 the neoplasm's anatomic location with histopathologic findings, without IHC (5, 10, 13).

150 However, in a wild barred owl (*Strix varia*) with follicular thyroid carcinoma, the neoplastic
151 cells were immunoreactive for thyroglobulin and pancytokeratin, demonstrating the usefulness of
152 IHC for diagnosis in this species (6). In the present case, although the same markers (for thyroglobulin
153 and pancytokeratin) were used, the neoplastic cells showed no immunoreactivity, possibly because
154 the neoplastic tissue had been preserved in formalin for 14 days, a condition that could hinder antigen

155 retrieval in the tissues, because the antibodies used were unable to bind to pigeon tissue antigens, or
156 because the neoplasm was not secreting thyroglobulin.

157 Thyroid hyperplasia (goiter) is a common disorder in birds and is most frequently observed in
158 budgerigars (*Melopsittacus undulatus*) and pigeons (*Columba livia*) (14, 25). There are also reports
159 in macaws (*Ara* sp.), cockatiels (*Nymphicus hollandicus*), Moluccan cockatoos (*Cacatua*
160 *moluccensis*), tanagers (*Tangara spp.*), turacos (*Tauraco spp.*), lovebirds (*Agapornis spp.*), and
161 cormorants (*Phalacrocorax spp.*), and in most cases it has been associated with dietary iodine
162 deficiency or consumption of vegetables containing goitrogenic substances (14, 16, 18, 26).
163 Hyperplastic nodules usually affect both thyroid lobes and tend to be small, non-encapsulated, and
164 do not always enlarge the affected thyroid lobe. Histologically, as described in dogs and in 30
165 different types of birds with thyroid hyperplasia, hyperplastic nodules form irregular follicles with
166 obliterated lumina containing little or no colloid, lined by large cuboidal to low columnar epithelial
167 cells (22, 26).

168 The causes of thyroid neoplasms in domestic animals have not been extensively studied.
169 However, in dogs, cats, and birds, advanced age has been correlated as a predisposing factor for the
170 development of neoplasms, including thyroid neoplasms. In this regard, it has been proposed that
171 mammals and birds that live longer are at greater risk of genetic damage leading to cellular mutations
172 (19, 22, 24, 31), which may have been the case in this pigeon, since it was 10 years old. However, no
173 studies have examined other predisposing factors specifically associated with the development of
174 thyroid neoplasms in avian species. The importance of thyroid neoplasms in birds lies in establishing
175 the diagnosis before death, which may be difficult due to their low frequency, the location of the
176 thyroid glands, and the nonspecific nature of the clinical signs, which may be confused with
177 respiratory and digestive disorders; therefore, unfortunately, in most cases the diagnosis is made
178 *postmortem* (10, 13).

179 We consider this to be the first report of follicular thyroid carcinoma in a domestic pigeon,
180 and although pigeons are not common pets, this condition should be considered as a differential

181 diagnosis in geriatric birds presenting with masses at the level of the coelom entry extending toward
182 the ingluvies, causing dyspnea, regurgitation, crop stasis, or changes in vocalization.

183

184 **Data Availability**

185 All the original contributions presented in this study are included in the article/supplementary
186 material. Further inquiries can be directed to the corresponding author.

187

188 **Author Contributions**

189 **Ana Cecilia Guevara:** Investigation, Writing – review & editing. **Nestor Ledesma:** Writing –
190 review & editing. **Félix Domingo Sánchez:** Writing – review & editing. **Elizabeth Morales:** Writing
191 – original draft, Writing – review & editing. All authors have read and approved the final version of
192 the manuscript.

193

194 **Conflict of Interest**

195 The authors declare that they have no competing interests.

196

197 **Generative AI Use Statement**

198 The authors did not use generative artificial intelligence tools or technologies in creating or
199 editing any part of this manuscript.

200

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205 immunohistochemical preparations, respectively.

206

207 **References**

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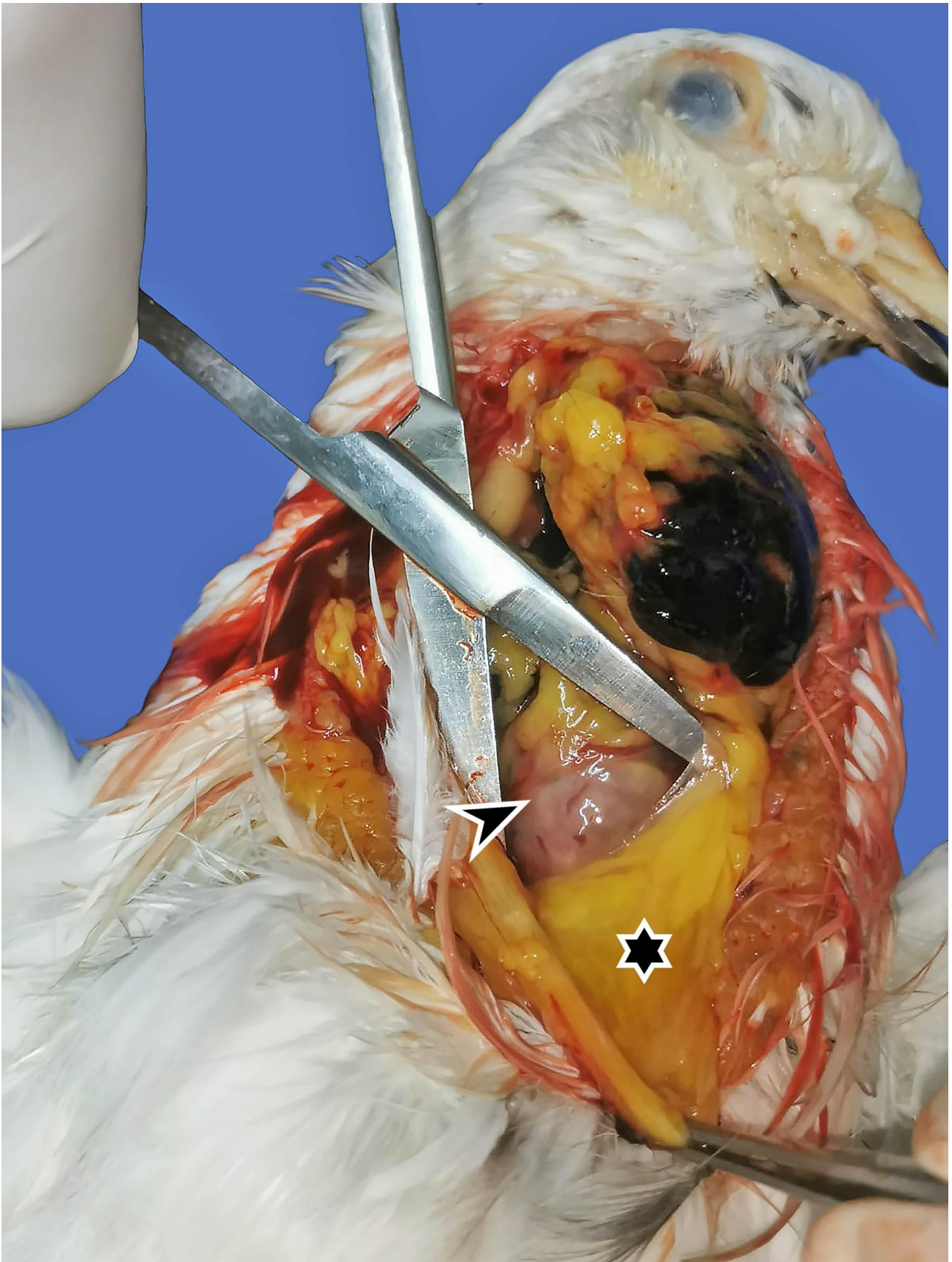
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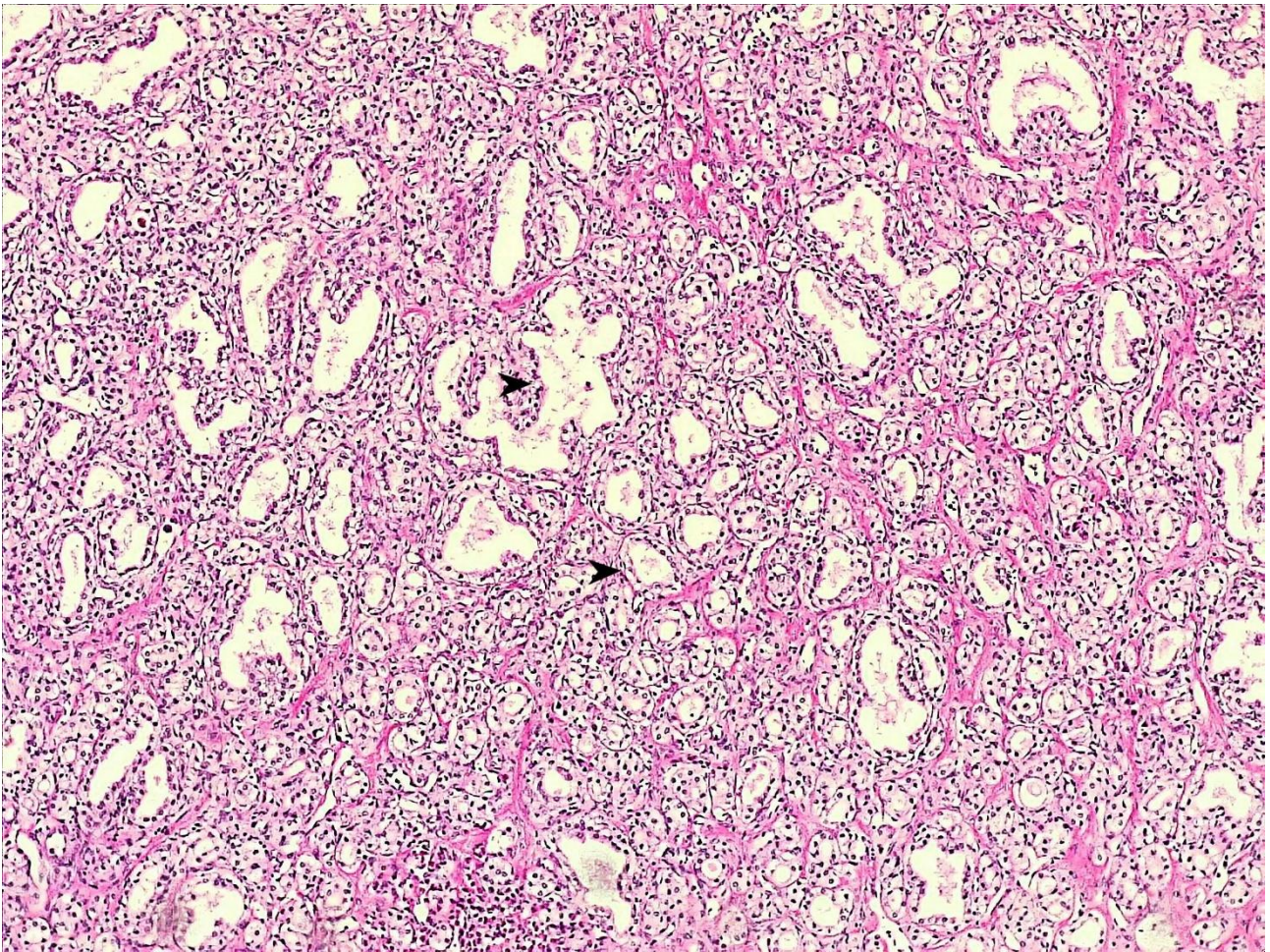
289 **Figure 1.** Thyroid carcinoma in the pigeon located at the base of the neck in the ventral position,
290 above the crop and adjacent to the trachea (arrow) and surrounding adipose tissue (asterisk).



292

293 **Figure 2.** Transverse sections of the thyroid carcinoma showing small cavitations delineated by solid
294 yellowish-white tissue and areas of hemorrhage.

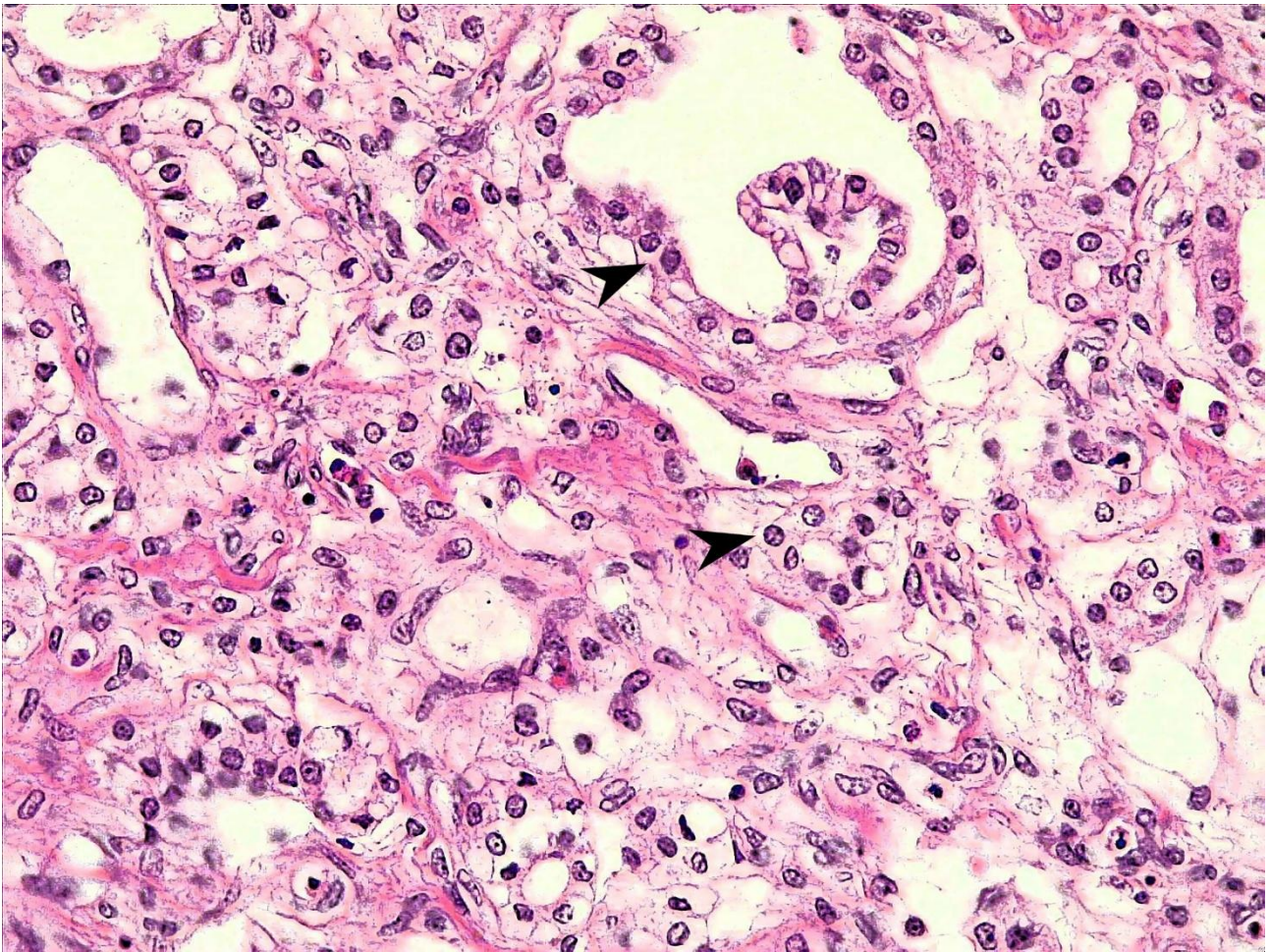
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297 **Figure 3.** Neoplastic tissue composed of follicles of different shapes and sizes (arrows), embedded
298 in a delicate fibrous stroma (follicular pattern). H&E, 100x

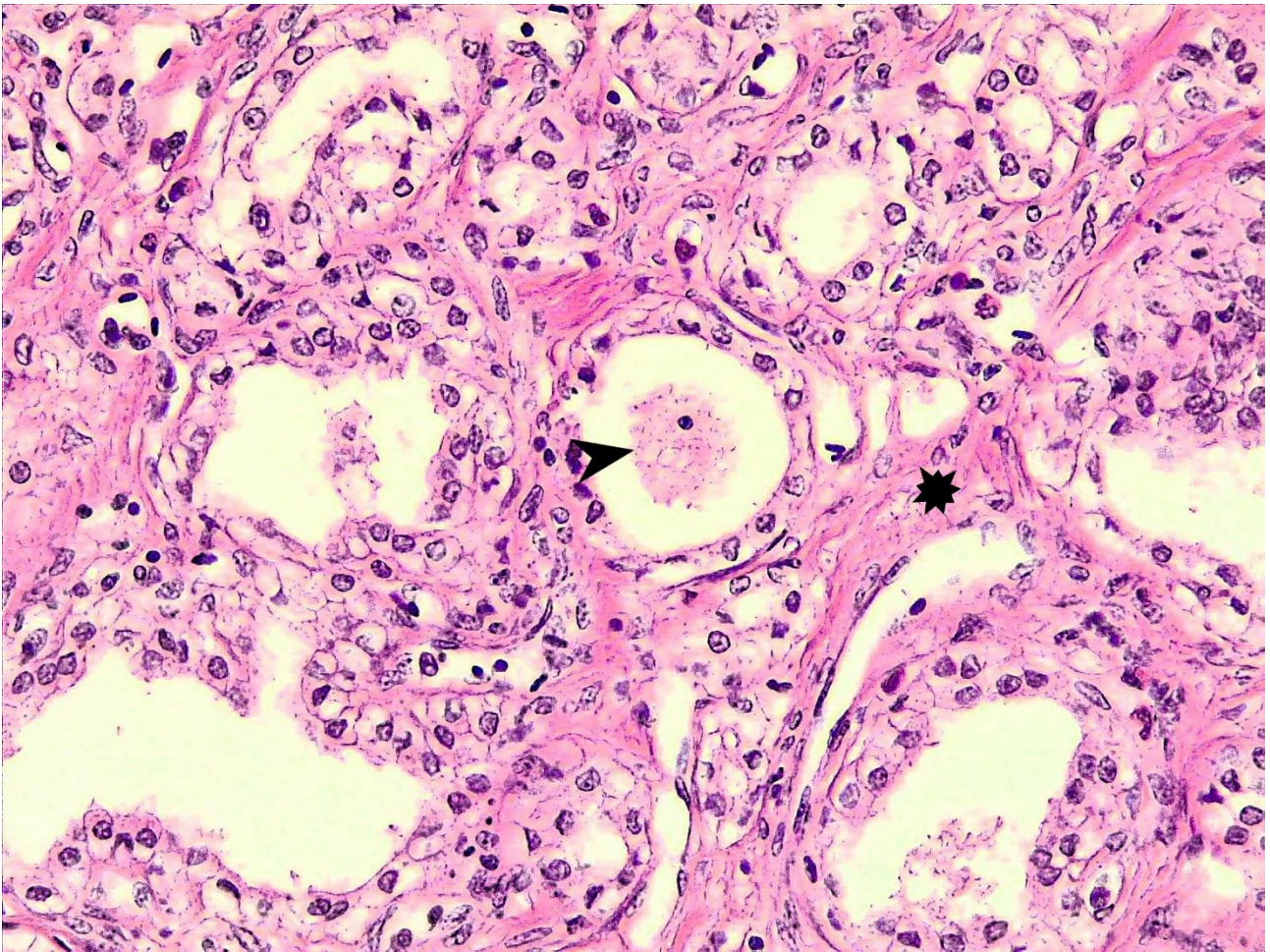
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301 **Figure 4.** The cells lining the follicles are cuboidal, with pale eosinophilic cytoplasm and
302 pleomorphic round to oval basophilic nuclei with finely granular chromatin, some hyperchromatic
303 and with prominent nucleoli (arrows). H&E, 400x

304



305

306 **Figure 5.** Some follicles contain scant amorphous eosinophilic material (colloid) (arrow) and are
307 embedded in a delicate fibrous stroma (asterisk). H&E, 400x.