Alternative techniques of diaphragmatic herniorrhaphy in dogs and cats

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Diaphragmatic hernia

- Diaphragmatic hernia is a condition in which the abdominal viscera enter into the thoracic cavity through the ruptured diaphragm.
Anatomy of diaphragm

- The diaphragm consists of the central tendinous portion and outer muscular portion.
- The muscular portion includes the pars lumbalis, pars costalis and pars sternalis.
- The pars costalis commonly tears.

(Bjorling and Sicard, 2004)
Anatomy of diaphragm

- The diaphragm has three openings
  - Caval foramen
  - Esophageal hiatus
  - Aortic hiatus
- The caudal phrenic artery is the main blood supply to diaphragm
- The motor innervation is provided by the phrenic nerve

(Bjorling and Sicard, 2004)
Pathogenesis

- Causes of diaphragmatic hernia
  - Trauma (85%)
    - Direct trauma from penetrating injury
    - Indirect trauma
    - Iatrogenic trauma
  - Congenital (15%)
    - Pleuroperitoneal hernia
    - Peritoneopericardial hernia
    - Hiatal hernia

(Baines, 2005)
Diaphragmatic hernia

Three types of diaphragmatic tears

- Circumferential 40%
- Radial 40%
- Combination 20%

(Bjorling and Sicard, 2004)
Diaphragmatic hernia

The herniated organs of diaphragmatic hernia

- Left side diaphragmatic hernia: Stomach, spleen, small intestine
- Right side diaphragmatic hernia: Liver, small intestine, pancreas
Diaphragmatic hernia

- Diaphragmatic hernia is common in small and young animals between 1-3 years of age (Stokhof, 1986)

- Mortality rate in dogs with acute and chronic DH were 27.8% and 26.2%, respectively

- Mortality rate in cats were 20% (acute) and 11.8% (chronic) (Worth and Machon, 2005)
The clinical signs are depended on the location of lesion and the herniated organs.

- Dyspnea is the most common clinical sign.
- Cardiac arrhythmias and shock.
- Enteric signs
  - Vomiting
  - Hematemesis
  - Diarrhea
  - Constipation

(Bojrab et al, 1997)
Diagnostic tools

- History
- Clinical signs
- Radiography
- Ultrasonography
- Positive contrast peritoneography
Treatment of diaphragmatic hernia

- Surgical treatment is necessary for resolution of signs
- The goal of herniorrhaphy is:
  - To atraumatically reduce the displaced viscera and repair the diaphragmatic defect
- Cardiovascular and pulmonary stabilization is warranted before herniorrhaphy (Bjorling and Sicard, 2004)
Surgical repair within the first 24 hrs. of trauma has the highest mortality rate (33%) (Schmiedt et al, 2003)

Emergency surgery is indicated in:
- Acute dilatation of a herniated stomach
- Strangulated intestines
- Supportive care cannot stabilize respiratory function (Bellah, 1998)
Surgical technique

- **Conventional herniorrhaphy:**
  - Anatomical reposition technique and suturing the diaphragmatic defect directly
  - Effective for small diaphragmatic defect, acute hernia or not extensively damaged diaphragm
  - Recurrence rate was 4% in dogs and 5.6% in cats (Stokhof et al., 1986) and 6.9% in dogs (วิจิตรและคณะ, 2549)
Surgical technique

- Alternative techniques of diaphragmatic herniorrhaphy
  - Artificial graft
  - Pedicle graft
  - Free graft
Surgical treatment

- Ideal material for DH repair
  - Safe
  - Promote wound healing
  - Resistance to infection
  - No restriction of chest wall development
  - No tissue reaction
  - Easy to use
  - Inexpensive
  (Sandoval et al., 2006)
Surgical technique

Alternative techniques of diaphragmatic herniorrhaphy

- Artificial graft
  - Silastic sheet (Robert, 1977)
  - Epoxy patch graft (Matsumoto et al., 1996)
  - Polylacticcoyglycolic acid (PLGA) mesh (Lally et al., 1993)
  - Polypropylene mesh (Moss et al., 1992)
  - Polytetrafluoroethylene mesh (Suzuki et al., 2002)
  - Polyethylene mesh (Nasr et al., 2009)
Surgical technique

- **Artificial graft**
  - **Advantage:**
    - Easy to use
    - Adjustable size for diaphragmatic defect
  - **Disadvantage:**
    - Weak against infection
    - Induce foreign body reactions
    - Chest wall deformities
    - Cost

(Suzuki et al., 2002; Nasr et al., 2009)
Surgical technique

- Alternative techniques of diaphragmatic herniorrhaphy
  - Free graft
    - Porcine small intestinal submucosa (PSIS)

(Sandoval et al., 2006; Andreoni and Voss, 2009; Vecchia et al., 1999)
Surgical technique

- Free graft
  - Porcine small intestinal submucosa (PSIS)
    - The patch deterioration was presented
    - The intact patch was thickened and adhered to the liver and spleen
    - Chronic inflammation with granulation tissue and calcification was observed
Surgical technique

- Free graft
  - Autologous fascia lata graft

- The maximal tensile strength at suture region was nearly the native diaphragm
- No recurrence was observed
- The fascia was covered by surrounding tissue & no inflammatory reaction

(Suzuki et al., 2002)
Surgical technique

- Pedicle graft
  - Omental pedicle flap

(Bright and Thacker, 1982)
Surgical technique

- Pedicle graft
  - Omental pedicle flap
    - At necropsy, adhesion of the omental patch to the liver was found
    - Histological examination revealed well vascularized, scar and mild inflammation
Surgical technique

- Pedicle graft
  - Autologous transverse abdominis flap

(Rosenkrantz and Cotton, 1964; Helphrey, 1982)
Pedicle graft

- **Autologous transverse abdominis flap**
  - Fluoroscopy showed no paradoxical motion of the diaphragm
  - From autopsy, minimal scarring and few adhesions was observed
  - Pressure & volume in excised lungs were in normal ranges
  - The posterior dehiscence of the suture line & esophageal hiatal hernia were presented
Surgical technique

- Pedicle graft
  - Rectus abdominis flap

![Diagram of surgical technique showing cranial and caudal epigastric arteries.](image-url)
Rectus abdominis flap

- Surgical procedure
Rectus abdominis flap

**Surgical procedure**

Chest drain was inserted through the 8th or 9th intercostal spaces, near the level of the costochondral junction.
Rectus abdominis flap

- **Surgical procedure**

![Surgical procedure images of Rectus abdominis flap](image-url)
Rectus abdominis flap

- Surgical procedure
## Data Collection and Analysis

### Evaluation vs. Postoperation

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Rectus abdominis flap

**Result**

- The use of RAPF did not cause ventral hernia.
- Diaphragmatic hernia recurrence & respiratory difficulty were not observed.
- Blood gases were in the normal range.
- Radiographic & fluoroscopic examinations revealed a normal appearance without paradoxical motion of the diaphragm.
Rectus abdominis flap

- **Gross examination**
Rectus abdominis flap

- Histopathological examination

(H&E, 4X)
Conclusion

- Use of rectus abdominis muscle flap (RAF) will be an alternative surgical treatment for diaphragmatic hernia with large or contracted defect which cannot be repaired by conventional herniorrhaphy.
- RAF has the advantages of no foreign body property and graft cost.
- It is readily obtained from the concurrent abdominal incision.
- When compared with the synthetic graft, use of the RAF for DH repair is more complicated and invasive.
References

References


References


