# Diagnostic imaging of migrating kebab (sosatie) sticks – a review of 8 cases

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## ABSTRACT

Complications related to extraluminal migration of ingested kebab (sosatie) sticks are infrequently diagnosed in small animals. A total of 8 cases diagnosed with extragastric migration of ingested kebab sticks were retrospectively evaluated. No significant breed or sex predilection was found but there was a tendency for animals to present at a younger age (less than 3 years). Clinical signs (of variable duration) were non-specific and included haemoptysis, abdominal pain, regurgitation, subcutaneous abscessation and chronic draining sinus tracts, making a clinical diagnosis difficult. Ultrasonography proved invaluable in facilitating the diagnosis of kebab stick migration in 6 of the cases and computed tomography unexpectedly identified a kebab stick that had migrated into the thorax in 1 patient. Survey radiography was generally found to be insensitive in identifying the kebab sticks. The aim of this article is to alert veterinarians to a clinical syndrome that may not be considered a differential diagnosis in patients with non-specific inflammatory disease of the thorax, abdomen or pelvic regions and to illustrate the usefulness of the various diagnostic imaging modalities in facilitating a diagnosis of kebab stick ingestion and its possible secondary complications.


**Keywords**: computed tomography, diagnostic ultrasound, kebab stick, linear foreign body, radiography, sosatie stick, wood.

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## INTRODUCTION

Barbeques or *braais* as they are more commonly known in South Africa are popular social events during which kebabs are frequently eaten. Meat kebabs or the remnant wooden kebab sticks are particularly attractive to dogs, who may snatch them from a table or raid a dustbin to obtain them. Invariably, in their eagerness, dogs ingest the kebab stick. Particularly if ingested whole, these pointed kebab sticks have a propensity to migrate from within the gastrointestinal tract. Kebabs are known as *sosaties* in South Africa and thus the term sosatie will be used in the remainder of this article. Imaging methods that can be used for diagnosis of foreign bodies include conventional radiography, fistulography, ultrasonography, computed tomography (CT) and magnetic resonance imaging (MRI)[1]. Wood is typically radiolucent and thus difficult to detect on survey radiographs[14]. Ultrasonographically, wooden foreign bodies are commonly described as bright interfaces with uniform acoustic shadowing[14]. Sosatie sticks have a typical linear appearance and may be intact or consist of several fragments. Failure to locate and remove foreign bodies can lead to long-term secondary inflammatory reactions or infections as well as chronic fistulas and abscessation[14].

## MATERIALS AND METHODS

This is a retrospective study of cases presented to the Onderstepoort Veterinary Academic Hospital (OVAH) during the 8-year period from 2003–2010 in which a diagnosis of sosatie stick ingestion and extragastric migration was made. There were 8 dogs, resulting in a rough incidence of 1 case per year. There were 2 dachshunds and 1 each of the following breeds: Dalmatian, English bulldog, Boxer, Rhodesian ridgeback, Saint Bernard and Jack Russell terrier. Males were slightly over-represented (5/8 cases) and animals varied in age from 5 months to 10 years with the majority (6/8 cases) being 3 years or younger. Ultrasonographic examinations were conducted by means of a Siemens Sonoline Omnia (Siemens, Berlin, Germany) ultrasound machine using a linear or curvilinear multifrequency transducer operated between 5 and 9 MHz. For the radiographic examinations, 2 standard views of the region of interest were taken by means of a Siemens Polymat 50 high output rotating anode X-ray machine and processed on a Fujifilm FCR indirect digital imaging system. For the only patient that underwent a computed tomographic study, a Siemens Emotion Duo Computed Tomography system (Siemens Medical Systems, Forchheim, Germany) with sliding gantry was used. Three-millimetre transverse slices of the thorax were obtained with the patient in sternal recumbency. Post-processing multiplanar reformatting (MPR) facilitated evaluation of the images in dorsal and sagittal planes. Images were viewed in bone (WW 1500, WL 450), mediastinal (WW 400, WL 40) and lung (WW 1200, WL-600) windows.

## RESULTS

Clinical details, diagnostic imaging findings and outcome of the dogs are presented in Table 1. The presenting complaint and duration of clinical signs varied among dogs and were largely related to site of extragastric sosatie stick migration. Three dogs presented with subcutaneous abscesses of unknown duration: 1 on the cranioventral abdomen (Case 3), 1 on the dorsal lumbar spine (Case 4) and 1 at the level of the 13th rib on the left (Case 6). Ultrasonographically or surgically these abscesses corresponded to an extraperitoneal exit point of 1 of the sosatie stick tips. One dog (Case 1) presented with a chronic draining sinus tract in the left pelvic region and intermittent left pelvic limb lameness of 8 months' duration. Repeated orthopaedic examinations and hip and left pelvic limb radiographs performed by the referring veterinarian failed to localise the source of the lameness or the cause of the chronic draining sinus tract. Upon referral to the OVAH, ultrasound examination of the draining sinus tract and abdomen revealed a sosatie stick traversing the caudodorsal abdominal wall with its caudal tip ending within a subcutaneous sinus tract at the level of the left ilium. The sosatie stick in Case 3 traversed the spleen, where it was outlined by a hypoechoic tract, and ended caudally within an intra-abdominal abscess (Fig. 1). The cranial tip of this

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Table 1: **Clinical details, diagnostic imaging findings and outcome of eight dogs in which a diagnosis of extraluminal migration of sosatie sticks was made.**

| Case | Breed | Sex | Age | Presenting complaint | Diagnostic imaging modalities | Imaging findings | Outcome |
|---|---|---|---|---|---|---|---|
| 1 | Dachshund | Male | 3 yrs | Chronic draining sinus tract in the left flank region and intermittent left pelvic limb lameness of 8 months duration | Radiography | Lateral and ventrodorsal pelvic radiographs revealed no abnormalities | Exploratory laporotomy was performed and a sosatie stick removed. Uneventful recovery post-surgery. |
| | | | | | Ultrasonography | At least 100 mm × 2 mm hyperechoic linear structure with distal acoustic shadowing observed with cranial tip embedded within an intra-abdominal abscess. Structure traversed the caudodorsal abdominal wall and its caudal tip extended within the subcutaneous tissues at the level of the left ilium. | |
| 2 | Dalmatian | Male | 8 yrs | Regurgitation, arched back, pyrexia of unknown origin. | Radiography | Poorly defined soft tissue opacity in caudodorsal mediastinal region. *Spirocerca lupi* oesophageal granuloma or oesophageal foreign body was suspected. | Euthanased |
| | | | | | Computed tomography | Largely intrathoracic hyperattenuating slightly obliquely orientated linear structure within the mediastinum. Associated mediastinitis and abscessation. Caudal tip of structure penetrated the oesophagus at the level of the cardia and terminated within the gastric fundus with tip projecting 17 mm into the lumen. | |
| 3 | English bulldog | Female | 1 yr | Abscess on cranioventral abdomen. | Ultrasonography | 150 mm × 3.8 mm hyperechoic linear structure with distal acoustic shadow observed intra-abdominally. Cranial tip of structure embedded within a subcutaneous abscess adjacent to the xiphisternum. It extended caudally, traversing the spleen and its caudal tip ended within an abscess in the caudoventrolateral abdominal cavity with focal peritonitis. | Euthanased |
| 4 | Boxer | Female | 5 mos. | Abscess on dorsal lumbar spine. | Radiography | Abdominal radiographs revealed a soft tissue swelling on the dorsum of the lumbar spine extending from the level of L4-L6. Poor abdominal serosal detail suggestive of peritonitis. | Euthanased |
| | | | | | Ultrasonography | At least 80 mm × 2 mm hyperechoic structure with distal acoustic shadowing observed intra-abdominally. Cranial tip of structure was within the right lateral liver lobe and exited the liver at the ventromedial aspect of the right kidney and its caudal tip ended within an abscess at the caudal pole of the right kidney | |

*Continued overleaf*

**Table 1** (*continued*)

| Case | Breed | Sex | Age | Presenting complaint | Diagnostic imaging **modalities** | Imaging findings | Outcome |
|---|---|---|---|---|---|---|---|
| 5 | Rhodesian ridgeback | Male | 10 yrs | Not eating for 1 week. Presented collapsed. | Radiography | Free abdominal gas noted and peritonitis suspected. 58 mm × 3.6 mm hyperechoic linear structure with distal acoustic shadowing adjacent to visceral surface of spleen. | Exploratory laporotomy was performed and a sosatie stick removed. Uneventful recovery post-surgery. |
| | | | | | Ultrasonography | Peritonitis (moderate amount of echogenically speckled free peritoneal fluid trapped between spleen and stomach with hyperechoic surrounding mesenteric fat). | |
| 6 | Dachshund | Male | 2 yrs | Subcutaneous abscess level of last rib on the left | Ultrasonography | Fluid filled stomach with linear hyperechoic structure with distal acoustic shadows seen exiting the stomach dorsally. | Exploratory laporotomy was performed and 150 mm long sosatie stick removed from stomach which it had perforated dorsally and exited peritoneum at level of last rib on the left. Uneventful recovery post-surgery. |
| 7 | Saint Bernard | Female | 2.5 yrs | Coughing up blood for 1 day, depressed and anorexic | Radiography | Widened caudoventral mediastinum, alveolar pattern within accessory lung lobe – suspected pulmonary neoplasm. | Thoracotomy revealed a migrated sostatie stick extending from the stomach into the accessory lung lobe. An accessory lung lobectomy was performed and the sosatie stick removed. Uneventful recovery post-surgery. |
| 8 | Jack Russell terrier | Male | 3 yrs | Anorexia & tense, painful abdomen of 1 day duration | Radiography | Initial assessment of abdominal radiographs revealed no abnormalities. Radiographs were retrospectively reassessed and a linear mineralised opacity seen at the 12th intercostal space on the left with caudal tip at fundus of stomach. | At exploratory laporotomy, a sosatie stick penetrating the fundus with cranial tip at the diaphragm was found and removed. Uneventful recovery post-surgery. |
| | | | | | Ultrasonography | Ultrasonography revealed a thickened gastric wall and associated focal peritonitis but a discrete foreign body could not be found. | |

sosatie stick ended within a subcutaneous abscess adjacent to the xiphisternum. In Case 4, the sosatie stick traversed the right lateral liver lobe and exited the liver at the ventromedial aspect of the right kidney, where its caudal tip was embedded in an abscess (Figs 2A and 2B).

In 2 dogs (Cases 2 and 7), the sosatie stick migrated partially into the thoracic cavity and resulted in a different clinical presentation. In Case 2, the sosatie stick migrated cranially, through the fundus of the stomach and caudal oesophagus in a right craniolateral direction through the mediastinum (Fig. 3). The course of this sosatie stick could clearly be defined on CT and resulted in secondary mediastinitis and mediastinal abscessation. This animal presented with regurgitation, an arched back and pyrexia of unknown origin. Survey thoracic radiographs revealed a poorly defined caudodorsal mediastinal/terminal oesophageal mass, and an oesophageal foreign body or *Spirocerca lupi* oesophageal granuloma was suspected, which prompted thoracic CT. The sosatie stick could not be appreciated on thoracic radiographs even when retrospectively assessed. Case 7 presented as anorexic and depressed, with haemoptysis. Radiographs revealed a marked focal alveolar pattern within the accessory lung lobe and neoplasia was suspected. No ultrasonography was performed in this case. Thoracotomy and accessory lung lobectomy revealed a sosatie stick within the accessory lung lobe that had migrated cranially from the stomach.

Case 5 presented as collapsed and ultrasonography revealed an intraperitoneal sosatie stick with focal peritonitis. Surgery confirmed that the sosatie stick had migrated into the peritoneal cavity from the duodenum and caused localised peritonitis. Case 8 presented with a tense painful abdomen and initial radiographs revealed no abnormalities. Ultrasonography revealed a thickened gastric wall with focal peritonitis but failed to identify the sosatie stick, which was later found at surgery to have perforated the stomach with its cranial tip adjacent to the diaphragm.

In the 5 cases in which surgery was undertaken, the animals made an uneventful recovery. The 8-year-old Dalmatian with a mediastinal sosatie stick was euthanased owing to the age of the patient, severity of thoracic changes and surgical risk. Cases 3 and 4 were euthanased due to cost constraints.

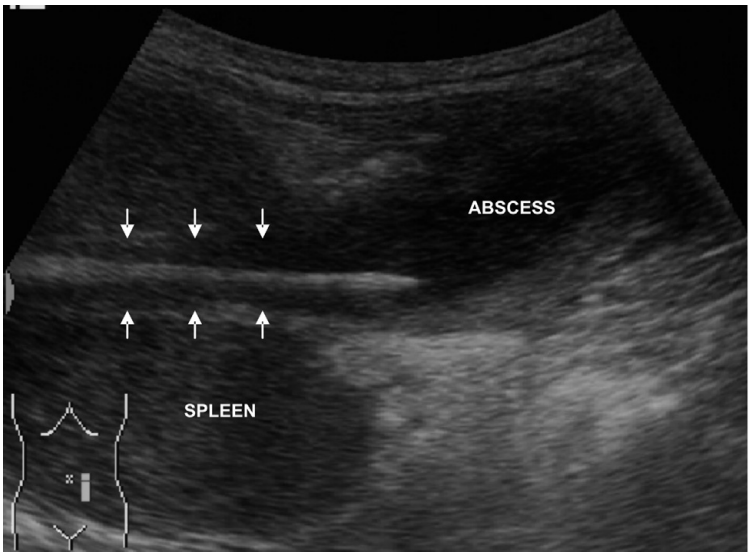


Fig. 1: **Ultrasonographic image of Case 3. The sosatie stick is seen as a linear hyperechoic structure traversing the spleen where it is surrounded by a hypoechoic tract** (outlined by arrows)**. The caudal tip of the sosatie stick ends within an abscess.**

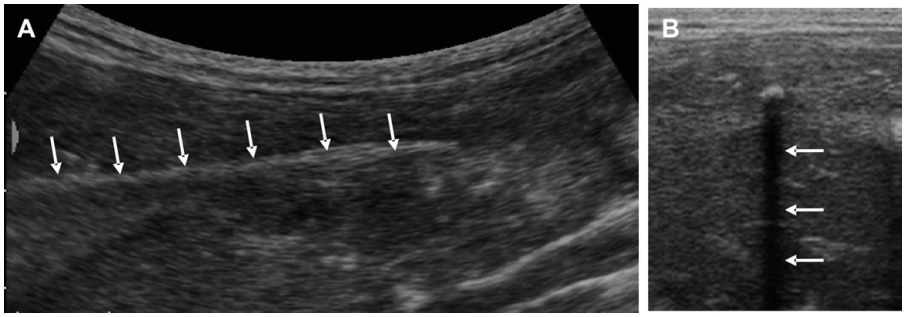


Fig. 2: **Ultrasonographic images of the sosatie stick traversing the liver in Case 4.** A: **Longitudinal orientation – note the hyperechoic linear appearance of the sosatie stick** (outlined by arrows) **with no appreciable distal acoustic shadowing.** B: **The distal acoustic shadow is readily identified in the transverse plane** (outlined by arrows)**.**

Fig. 3: **Dorsal CT view of the thorax displayed in a bone window** (WW 1500, WL 450)**. Note the right cranial to left caudally directed linear hyperattenuating sosatie stick outlined by the white arrows. The caudal tip of the sosatie stick can be seen within the gastric bubble.**

## DISCUSSION

Detection of ingested and perforating wooden foreign bodies has been described[2,4,5,7,8,12,14,18]. A variable degree of

migration of such foreign bodies from the gastrointestinal tract has been documented, which includes migration of a sosatie stick to a lumbar vertebra with secondary vertebral osteomyelitis in an animal that presented with lumbar pain of 10 months' duration[2]; migration of an ice-lolly stick from the jejunum into the bladder[18]; a non-healing wound on the thorax diagnosed as gastrocutaneous fistula formation secondary to migration of an ice-lolly stick[4], and migration of 2 cocktail sticks into the sublumbar musculature[11].

Ultrasonography has been shown to facilitate the diagnosis of foreign bodies. Ultrasonographically, the reflective quality of a foreign body depends on the acoustic impedance, which varies with physical density[9]. Metal and glass are therefore more reflective than plastic and wood. Metallic foreign bodies have been associated with comet tail artifacts[16]. Ultrasonographically, wooden foreign bodies are commonly described as bright interfaces with uniform acoustic shadowing[14.] In the longitudinal plane the sosatie stick acoustic shadow may not always be readily identified (Fig. 2A). However, on transverse images, the acoustic shadow is much easier to identify (Fig. 2B). Although wooden foreign bodies are commonly described as hyperechoic, they can become progressively less echogenic over time and may eventually no longer be distinguishable from surrounding inflammation[9]. It is common to identify a poorly echogenic area around the foreign body[14], and this can be related directly to the foreign body in many instances. Additionally, ultrasonography is useful in assessing local changes such as fluid accumulation (which may represent seromas, haematomas or abscesses), gastrointestinal mural thickening or perforation, and free air. The echogenicity of a fluid accumulation often gives an indication of its nature. Low cellularity fluid has an anechoic appearance. As the cellularity increases the fluid generally contains more and larger reflectors and becomes more echogenic, for example exudates[17]. Definitive diagnosis of the nature of fluid requires aspiration and cytological evaluation. In this study, intra-abdominal abscessation associated with 1 tip of the sosatie stick was diagnosed in 4 cases, based on the ultrasonographic appearance of echogenically speckled hypoechoic localised intra-abdominal fluid and cytologically confirmed subcutaneous abscessation at the more superficial tip of the sosatie stick.

Animals with subcutaneous foreign bodies such as thorns or porcupine quills that entered the body by external penetration of the skin may also present with chronic draining tracts, and these must be differentiated ultrasonographically from sosatie sticks that have migrated extraluminally from the gastrointestinal tract. Porcupine quills, for example, usually have echogenic walls, a fluid-filled anechoic lumen and a tapering point ultrasonographically[6].

One study documented the migration of wooden skewer foreign bodies (including a cocktail stick, ice-lolly stick and hot dog stick) from the gastrointestinal tract in 8 dogs, including the migration of a wooden skewer through the stomach and diaphragm with development of secondary pneumothorax[7]. Ultrasonography was not utilised in any of the cases to assist the diagnosis. Wooden foreign bodies were only seen radiographically in 2 of the dogs (where they were described as linear objects of wood or soft bone opacity). The diagnosis in the remaining dogs was based on secondary nonspecific radiographic changes (chronic proliferative bony changes), fistulography or surgical exploration[7]. Unlike the above study, ultrasonography proved invaluable in this study as the sosatie sticks, their path of extraluminal migration, and secondary complications such as abscessation and peritonitis were accurately documented in 5 of the 6 cases that underwent ultrasonography.

Radiography is useful in detecting radiopaque foreign bodies but is of little use in detecting radiolucent foreign bodies such as wood, plastic or glass[14]. In 4 cases that underwent ultrasonography, radiographs of the affected region were also taken and initial radiographic assessment failed to identify the sosatie sticks. Retrospectively the sosatie stick was seen as a linear structure with greater opacity than soft tissue penetrating the gastric fundus in 1 of the cases. Radiographs were also taken in another 2 cases in which ultrasonography was not conducted and in those too radiography failed to identify the sosatie sticks. Radiographs did, however, assist in identifying changes secondary to gastrointestinal perforation in 2 of the cases in which a sosatie stick was later identified ultrasonographically. Non-specific radiographic changes such as localised periosteal reactions on vertebra or ribs, poor abdominal detail or free peritoneal gas are suggestive of a perforating foreign body. Ventral vertebral periosteal reactions in the L1 to L4 region have been associated with grass awn inhalation and secondary migration *via* the diaphragmatic crura to their origin at L3 and L4 with associated lumbar vertebral abscessation in hunting dogs[5].

Magnetic resonance imaging and computed tomography are advanced imaging modalities that can be useful to diagnose wooden foreign bodies. Not all wooden foreign bodies will be directly visible. Size, hydration of wood, composition of surrounding tissues, and presence of inflammatory response are all likely to play a role in visibility on MRI or CT[19]. MRI is an excellent method for visualising the inflammatory tissue reactions associated with soft tissue foreign bodies because of its contrast resolution and depiction of anatomy in multiple imaging planes. The surrounding tissue inflammatory reaction may constitute the most visible abnormality, which is seen as hyperintense lesions relative to the surrounding musculature on T1- and T2-weighted MRI images and usually exhibits contrast enhancement, as described for foreign bodies in canine sublumbar musculature[5].

Computed tomography of non-gastrointestinal wooden foreign bodies has been described in dogs[10]. The CT identification of wooden foreign bodies in these cases was based primarily on linear shape or orientation along a plane that did not match a known anatomical structure[10]. In human cases, wooden sticks have been described to have an increased attenuation on CT images because of their high inherent density or absorption of fluids. Additionally, they may have internal striations or a 'target' shape in transverse images[3,15]. Computed tomography has been found to be more sensitive than ultrasound and MRI in detecting wooden foreign bodies in the manus[13]. In this study, a CT scan was conducted on Case 4 for research purposes due to suspected spirocercosis seen on thoracic radiographs. Unexpectedly, a mediastinal sosatie stick with secondary mediastinitis and abscessation was found. The linear, hyperattenuating appearance of the foreign body was typical of a sosatie stick.

## CONCLUSION

Animals having ingested sosatie sticks can present with a plethora of clinical signs ranging from haemoptysis, abdominal pain and regurgitation to chronic draining sinus tracts and subcutaneous or intra-abdominal abscessation. Veterinarians should be aware of the complications associated with extraluminal migration of sosatie sticks and utilise 1st-line diagnostic imaging modalities such as ultrasonography in animals presented with evidence of unexplained inflammatory disease of the thorax, abdomen and pelvic regions in order to rule out this syndrome. Owners should be warned of the risks of allowing their animals access to sosatie sticks and appropriate histories of their possible ingestion should be obtained.

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