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NOTE

Pathology

Extraskeletal osteosarcoma associated with two different types of synthetic fibers derived from a surgical swab in a dog

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ABSTRACT. A 10-year-old spayed female Japanese Shiba Inu had an intraperitoneal mass that was excised surgically. The central area of the mass was composed of osteoblast-like neoplastic cells, osteoid, macrophages, and numerous fibers. The neoplastic cells showed nuclear atypia and many mitotic figures. Therefore, the central area of the mass was diagnosed as an extraskeletal osteosarcoma. The peripheral area of the mass was granuloma tissue with numerous fibers. The neoplastic and granuloma area included two types of fibers, which were identified as rayon and polyester by their morphological and staining characteristics. These fibers were consistent with those of commercial surgical swab, suggesting that the fibers may have been derived from retained surgical swabs at the time of ovariohysterectomy. Therefore, this lesion was considered an extraskeletal osteosarcoma associated with a retained surgical swab.

KEYWORDS: canine, extraskeletal, osteosarcoma, surgical swab

A retained surgical swab is an uncommon medical error but potentially occurs in veterinary and human medical procedures. Foster *et al.* reported 13 canine cases of retained surgical swabs between 2003–2010 in the United Kingdom, and other reports of canine cases have also been published, but the exact number of complications associated with retained surgical swabs is uncertain [1, 2, 4, 6]. Granulomatous inflammatory reaction is one of the complications, which is called Gossypiboma (textiloma). Also, there are a few reports on canine sarcoma associated with a granulomatous inflammatory reaction to foreign bodies [5, 7, 11, 12, 14]. Those reports discussed the association between foreign bodies and sarcoma but did not verify the material when the foreign body was fiber. Here, we present a rare case of canine osteosarcoma associated with numerous fibers derived from a large surgical swab composed of two different types of fibers.

A 10-year-old spayed female Japanese Shiba Inu acutely lost vigor and presented to an animal clinic. The dog had a surgical history of ovariohysterectomy. A complete blood count showed hypoglobulia ($437 \times 10^4/\mu L$), anemia (hematocrit 27.4%), and high white blood cell count (30,660/μL). Blood biochemistry revealed high C-reactive protein concentration (3.5 mg/dL). Ultrasonography revealed intraperitoneal hemorrhage and a mass, and emergency laparotomy was performed. The mass was found on the mesentery and adhered to the intestine, but the original tissue of the mass was unclear. No perforations were observed in the gastrointestinal tract. The mass ruptured and separated into two pieces during the surgery. The resected mass was fixed in 10% neutral buffered formalin and sent to the Laboratory of Veterinary Pathology at Gifu University. One piece of the mass was reddish-brown in color and had a hematoma-like appearance. The other piece of the mass was hard, 5 × 4.5 × 6 cm in size, mostly covered with mesenteric adipose tissue. The cut surface of the hard mass was white to grayish in color, and there were no visible foreign bodies. The hard mass was decalcified using 10% formic acid and embedded in paraffin. Sections were routinely stained with hematoxylin and eosin (H&E), direct fast scarlet (DFS), and methylene blue.

Histopathological examination revealed that the mass had two areas with different components (Fig. 1). Although the peripheral area was granuloma tissue with numerous fibers (Fig. 2), the central area (approximately 80% of the mass) was composed of spindle to polygonal osteoblast-like neoplastic cells with rich osteoid, as well as many fibers and macrophages (Fig. 3). Some fibers in the neoplastic area were embedded in the osteoid. The neoplastic cells had round to oval nuclei with one or more prominent nucleoli and

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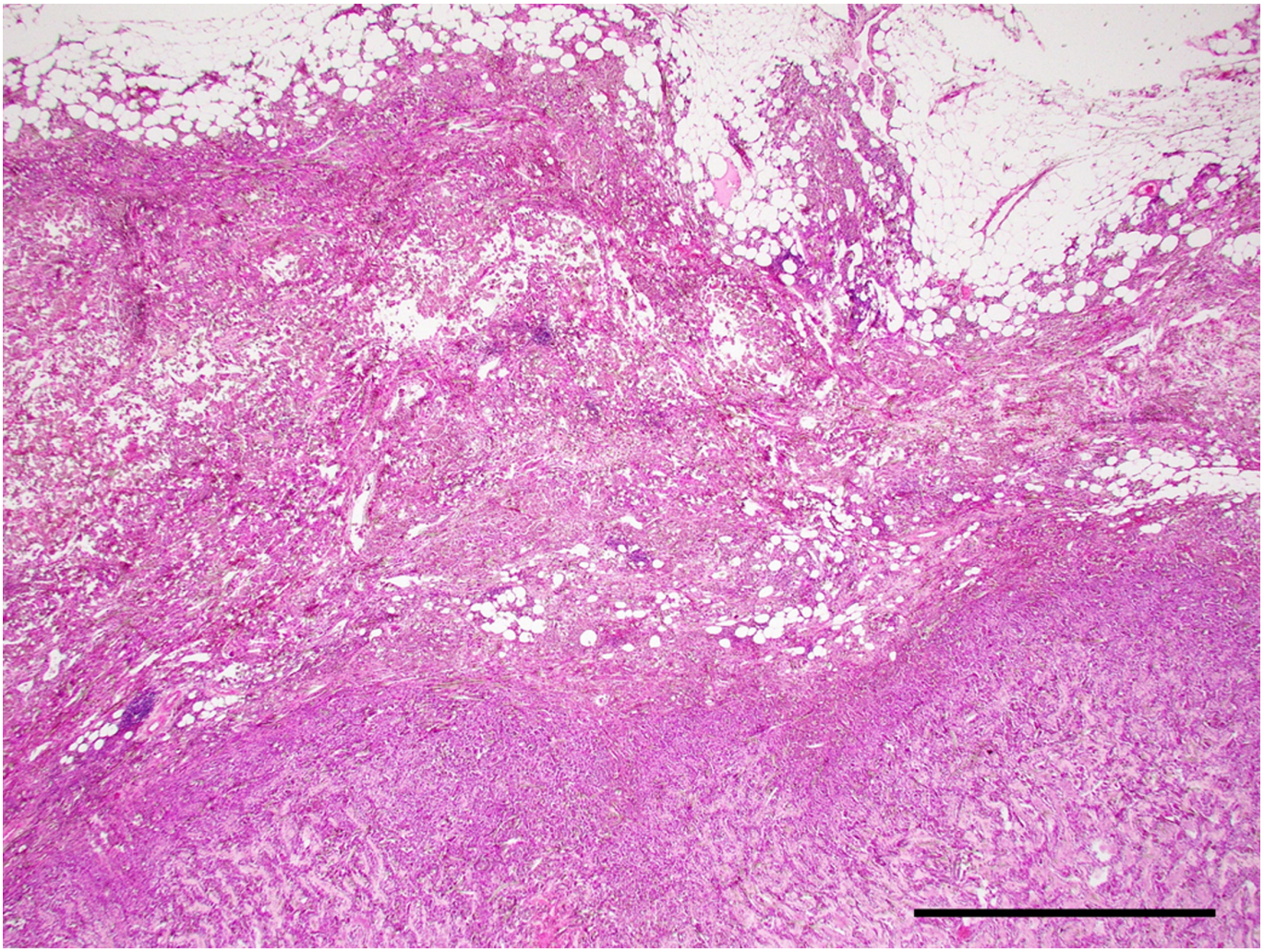

Fig. 1. The components of the mass were different between the peripheral area (top of the picture) and the central area (bottom of the picture). H&E, bar=2 mm.

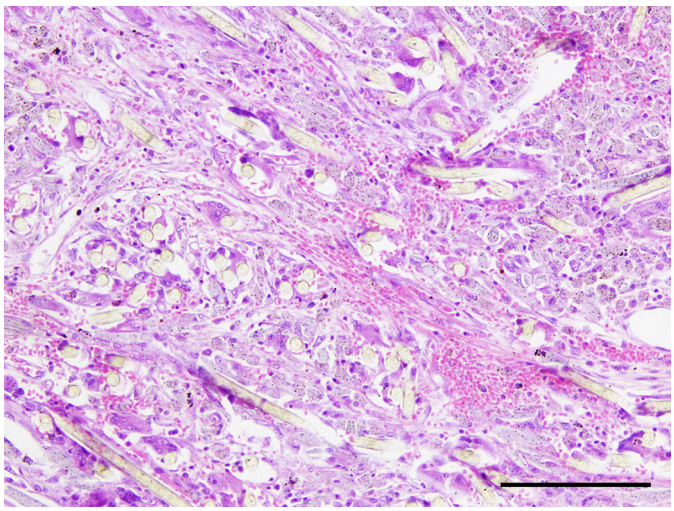

Fig. 2. The peripheral area of the lesion was granuloma tissue. There were numerous fibers with macrophages and multinucleated giant cells. H&E, bar=100 µm.

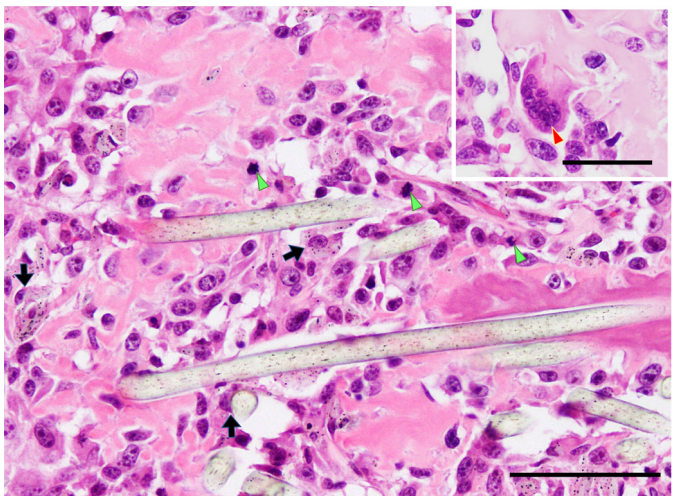

Fig. 3. The central area of the lesion was neoplastic tissue. Spindle to polygonal osteoblast-like neoplastic cells produced osteoid, and some fibers were embedded in the osteoid. Mitotic figure (green arrowhead), osteoclast (inset, red arrowhead), and macrophages (black arrow) were observed. H&E, bar=50 µm, inset bar=20 µm

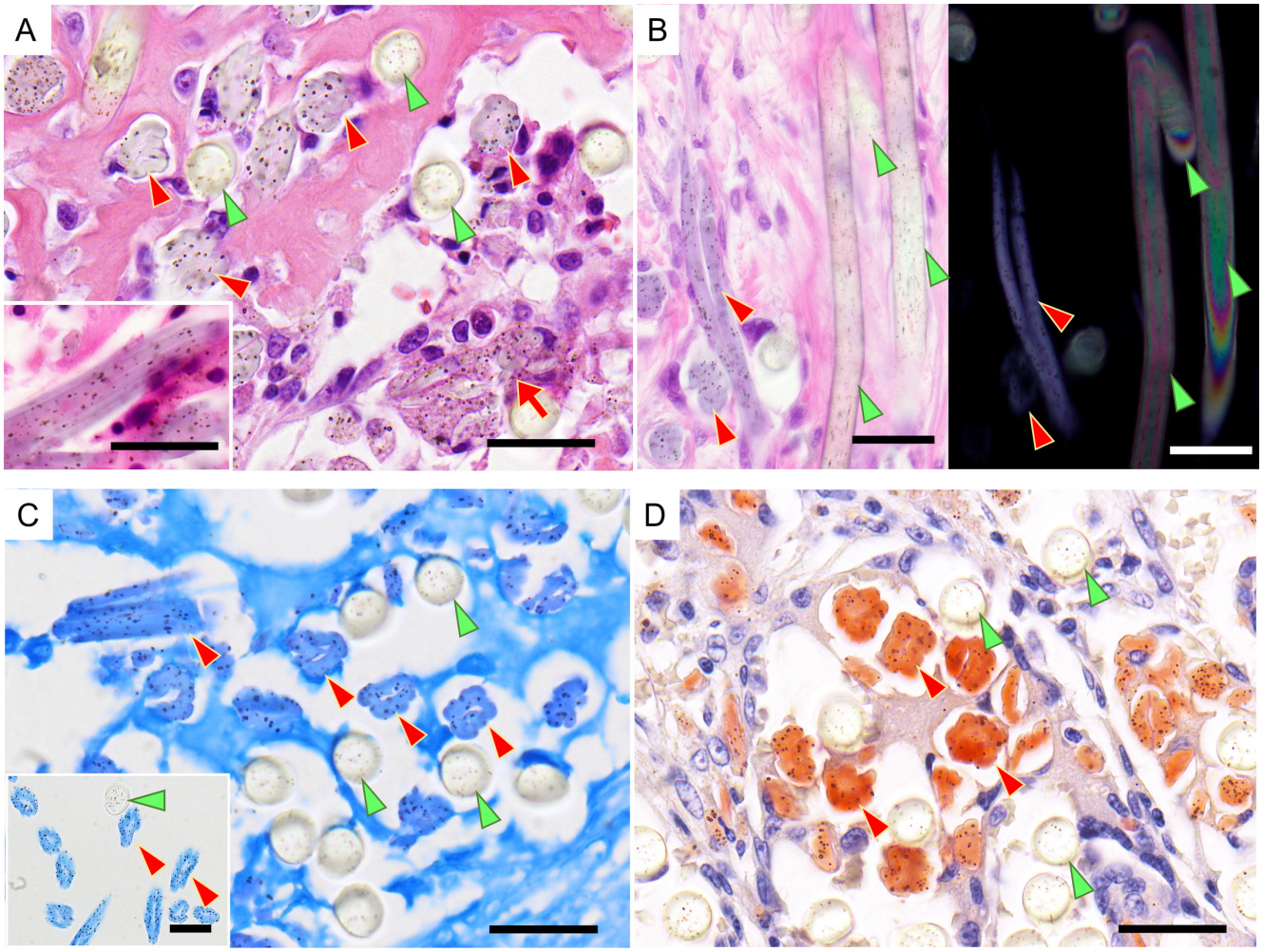

Fig. 4. The morphological and staining characteristics of fibers. **A**: One type of fiber with a smooth surface, round in the transverse section (green arrowhead), the other type of fiber with lines running parallel to the fiber, jagged in the transverse section (red arrowhead); the fiber in the macrophage was torn apart (red arrow). H&E. Inset: Lines running parallel to one type of fiber. **B**: Longitudinal section of the fibers. Smooth fibers showed birefringence (green arrowhead), and jagged fibers had no birefringence (red arrowhead). Left: H&E, right: under polarized light. **C**: Smooth fibers were not stained with methylene blue (green arrowhead), but jagged fibers were stained (red arrowheads). Inset: Commercial gauze composed of rayon (jagged fibers, red arrowhead) and polyester (smooth fibers, green arrowhead). Methylene blue. **D**: Smooth fibers were not stained with direct fast scarlet (green arrowhead), but jagged fibers were stained (red arrowheads). Direct fast scarlet, bars=20 µm.

moderate to marked anisokaryosis. The mitotic count of neoplastic cells was 15/10 high power field (2.37 mm^2). Many osteoclasts adhered to the osteoid in the neoplastic area (Fig. 3 inset), and macrophages and multinucleated foreign-body-type giant cells were observed. The neoplastic lesion was diagnosed as osteosarcoma based on findings of osteoid formation, cellular atypia and high mitotic count. Numerous fibers with no morphological features of silk, cotton, and animal hair were present throughout the neoplastic and granuloma tissue areas. These fibers were approximately 8 µm in diameter and classified into two types by their morphological characters (Fig. 4A). One type of fiber had a smooth surface, round in the transverse section, and some of them were phagocyted by macrophage or embedded in the osteoid (Figs. 3, 4A). No morphological changes were seen in the fibers phagocytosed by macrophage. Birefringence was observed under polarized light and these fibers were not stained with methylene blue and DFS (Fig. 4B–D). These morphological and staining features are consistent with polyester, which are difficult to stain with dyestuffs other than disperse dyes [3, 15, 17]. The other type of fiber had lines running parallel to the fiber (Fig. 4 inset), jagged in the transverse section, and some of them were phagocytosed by macrophages and torn lengthwise (Fig. 4A, red arrow). Very few fibers were embedded in the osteoid. No birefringence under polarized light, and these fibers were stained with methylene blue and DFS (Fig. 4B–D). These features were consistent with rayon [3, 15]. In addition, the staining pattern and morphological characteristics of both fibers were validated using a commercial rayon and polyester mixed gauze. These fibers of commercial gauze were consistent with the morphological characteristics in the transverse section of each fiber in the mass and only rayon fibers were stained with methylene blue (Fig. 4C, inset). Surgical swabs composed of rayon and polyester are used in routine veterinary operations [19]. Both types of fibers were mixed evenly in the lesion, embedded in the osteoid, and surrounded by macrophages and multinucleated foreign body-type giant cells. Therefore, these

fibers were considered to be derived from the same cloth woven or nonwoven with rayon and polyester. Based on the medical history, this cloth may be a surgical swab that remained during ovariohysterectomy and the dog was diagnosed with extraskeletal osteosarcoma associated with a retained surgical swab.

Some cases of canine extraskeletal osteosarcoma associated with granulomatous tissues induced by retained surgical swab have been reported [7, 11, 14]. But no case has been reported in which the presence of a swab was identified by demonstration of a large number of two different types of fibers despite no visible cloth in the lesion, as in this case. The two types of fibers were differentiated based on their form, appearance under polarized light, and staining features. To the best of our knowledge, there are no reports identifying two different types of fibers from pathologically examined tissues. These methods can be applied to identify artifacts or retained fibers detected in tissues from animals whose medical history is unknown.

In this lesion, the neoplastic tissue was surrounded by granuloma tissue, but a granulomatous inflammatory reaction to fibers was observed in all areas, including osteosarcoma. Based on these findings, we considered that the process of lesion formation started from a foreign body granuloma induced by a retained surgical swab. Subsequently, osteosarcoma cells may proliferate at the central area of the granuloma. Such considerations of tumorigenesis have been suggested in previous reports [7, 8, 12, 16]. Reactive oxygen and nitrogen species released from macrophage are known to be mutagenic. Also, cytokines and growth factors produced by activated inflammatory cells may be involved in tumorigenesis as promotors [8, 9, 12]. However, not all inflammation induce tumor, the difference between tumorigenic and nontumorigenic inflammation is unclear [9]. Although it has been reported that the frequency of tumor formation differs depending on the type of foreign body, the report did not compare the two types of fibers found in this case [10]. In the present case, we could not identify which of the two types of fibers was involved in tumor formation.

Both types of fibers were phagocytosed by macrophages and embedded in osteoid. Interestingly, rayon was predominantly phagocytosed, while polyester was predominantly embedded in the osteoid. Although a part of the phagocytosed rayon was torn lengthwise (Fig. 3), almost all polyester retained their normal form. This difference may be related to the chemical characteristics of the raw material and manufacturing process. Rayon is synthesized from wood-derived cellulose. In contrast, polyesters or similar synthetic fibers are processed by chemically synthesized materials such as esters [15]. Therefore, rayon may be easier to disrupt or tear by macrophages than polyester and other similar synthetic fibers.

Retained surgical swabs that induce granulomatous inflammation are uncommon medical errors, but several cases have been reported, and some rare cases may progress to more severe condition such as neoplastic lesions. In medicine, the gauze counting method is stricter according to the World Health Organization guidelines, but in the veterinary field, there are cases in which the gauze counting is insufficient [13, 18]. To reduce the number of incidents of retained surgical swabs, it is important to count the number of surgical swabs, and the use of gauze with a radiopaque marker should also be considered [13, 19]. We hope that this case reports will provide an opportunity for veterinarians to review and revise their gauze management practices.

CONFLICT OF INTEREST. There are no conflicts of interest.

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