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Imaging of cancerous horn using computed radiography and computed tomography in cattle

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ABSTRACT

Aim: Purpose of the study was to evaluate anatomical structures of cancerous horn using computed radiography and computed tomography in cattle.

Method and materials: Study was conducted on 10 cancerous horns of cattle using computed radiography and computed tomography and images of cancerous horns were evaluated.

Results: Computed radiography and computed tomography techniques revealed detailed information regarding anatomical structure of the cancerous horns viz; horn sheath, bony core, bony septa, connective tissue layer and pneumatic cavity.

Conclusion: It was concluded that computed tomography is advanced and effective imaging diagnostic tool for early diagnosis of horn cancer. Computed radiography and computed tomography provide details and early confirmation for affected anatomical structures of cattle horn viz; horn sheath, bony core along with bony septa and connective tissue layer.

Keywords: Computed radiographic, Computed tomographic, Imaging diagnostics, Horn cancer.

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Introduction

Cattle horns are important structure for the breed characteristics. Both male and female cattle have horns, although the horns of female animal are smaller in size (Dyce and Wensing, 1971). The conditions which affect the productivity and lead economic loss to the farmer are supposed to be taken care on priority. The production losses due the horn affections in cattle count a major share to the farmer (Rao *et al.,* 2014). The horns are prone to be affected like avulsion, fracture, overgrowth, sepsis, fissures and cancer (Singh and Kumar, 2012).

For the diagnosis of such affections, diagnostic imaging techniques proper detail and confirmation as well as clinical evaluation and medical preposition (Olsen *et al.,* 2007). Imaging diagnostics help to set up normal anatomical and functional parameters that are useful for clinical and research purpose (Thomas and Pickstone, 2007).

In clinical veterinary practices, x-ray diagnostic techniques are commonly used to include digital radiography and computed tomography (Chen *et al.,* 2012). Radiography allows side evaluation of fracture, arthritis, bone degeneration, bone neoplasm, tendon or ligament attachment problem and site of soft tissue swelling or infection (Farrow, 1985). The digital radiographic images have more exposure latitude (grey shades), which makes it possible to evaluate both bone and soft tissue detail in the same image (Chen *et al.,* 2012).

CT images provide accurate anatomic evaluation of tissue planes and regions that often can not be visualised with radiography. CT images have superior contrast resolution and elimination of anatomic superimposition (Bontrager and Lampignano, 2010). Cross-sections provide three-dimensional details of tissue to evaluate normal anatomy for disease diagnosis and treatment (Bamniya and Kumar, 2023). The greatly increased tissue resolution allows differentiation between fluid and solid tissues and assessment of the internal structure of soft tissues.

Application of CT scan to produce diagnostic images in cattle is very uncommon though valuable or costly cattle are preferred for such diagnostic techniques (Nuss *et al.,* 2011).

Diagnostic imaging techniques have advanced the basic diagnosis and provide comparative details of normal as well as diseased condition (Doi, 2006). Therefore, it was proposed to evaluate anatomical structure of cancerous horn using computed radiography and computed tomography.

Materials and Methods

The study was carried out on cancerous horn of cattle. These horns were scanned with computed radiography and computed tomography. Computed radiography and computed tomography examination of samples were conducted at Med. Diagnostic Laboratory. Radiological examination in lateral views was carried out on cancerous horns using radiography machine (Allengers X Ray machine, mA 500). The horns were radiographed on lateral view using technical/exposure factors at 60kVp, 35 mAs and 90 cms FFD. The diagnostic images were interpreted and analysed. The CT images were obtained with multi-slice CT scanner, which has high contrast spatial resolution and consequently better conspicuity of small structures. The horns were extended and placed within the CT scanner machine (GE Healthcare 16 CT Scanner). A scout image (120 kV and 60 mA) was obtained for use in planning image acquisitions to ensure symmetry in positioning and inclusion of the entire region of interest. The acquisition settings were for soft tissue (window width = 350, level = 60), bone (width = 2000, level = 500), slice thickness of 2 mm and matrix size of 512. The horns were scanned in helical fashion (starting at a level of base of horn and continuing to the tip of horn). Computed tomographic images examined continuously series of sagittal and transverse manner. The diagnostic image was interpreted and analysed with DICOM file software i.e. RadiAnt software, 3D slicer and Sante software.

Results and Discussion

Among various diagnostic imaging techniques radiography is the first imaging modalities of choice when a bony or soft tissue injury is suspected (Raes *et al*., 2011). However, Stover *et al*. (1986) stated that radiography provides little information on soft tissue structures, is hampered by the possibility of bone superimposition and the acute skeletal abnormalities may not be radiographically visible. Stover *et al.* (1986) also advocated bone superimposition in skeletal radiography.

In present study, radiographic images of cancerous horn revealed that bony core was radiodense structure with extended osteolysis towards the apex (Fig. 1). The pneumatic cavity was observed with opacity from the mid to apex of horn indicating tissue which appeared greyish in color. Horn sheath was observed with its outer margin; however, apex was more radiodense because of the superimposition of curved tip of horn. Apex part of pneumatic cavity was observed black tinged patches due to air occupied space.

In present study, radiographic examination of cancerous horns provided differential diagnosis. However, Motta *et al.* (2017) described digital radiographic examination for effective diagnose of various orthopaedic diseases and radiographs are employed along with other imaging techniques in cases of suspected oral neoplasia. Radiographic evidence of bone lysis displays 90% of osteosarcoma (Farcas *et al.,* 2014).

In present study, radiographic examination of cancerous horn revealed new radiographic opacity depicting soft tissue opacity within the pneumatic cavity which varied in size and location according to severity of the cases. Singh *et al.* (1986) also advocated homogenous soft tissue mass within pneumatic cavity which appeared granular and mottled with irregular margins. Naik *et al.* (1989) also recommended anterio-posterior radiograph for the malignant growth in horn core.

In present study, interpretation of radiographic images of cancerous horn also revealed osteolysis of bony core and bony septa. Similarly, Naik *et al.* (1989) also observed osteolytic changes (bony core and bony septum), loss of sinus pattern and dense soft tissue. However, Singh *et al.* (1986) revealed that horn core appeared osteolytic without any evidence of periosteal proliferation or sclerosis around the margins. Udharwar *et al.* (2008) also observed similar radiographic signs of horn cancer with negative air contrast technique. Shivaprakash (2008) also adopted radiography for early diagnosis of horn cancer which made the prognosis and survival more favourable for affected animals. Eberle *et al.* (2010) also reported variation of lytic, mixed or productive Patterns and similar patterns in bone tumours. Robert (2000) and Liptak *et al.* (2004) also observed loss of the fine trabecular pattern in metaphyseal bone and pathologic fracture with metaphyseal collapse in canine appendicular osteosarcoma.

Fig. 1. Radiograph of cancerous horn with complete osteolysis from the mid to apex horn and pneumatic cavity showing complete homogenous density and white radiopaque bony core with mild osteolytic changes at the base of horn.

Computed tomography was not initially used in veterinary medicine because of its limited accessibility and high costs. However, accessibility has improved, which has increased the need of expertise in the use of this technique in animals (Ottesen and Moel, 1998 and Raji *et al*., 2008). In present study, computed tomography was used for scanning of cancerous horns. It was observed decreased spatial resolution compared to radiographs, reduced anatomical superimposition and superior contrast resolution images to detect lesions throughout in the present study. Forrest (2018) and Hoskinson and Tucker (2001) also reported that CT technology provides images without superimposition of structures and better soft tissue delineation compared with radiography. Whereas, Nykamp and Randall (2019) elaborated the advantages and limitations of computed tomography (CT). The horn structures in present study were characteristically featured by morphology, distribution pattern, attenuation and contrast-enhancement of various part of horn. Lamb and David (2012) also reported that advanced imaging modalities are inherently better detectors of morphological lesions which provide the possibilities of more accurate diagnosis and staging, with correspondingly better patient outcomes. Whereas, Lee *et al*. (2009) also used CT scan for rapid and accurate diagnosis of bovine orthopaedic disorders. However, Marincek and Young (1980) reported that CT provides excellent detail of osseous structures and can detect bony changes. In present study, CT images provided fine details of horn structures as compared to radiography. However, Yamazoe *et al.* (1994) considered CT scan to be superior for evaluating 3D relationship in complicated lesion. Moreover, soft tissues could be evaluated via CT (Bienert and Stadler, 2006 and Vanderperren *et al.*, 2008).

In present study, Computed Tomographic examination of cancerous horn revealed new CT features in context of horn imaging depicting neoplastic tissue opacity, size and location within the pneumatic cavity which varied in size and location according to severity of horn cancer. Similarly, Davis *et al.* (2002) also reported computed tomography to predict tumor length or size where intramedullary fibrosis was taken into account. Castells *et al.* (2019) stated that Computed tomography provides a clear picture of the tumour nodules inside the lung and their different sizes and locations. CT has also allowed serial CTs to evaluate the progression of the disease.

In the present study, computed tomographic features of horn cancer had manifested heterogenous soft tissue mass density associated with bony lysis in pneumatic cavity. Similarly, Fromberg *et al.* (2010) also reported nasal neoplastic disease in dogs with presence of a homogenous or heterogeneous soft tissue density associated with osseous lysis, mass effect and often a unilateral orientation. Gendler *et al.* (2010) also reported heterogeneous contrast CT features in case of oral SCC in cats. Gregori *et al.* (2014) also reported fibrous encapsulation of the tumor with heterogeneous pattern CT images of adrenal neoplasia in dog.

In series of transverse slices of horn images revealed osteolysis of bony core and bony septa at base of horn. Middle part of pneumatic cavity appeared heterogeneous greyish with osteolysis of bony core whereas apex part was observed with less heterogeneous greyish pattern which indicating neoplastic growing tissue (Fig. 2).

CT images in continually sagittal slices revealed that pneumatic cavity of horns were observed with greyish heterogeneous density depicting neoplastic mass with osteolysis of bony

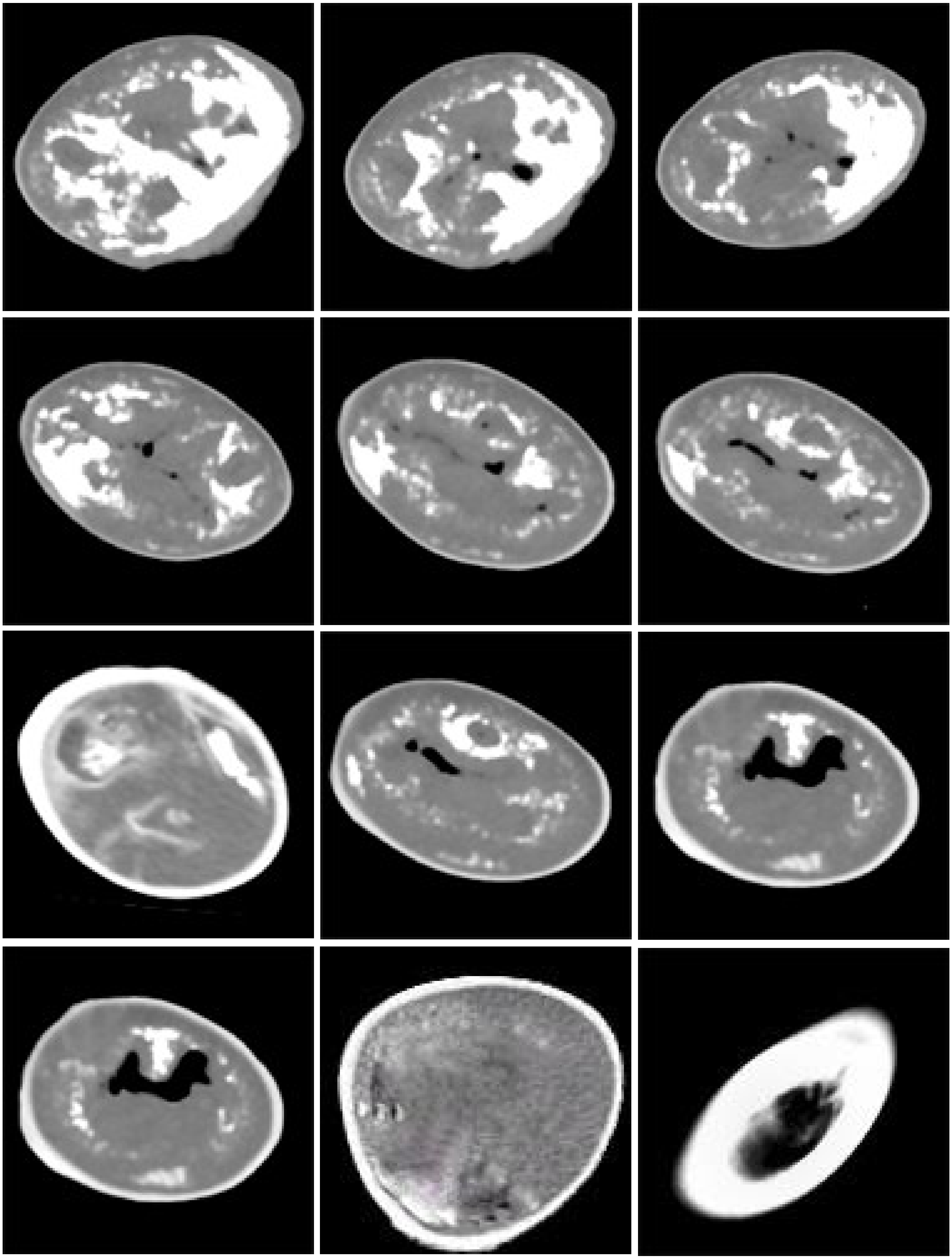

Fig. 2: CT images (Transverse slices) of cancerous horn from base to apex indicating osteolytic bony fragments at base of horn. Greyish pneumatic cavity indicating presence of neoplastic mass and complete osteolysis of horn core.

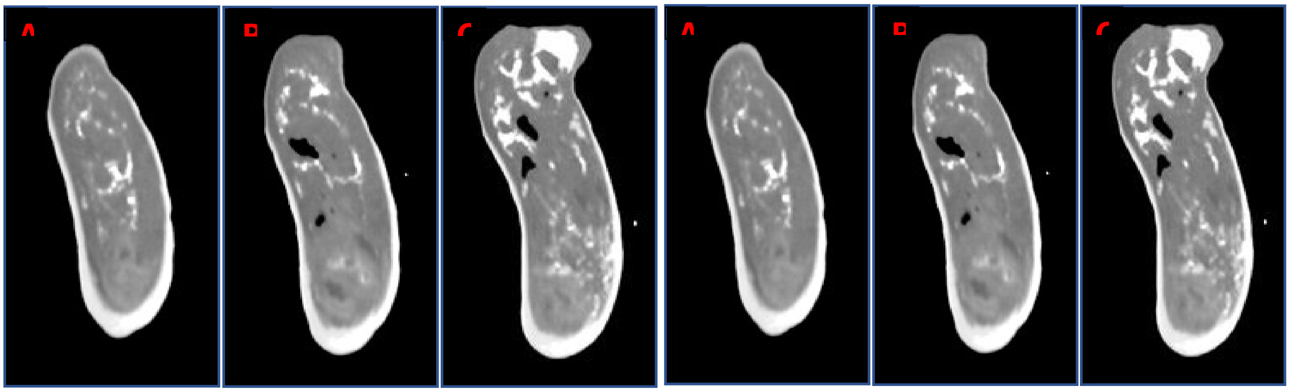

Fig. 3: CT images (sagittal slices) of cancerous horn showing hyperdense osteolytic bony core fragments at the base of horn and pneumatic cavity with heterogeneous greyish pattern and osteolysis of bony core.

septum and osteolytic bony fragments were also observed at the base of horn (Fig. 3). Horn sheath was found with greyish-white outer margins (Wuersch *et al*., 2009). Apex part of pneumatic cavity was observed with dark greyish pattern which indicated growing neoplastic tissue.

Conclusion

It was concluded that computed radiography and computed tomography were found effective diagnostic tool for early the diagnosis of horn cancer. Computed tomography was found to eliminate superimposition and provided detailed information of compact bony and soft tissues.

Computed radiography and computed tomography confirmed origin of horn cancer at mid half ofhorn. Computed radiography and computed tomography confirmed initiation of osteolysis from the mid half horn. Horn sheath was found unaffected at any stage of horn cancer in both diagnostic imaging modalities.

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