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Evaluation of port placement approaches for thoracoscopic examination in cattle

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Abstract
Thoracoscopy was conducted to evaluate the port placement approaches for thoracoscopic examination in cattle. Twelve animals were randomly divided into two equal groups for thoracoscopy based on the placement of port, in group I animals dorsal port was created at 15 cm ventral to transverse process of thoracic vertebra in 9th and 10th ICS of right and left hemithorax and in group II placement of ventral port was created at 30-35 cm ventral to transverse process of thoracic vertebra ventrally in 7th and 8th intercostal space of right and left hemithorax. In all the animals. Standing sedation was achieved with Inj. butorphanol @ 0.05 mg/kg and port site anesthetized with Inj. 2% lignocaine HCl. Passive lung collapse was achieved by using teat cannula. A 57 cm, 0^{0} rigid telescopes with 10 mm diameter was used for thoracoscopy and all visible structures were identified and noted. At the end of the thoracoscopy the cranial port site wound was sutured by cruciate technique and suction was applied in caudal port to resolve the pneumothorax. The mean HR, SpO_2, AST, ALT, ALKP and serum creatinine were showed non-significant change between the groups. Whereas, the mean RR was highly significant and mean BUN showed significant increase between the groups. Postoperatively, animals were treated with broad spectrum antibiotic and analgesic for five days. Thoracoscopic examinations of the intrathoracic structures were visible and best achieved through the dorsal port at 9th ICS and ventral port at 7th ICS. Ventral port allowed closer examination of thoracic structures than achieved through dorsal port whereas, more discomfort to animal was observed at ventral port.

Keywords: thoracoscopy, standing thoracoscopy, butorphanol, examination of cattle thorax, hydrothorax

Introduction
Thoracic affections are one of the major clinical problems in large animal practice, the common thoracic disorders are pleural effusion, pneumothorax, diseases of the pleural space, space-occupying lesions such as diaphragmatic hernia, pericardial effusions, tumors, etc. Death due to thoracic diseases are high because most of these cases remain undiagnosed due to the unavailability of diagnostic imaging facility. Generally, radiography, ultrasonography along with open methods is commonly used for the diagnosis of various surgical conditions of thoracic cavity in large animals. Accurate diagnosis of thoracic disorder is essential for management and treatment of such cases.

The benefits of thoracoscopy include decreased pain and healing time of surgical wound, a short stay in hospital and fewer complications over the conventional thoracic surgeries (Daly *et al*., 2002) [2]. Thoracoscopy has become more powerful tool for examination of the thoracic cavity as it gives an access to surgically inaccessible intrathoracic areas (McCarthy, 1999) [6].

The surgeon must be familiar with thoracoscopic anatomy, thoracoscopic techniques, limitations of the technique and possible complications. The port choice for thoracoscope insertion into the thoracic cavity can make the difference between a successful examination and a failed one. However, while performing thoracoscopy in veterinary practice, need of adequate knowledge of thoracic anatomy of patients is very essential (De Rycke *et al*., 2001) [3]. Keeping in view the referral practice of large animals especially cattle the study was undertaken.

Materials and Method
The present study was carried out in the Department of Veterinary Surgery and Radiology, Collage of Veterinary and Animal Sciences, Udgir. Twelve clinical cases with the history of chronic cough, anorexia, dyspnea, exercise intolerance, labored breathing, nasal discharge etc. Twelve animals were randomly divided into two equal groups for thoracoscopy based on the

placement of port, in group I animals dorsal port was created at 15 cm ventral to transverse process of thoracic vertebra in 9th and 10th ICS of right and left hemithorax and in group II placement of ventral port was created at 30-35 cm ventral to transverse process of thoracic vertebra ventrally in 7th and 8th intercostal space of right and left hemithorax. In all the animals' pre-operative and postoperative radiographic examination of thorax was carried out. Standing sedation was achieved with Inj. butorphenol @ 0.05 mg/kg and port site anesthetized with Inj. 2% lignocaine HCl. Passive lung collapse was achieved by using teat cannula. A 57 cm, 0^0 rigid telescopes with 10 mm diameter was used for thoracoscopy and all visible structures were identified and noted. At the end of the thoracoscopy the cranial port site wound was sutured by cruciate technique and suction was applied in caudal port to resolve the pneumothorax. Physiological parameters from group I and group II animals at 15 min before procedure, during procedure at 10 min (after 10th ICS from group I and 8th ICS from group II animals) and 24 hrs after procedure with the help of multipara patient monitoring unit were recorded. Heart rate, respiratory rate and oxygen saturation were monitored on multipara patient monitoring unit. Postoperatively all the animals from group I and II were administered with broad spectrum antibiotic Inj. Cefoperazone and sulbactum @ 10 mg/kg IM and inj. Meloxicam @ 0.5 mg/kg IM once daily for five days. The surgical wound was dressed daily with povidone iodine and applied povidone iodine ointment. Clinical and routine observations of operated cases were noted and complications if any were recorded.

Result and Discussion

All the thoracoscopy procedures in both the groups were carried out in standing position. And well tolerated by all the animals of group I and II. (Villalobos *et al*., 2017) [14] reported that thoracoscopy procedure in calves severely affected by bovine respiratory syndrome was performed in standing position except two calves which had recumbency because of prior injury. Similarly, in the present study the standing thoracoscopy was found suitable in all the animals of both groups with minimal impulsive complications. Whereas, two animals (33.33%) from group II were showed weight shifting and discomfort during thoracoscopic procedure. Post thoracoscopic radiographic examination was carried out in all animals of group I and II and no incidence of pneumothorax was observed. The complications *viz*, pneumothorax, pneumonia, pleuritis, lung collapse, lung lacerations, post-operative air leak were not found in any animal of group I and II animal. Similarly, (Scharner *et al*., 2013) noted postoperatively no incidence of residual pneumothorax.

In present study passive lung collapse was used by using teat cannula techniques and it was found suitable and no any lung laceration and complications were found in all the animals from group I and II. Similar, technique was used by (Scharner *et al.*, 2013). The structures were visible through the dorsal port of left and right hemithorax (group I) were almost same and did not vary regardless of port placement either located in 9th or 10th ICS, 15 cm ventral to transverse process of thoracic vertebra. Placement of port in 10th ICS made manipulation of the telescope in the ventral and caudal direction more difficult, compared with that of port location in the 9th ICS, due to its closer proximity to the diaphragm. Similarly, the (Scharner *et al*., 2013) also find the difficulty on the movement of telescope towards the ventral side because of short distance of the diaphragm from 10th ICS.

All the animals (100%) from both the groups tolerated the standing thoracoscopy well with Inj. Butorphanol @ 0.05 mg/Kg b.wt. IV. Similarly, (Relave *et al.*, 2008) [12] used butorphanol @ 0.02 mg/kg IV preoperatively as an additional analgesia with detomidine in horses during thoracoscopic lung biopsy procedure. (Villalobos *et al*., 2017) [14] suggested that sedation was necessary to ensure the safety of animals and surgeons. In present study no any signs of anxiety or restlessness and increased respiratory rate except in one (16.66%) animal from group II was noticed.

In this study a 57 cm, 0^0 rigid telescope with a diameter of 10 mm was found suitable for examination of organs from both hemothorax of cattle in both group I and group II. (McCarthy *et al*., 1999) [6] explained important feature of viewing angle that ranges from 0^0 to more than 90^0 (Walton, 2001) [15] also used that straight forward or 0^0 telescope was used for more natural field of view and normal organ orientation.

In group I, two animals found suffering from hydrothorax, from one animal 2.5 L and 1.8 L fluid was suctioned with suction unit from the left and right hemithorax respectively, unfortunately the animal was died after 24 hrs of last thoracoscopic procedure and it was already tested positive for theileriosis this might be the reason of death of animal. From another animal a total of 2.7 L fluid was withdrawn from left and right hemithorax whereas, after 36 hrs the animal was died. Further, Pollock and Russell (2006) [11] drained approximate 40 L of hemorrhagic fluid from bilateral thoracentesis and then decision was taken to explore thorax of horse by using thoracoscopy through 10th and 12th ICS whereas, in the present study from two animals of group I pleural fluid was suctioned during thoracoscopy.

In group II, ventral port was located in the 7th and 8th ICS. Manipulation of telescope in group II animals through ventral port was more difficult than manipulation of telescope through dorsal port in group I animals, this might be because of 8th rib was the last sternal rib which distracting the telescope to advance cranially (Peroni *et al.*, 2000 and Scharner *et al*., 2014) [9, 13]. However, signs of pains were stimulated when telescope was moved cranially and caudally via ventral port as evidenced by agitation and shifting of weight by animals and reluctance to the procedure by the group II animals. From group II animals, the ports were allowed visualisation of structures in the cranioventral aspect of left and right hemithorax, further, these structures were better observed when port was located in the 7th ICS than it was located in the 8th ICS. Thoracoscopic examination through the ventral port allowed improved visualization through telescope at 8th ICS in the ventral aspect of the hemithorax such as the heart and pericardium and laparoscopic forceps inserted through 7th ICS were used and displaced the caudal lung lobes for better examination of diaphragm. However, pain was frequently observed during examination through ventral port. (Scharner *et al*., 2013) reported that the cow exhibited the discomfort by shifting back and forth when the endoscope was advanced cranially in the 8th ICS. Further, they suggested that satisfactory examination of the intrapleural structures were achieved through 9th ICS with port located at the level of ventral margin of the tuber coxa.

In group I, thoracoscopic examination was found suitable through dorsal port at 9th and 10th ICS, whereas, 9th ICS was more convenient, because 10th ICS resulted in limited movement of telescope in the ventral and caudal direction, due to closer proximity to the diaphragm. In group II thoracoscopic examination of structures through ventral ports at 7th and 8th ICS were allowed close examination in the cranioventral portion of thorax.

In animals of group I, thoracic structures *viz.* pleural surface of ribs, intercostal muscle, aorta and aortic arch, sympathetic trunk, aortic hiatus, azygous vein, costocervical vein, thoracic esophagus, dorsal branch of vagus nerve, pulmonary ligament, diaphragm, caudal and cranial lung lobe, intercostal nerve bundle, mediastinal lymph nodes were visualized and easily approached through dorsal port located at 9th and 10th ICS, 15 cm ventral to transverse process of thoracic vertebra in both left and right hemithorax. Whereas, cranial mediastinum and cranial lung lobe were approached only in left hemithorax and middle lung lobe was approached in right hemithorax through both dorsal port located at 9th and 10th ICS, similar findings were noted by Michaux *et al.* (2014) [7].

In group II animals pleural surface of ribs, intercostal muscle, aorta and aortic arch, sympathetic trunk, aortic hiatus, azygous vein, costocervical vein, thoracic esophagus, dorsal branch of vagus nerve, pulmonary ligament, diaphragm, caudal lung lobe, intercostal nerve bundle, mediastinal lymph nodes were visualized and approached through ventral port located at 7th and 8th ICS, 30-35 cm ventral to transverse process of thoracic vertebra in both left and right hemithorax. Whereas, cranial mediastinum and cranial lung lobe was approached in left hemithorax and middle lung lobe was approached in right hemithorax through both 7th and 8th ICS of ventral port as stated by (Michaux *et al.*, 2014) [7]. Postoperatively, animals were treated with broad spectrum antibiotic and analgesic for five days. Thoracoscopic examinations of the intrathoracic structures were visible and best achieved through the dorsal port at 9th ICS and ventral port at 7th ICS. Ventral port allowed closer examination of thoracic structures than achieved through dorsal port whereas, more discomfort to animal was observed at ventral port.

The mean heart rate before 15 min of sedation, during thoracoscopy at 10 min and after 24 hrs of thoracoscopy in group I and II were 64.83±1.953, 73.25±2.17 and 65.83±2.00 beats/min and 69.75±1.93, 77.83±1.858 and 70.50±1.94 beats/min respectively showed non-significant change when compared between the group. (Pigatto *et al*. 2008) [10] observed initial increased heart rate after production of pneumothorax with room air.

Statistically mean respiratory rate during thoracoscopy at 10 min increased highly significant in group II and after 24 hrs of thoracoscopy it was 27.50±1.36 and 32.25±1.96 (breaths/min) respectively found non-significant between the groups. The significant increase in respiratory rate at 10 min during thoracoscopy might be because of the evident of pain lead to cardiorespiratory alterations.

Mean SpO_2 of group I and group II before 15 min of sedation, during thoracoscopy at 10 min and after 24 hrs of thoracoscopy were 98.16±0.20, 97.08±0.19 and 98.08±0.14 (%) and 98.16±0.24, 96.91±0.22 and 98.08±0.22 (%) found non-significant. Michaux *et al.* (2014) [7] noted decrease in SpO_2 after induction of pneumothorax regardless of hemithorax during the thoracoscopic procedures.

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