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Evaluation of Intraoperative Complications in Pericardiectomy with Transdiaphragmatic Thoracoscopic Approach in Dog

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Abstract

Objectives- Recording intraoperative cardiorespiratory events in thoracoscopic total pericardiectomy via transdiaphragmatic camera port in dog to evaluate feasibility and risks of mechanical stimulation of pherenic nerve during this surgical approach.
Design- Technical assessment, experimental study.
Animals- Nine healthy, male mixed breed dogs
Procedures- Under one lung ventilation inhalation general anesthesia pericardiectomies performed by thoracoscopic method using paraxiphoid transdiaphragmatic approach as camera port and two other on left thoracic wall as operating port. Cardiorespiratory parameters were recorded during operation.
Results- Eight dogs tolerate surgical procedure, there was mild hypoxia during anesthesia due to one lung ventilation, and transient bradycardia during surgical manipulation of pericardium and some cardiac arrhythmias was recorded.
Conclusion and Clinical Relevance- Thoracoscopic total pericariectomy is feasible via a paraxiphoid transdiaphragmatic camera port in dog intensive anesthetic monitoring, gentle handling of operative instrument in thoracic cavity and good experience in thoracoscopy to perform safe operation.
Key Words- Pericardiectomy, Thoracoscopy , Transdiaphragmatic , Pherenic Nerve

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Introduction

Thoracoscopy is one of non invasive procedures in modern surgery that accomplished by an endoscopic camera and specified endosurgery instrument via small incisions on thoracic wall. [1,2,3] The main purpose of thoracoscopic surgery is to decrease the trauma of conventional thoracotomy without reducing the operating exposure, rapid diagnosis and treatment, shorter convalescence, rapid return to full activity, reduced post operative pain and morbidity.[1,4,5,6] Thoracoscopy allowing direct visualization of the thoracic cavity, including pulmonary parenchyma, mediastinum, pleura, pericardium, heart, and major blood vessels. In many cases, the view obtained during thoracoscopy is superior to that obtained during open thoracotomy due to the ability to get the tip of the scope near thoracic structures, magnification, and ability to get the scope in places that are inaccessible to a surgeon during open thoracotomy. [4,7] There are four major aspects for thoracic cavity visualization : left intercostals, right intercostals, thoracic inlet and diaphragmatic.[5,6,8] In thoracoscopic procedures , there are limitations to decrease the size of incision and finding the best view point according to the target organ in surgical planning.[9,10] Several thoracoscopic pericardiectomy where reported by using left or right intercostal approach camera port placement but for best visualization in both craniolateral and caudomedial aspects of pericardium specially in total pericardiectomy these approaches have difficulties to view a 360 degree circular view of heart on baseline attachments of pericardium.[9,5,11,12] Paraxiphoid transdiaphragmatic approach provides a circular view in apex-base direction around conical shape of heart. This approach provides excellent visibility and access to ventral structures in the thorax and mediastinum, and access to the helium of the lung.[6,12] Application of paraxiphoid transdiaphragmatic approach for camera port placement has technical difficulties in port placement and some risks such as liver lung or cardiac injury and cardiac arrhythmias intra operatively and pnuemothorax postoperatively, that restricts the usage of this approach.[3,6]

Materials and Methods

Nine mixed breed healthy male dogs weighting 18±3 kg were prepared for this study, after taking lateral thoracic radiograph, and electrocardiographic, blood cell and biochemistry evaluations (including blood glucose and plasma cortisol) the animals underwent thoracoscopic pericardiectomy.

General anesthesia inducted by ketamine/diazepam combination and maintained with inhalation of halothane by one lung (right) positive pressure ventilation. The dogs positioned in dorsal recumbency and after clipping and aseptic surgical preparation, the first port was placed in ventrodorsal midpoint of sixth intercostal space of left hemithorax using a 10 mm trocar and camera guided to thoracic cavity then under direct vision and by coetaneous palpation on left paraxiphoid region the safe point for placement of paraxiphoid trans diaphragmatic port detected. The 10mm trocar was handled palm grip and directed cranioventrad, left lateral to the xiphoid process of sternum, medial to costal arch. After penetration of intrathoracic diaphragmatic surface the sharp end of trocar extracted 2 cm caudate to avoid damaging intraplural structures.(Fig.s 1 and 2)

The camera moved to diaphragmatic port and third port (5 mm trocar) placed on left third intercostals space in axilla under direct vision of camera. After detection of left and right pherenic nerves with camera, by maneuver of two operating instruments (one grasping forceps on sixth intercostal space and scissors on third intercostals space) an incision made at a circular line 1cm under pherenic nerve from left craniolateral to the caudal then to the right cranial by rolling the animal slightly toward left side to have better view of right side of heart base. After completing the incision the diaphragmatic attachment of pericardium dissected by scissors and pericardium removed by grasping forceps (Fig. 3), thoracic cavity explored to control any bleeding and damage. After instrument port removal, and suturing intercostals muscles and skin, the camera port was removed and muscles were sutured under continues positive pressure inspiratory condition to avoid pneumothorax, followed by closing the subcutaneous tissue in routine manner. To avoid any bias in electrocardiograph no lidocain and no electrocutery were used.

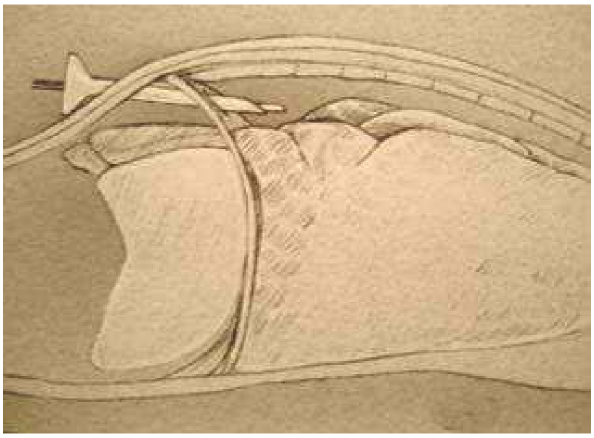

Figure 1. Sagital schematic view of paraxiphoid trans diaphragmatic camera port.

Figure 2. Port placement position

In all stages of anesthesia electrocardiography, heart and respiratory rates, end tidal CO2, saturation of blood O2 and non invasive blood pressure recorded by an anesthetic monitor. All surgical procedures and time were recorded by video recorder attached to thoracoscopic monitor. Time of intubation and extubation were determined as start and end of anesthesia. Time of incision was recorded as beginning of surgical procedure and tying of the last skin suture was detected for end of surgery. Animals were intensively monitored four hours postoperatively and examined twice daily for 21 days.

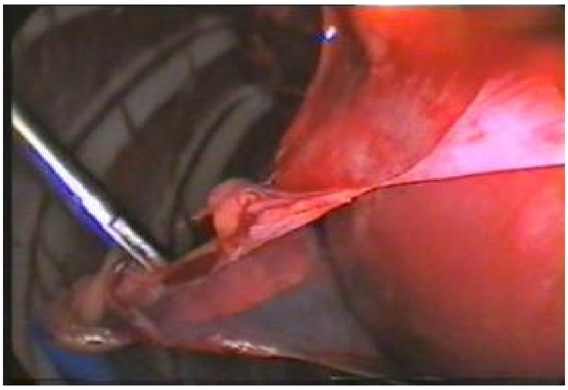

Figure 3. Cutting the pericardium at subpherenic level thoracoscopic view from camera port.

Results

One dog died during operation because of pherenic nerve injury, Table 1 shows the events during surgery of this dog.

Table1. Intra operative anesthetic data of the one expired dog. Bradycardia began at the time of incision and extended to cardiac arrest due to pherenic nerve injury which detected in necropsy, the animal did not respond to cardiopulmonary resuscitation even intra cardiac administration of epinephrine.

Time (min)	HR	RR	NIBP (mmHg)	ETCO2 (%)	SpO2 (%)	steps during operation
5	123	16	143/76	31	97	Port placement
10	120	15	121/45	34	93	Port placement
15	98	12	112/20	29	89	Grasping pericardium
20	86	14	93/34	44	88	Start Incision
25	43	14	84/22	51	76	Incision
30	12	14	--------	58	57	Incision
35	0	------	-------	------	44	Incision
40	0	------	--------	---------	-----	End

HR: Heart rate. RR: Respiratory rate. NIBP: Non Invasive Blood Pressure. $ETCO_2$: End Tidal CO_2. SpO_2: Saturated pressure of O_2.

The mean ventilated tidal volume in 9 dogs before lung ventilation was 17.65 ±3.24 ml/kg with an average respiratory rate 8.23±1.46 breath per minute. After selective ventilation the mean tidal volume was reduced to 9.32±56 ml/kg, and the average respiratory rate was increased to 15.89±67 breath per minute to maintain $ETCO_2$ <45 mmHg. Time of surgical operation was significantly decreased with surgeons experience during nine operations, at first operation length of procedure recorded 38±2 minutes and it shorted to the last operation to 6±1 minutes.
Before one lung ventilation, oxygenation was adequate as evidenced by a mean SaO2 of 96.41±2.12 in all dogs. Transition to one lung ventilation did not result in hypoxia (SaO2>90%) in six dogs in three dogs oxygenation subsequently improved by slowly increase tidal volume in fifteen minutes.
Eight dogs tolerated surgical procedure well and survived. In five dogs a transient bradycardia (mean less than 3 minutes) were seen during the time of pericardial incision due to grasping pericardium near the pherenic nerve. In three dogs, ST elevation were seen in electrocardiograph due to contact of instrument tip to myocardium these three dogs showed bradycardia

concurrently. Any dogs showed decrease in blood O2 saturation concurrently. Two dogs showed ventricular fibrillation extended less than 20 seconds during incision of pericardium. Three dogs showed decrease in blood pressure and bradycardia concurrently. Table 2 shows cardiac arrhythmia during surgery.

Table 2. Cardiac arrhythmia in dogs underwent thoracoscopic pericardiectomy.

Event	Bradycardia	ST Elevation	Cardiac Arrest	Ventricular Fibrillation	Blood pressure decrease
Number	5	3	1	2	3
%	55.55	33.33	11.11	22.22	33.33

Three dogs had short time apnea (mean less than 2 minute) at the time of placement of paraxiphoid transdiaphragmatic port placement that may attribute to diaphragmatic stimulation. No dyspnea or any complication about this port placement was detected in postoperative observations. In 21st day radiographs no abnormality detected.

Discussion

Extensive skin incision, subcutaneous tissue and muscle dissection, followed by rib retraction all contribute to the postoperative pain and morbidity associated with open thoracic procedure.[1,2] On the other hand thoracoscopy, is now popular due to the recent development of video- assisted technique. Contraindications to thoracoscopy are relatively few. In addition to general consideration, like recent myocardial infarction and severe coagulopathy, specific contraindications include pleural symphysis and inability to tolerate selective one lung ventilation.[3,6,10] McCarthy in 1990 and Walsh in1999 described partial pericardiectomy via thoracoscopy in dogs placed in lateral recumbency,but in this study dorsal recumbency selected for best visualization because the lungs fall dorsally by gravity, thereby allowing proper dissection and complete 360 degree circular incision on pericardium.[5] Although one lung ventilation provides a safe free space for manipulating instruments in thoracic cavity, selective intubation has its limitations such as decreasing tidal volume.[3,12] Usage of electrocuterry have been advised in many papers [6,7,8,10] but in this study bleeding were not so severe so we did not use electrocuterry and this experience should be noted in subtotal pericardiectomy. Ventilation and respiratory rates change due to one lung ventilation was similar to other studies reports.[7,13,14] Time of operation significantly related to surgical team experience as reported in many references.[8,10,14,15,16] Evaluating this combination of port placements design was not reported before for total pericardiectomy, Potter suggested this approach for partial pericardiectomy in 1999 but any assessment of intra operative cardio respiratory complication.[6] Dupre reported nine partial pericardiectomy with success in dogs with cardiac neoplasia with lateral thoracoscopic approach but reported some technical difficulties in pericardial grasping specially in caudomedial side of heart, there for, for total pericardiectomy a new approach seems to be designed.[12] Actually we need more and more experience and trial studies for more reliable conclusion about the technical risk factors of total pericardiectomy via thoracoscopy with trans diaphragmatic paraxiphoid approach.

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چکیده :

ارزیابی مشکلات حین جراحی پریکاردیکتومی بااستفاده از رهیافت داخل دیافراگمی به شیوه توراکوسکوپی در سگ

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هدف- ثبت رخدادهای قلبی و تنفسی حین جراحی برداشت کامل پریکارد به شیوه توراکوسکوپی با استفاده از رهیافت داخل دیافراگمی برای دوربین ونیزامکان پذیری عملی و تعیین ریسک تحریک مکانیکی عصب فرنیک.

طرح- مطالعه تجربی . ارزیابی تکنیکی

حیوانات- نه قلاده سگ نر سالم با نژاد مخلوط

روش- جراحی پریکاردیکتومی به روش توراکسکوپی بر روی نه قلاده سگ بصورت انتخابی تحت شرایط بیهوشی استنشاقی وبا شیوه یک طرفی ریه انجام شد. برای کارگذاری دوربین توراکوسکوپی از رهیافت کنار زایده خنجری – داخل دیافراگمی استفاده شد و رهیافت بین دنده ای جابی چپ برای ورود تبزارهای جراحی انتخاب شد. پارامترهای قلبی و تنفسی و نیز رخدادهای حین جراحی جهت ارزیابی خطرات و مشکلات تکنیکی ثبت شدند.

نتایج- هشت قلاده سگ مراحل جراحی را بخوبی تحمل کردند . در حین جراحی هیپوکسی خفیف ناشی از تهویه یک طرفی ریه ها ونیز برادی کاردی گذرا به همراه برخی آریتمی های قلبی حین برش پریکارد مشاهده شد.

نتیجه گیری و کاربرد بالینی- انجام پریکاردیکتومی کامل در سگ به شیوه توراکوسکوپی با کارگذاری دوربین در رهیافت داخل دیافراگمی قابل انجام است . رعایت مواردی مانند مانبتورینگ دقیق بیهوشی و بکارگیری ابزارهای اختصاصی جراحی توراکوسکوپی و نیز تجربه جراح در موفقیت این روش نقش مهمی دارند.

کلید واژگان- پریکاردیکتومی، توراکوسکوپی، رهیافت داخل دیافراگمی، عصب فرنیک.