

## Published research

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*Bernard, F., S. T. Kudnig, et al. (2006). "Hemodynamic effects of interpleural lidocaine and bupivacaine combination in anesthetized dogs with and without an open pericardium." Vet Surg 35(3): 252-8.*

**OBJECTIVE:** To identify dysrhythmias and hemodynamic changes after lidocaine and bupivacaine infusion into the interpleural space with an open pericardium. **STUDY DESIGN:** Experimental study. **ANIMALS:** Six adult dogs. **METHODS:** Systemic arterial pressure and electrocardiogram were recorded. A 7.5 Fr Swan-Ganz catheter was advanced to the level of the main pulmonary artery to record pulmonary arterial pressure. Cardiac output was measured by a thermodilution technique. A pericardial window (PW) was performed in 3 dogs using thoracoscopy. Hemodynamic variables were recorded before and 15 minutes after injection of lidocaine (1.5 mg/kg) and bupivacaine (1.5 mg/kg) into the pleural space in the control group and in the pericardial space for the PW group. A randomized-block ANOVA for repeated measures was used to evaluate the effect of local anesthetic administration on hemodynamic and electrophysiologic variables in dogs with a pericardectomy. **RESULTS:** Each dog maintained sinus rhythm. Infusion of local anesthetic induced a significant increase in right ventricular diastolic pressure ( $P = .002$ ) and a significant decrease in stroke volume ( $P = .047$ ) in both groups; however, the effects were not significantly different between groups. **CONCLUSIONS:** Infusion of lidocaine and bupivacaine, either intrapleural or in the pericardial space, had a mild detrimental effect on cardiac output. **CLINICAL RELEVANCE:** Intrapleural administration of lidocaine and bupivacaine at a therapeutic dose can be used safely in healthy dogs with a pericardectomy.

*Kudnig, S. T., E. Monnet, et al. (2006). "Effect of positive end-expiratory pressure on oxygen delivery during 1-lung ventilation for thoracoscopy in normal dogs." Vet Surg 35(6): 534-42*

To evaluate the effect of positive end-expiratory pressure (PEEP) on oxygen delivery ( $DO(2)$ ) with 1-lung ventilation during thoracoscopy in normal anesthetized dogs. Prospective, controlled experimental study. Eight, adult, intact Walker Hound dogs weighing 25.6-29.2 kg. Anesthetized dogs had 1-lung ventilation during an open-chest condition. A Swan-Ganz catheter was used to measure pulmonary hemodynamic variables and to obtain mixed venous blood samples for blood gas analysis. A dorsal pedal catheter was used for measurement of systemic arterial pressure and to obtain arterial blood samples for blood gas analysis. Oxygen delivery was calculated and used to assess the effect of 0, 2.5, and 5 cm H<sub>2</sub>O PEEP during 1-lung ventilation on cardiopulmonary function. Each dog was its own control at 0 cm H<sub>2</sub>O PEEP. A randomized block ANOVA for repeated measures was used to evaluate the effect of the treatment on hemodynamic and pulmonary variables. Use of 5 cm H<sub>2</sub>O PEEP induced a significant augmentation in the arterial partial pressure of oxygen ( $PaO(2)$ ). Shunt fraction ( $Q(s)/Q(t)$ ), physiologic dead space ( $V(D)/V(T)$ ), and the alveolar-arterial oxygen difference ( $P(A-a)O(2)$ ) decreased significantly after 5 cm H<sub>2</sub>O PEEP, compared with 1-lung ventilation without PEEP. Use of 2.5 cm H<sub>2</sub>O PEEP had no significant effect on cardiopulmonary variables. Use of PEEP had no significant effect on arterial oxygen saturation ( $SaO(2)$ ),  $DO(2)$ , and hemodynamic variables in normal dogs. PEEP had no effect on  $DO(2)$  in

normal dogs undergoing open-chest 1-lung ventilation because it had no adverse effect on hemodynamic variables. PEEP in normal dogs during open-chest 1-lung ventilation for thoracoscopy is not detrimental to cardiac output and can be recommended in clinical patients.

*Riquelme, M., E. Monnet, S. Kudnig et al. (2005). "Cardiopulmonary changes induced during one-lung ventilation in anesthetized dogs with a closed thoracic cavity." Am J Vet Res 66(6): 973-7.*

**OBJECTIVE:** To evaluate the effects of one-lung ventilation (OLV) on oxygen delivery (DO<sub>2</sub>) in anesthetized dogs with a closed thoracic cavity. **ANIMALS:** 7 clinically normal adult Walker Hound dogs. **PROCEDURE:** Dogs were anesthetized. Catheters were inserted in a dorsal pedal artery and the pulmonary artery. Dogs were positioned in right lateral recumbency. Data were collected at baseline (Paco<sub>2</sub> of 35 to 45 mm Hg), during two-lung ventilation, and 15 minutes after creating OLV. Hemodynamic and respiratory variables were analyzed and calculations performed to obtain DO<sub>2</sub>, and values were compared among the various time points by use of an ANOVA for repeated measures. **RESULTS:** OLV induced a significant augmentation of shunt fraction that resulted in a significant reduction in Pao<sub>2</sub>, arterial oxygen saturation, and arterial oxygen content. Cardiac index was not significantly changed. The net result was that DO<sub>2</sub> was not significantly affected by OLV. **CONCLUSIONS AND CLINICAL RELEVANCE:** Use of OLV in healthy dogs does not induce significant changes in DO<sub>2</sub>, which is the ultimate variable to use when evaluating tissue oxygenation. One-lung ventilation can be initiated safely in dogs before entering the thoracic cavity during surgery. Additional studies are necessary to evaluate OLV in clinically affected patients and variations in age, body position, and type of anesthetic protocol.

*Riquelme, M., E. Monnet, S. Kudnig et al. (2005). "Cardiopulmonary effects of positive end-expiratory pressure during one-lung ventilation in anesthetized dogs with a closed thoracic cavity." Am J Vet Res 66(6): 978-83.*

**OBJECTIVE:** To evaluate the effects on oxygen delivery (DO<sub>2</sub>) of 2.5 and 5 cm H<sub>2</sub>O of positive end-expiratory pressure (PEEP) applied to the dependent lung during one-lung ventilation (OLV) in anesthetized dogs with a closed thoracic cavity. **ANIMALS:** 7 clinically normal adult Walker Hound dogs. **PROCEDURE:** Dogs were anesthetized, and catheters were inserted in a dorsal pedal artery and the pulmonary artery. Dogs were positioned in right lateral recumbency, and data were collected during OLV (baseline), after application of 2.5 cm H<sub>2</sub>O of PEEP for 15 minutes during OLV, and after application of 5 cm H<sub>2</sub>O of PEEP for 15 minutes during OLV. Hemodynamic and respiratory variables were analyzed and calculations performed to obtain DO<sub>2</sub>, and values were compared among the various time points by use of an ANOVA for repeated measures. **RESULTS:** PEEP induced a significant decrease in shunt fraction that resulted in a significant increase in arterial oxygen saturation. However, it failed to significantly affect arterial oxygen content (CaO<sub>2</sub>) or cardiac output. Thus, DO<sub>2</sub> was not affected in healthy normoxemic dogs as a net result of the application of PEEP. **CONCLUSIONS AND CLINICAL RELEVANCE:** The use of PEEP during OLV in anesthetized dogs with a closed thoracic cavity did not affect DO<sub>2</sub>. Use of PEEP during OLV in dogs with a closed thoracic cavity is recommended because it does not affect cardiac output and any gain in CaO<sub>2</sub> will be beneficial for DO<sub>2</sub> in critically ill patients.

Chandler, J. C., S. T. Kudnig, et al. (2005). "Use of laparoscopic-assisted jejunostomy for fecal diversion in the management of a rectocutaneous fistula in a dog." *J Am Vet Med Assoc* 226(5): 746-51

A 2-year-old female Siberian Husky was referred for evaluation of a rectocutaneous fistula of unknown etiology. On evaluation, a rectal tear and an associated perivulvar abscess and draining tract were identified. Several attempts were made to repair the rectocutaneous fistula and associated rectal tear. Primary repair and fascia lata graft repair failed. Successful management was achieved via a laparoscopic-assisted end-on jejunostomy for fecal diversion, and the wound healed readily by second intention. During the period of hospitalization, the dog lost a considerable amount of weight. Particular care should be taken regarding fluid therapy, administration of antimicrobials, and adequate nutrition in patients with rectocutaneous fistulas. Overall, the use of laparoscopic-assisted end-on jejunostomy for fecal diversion in the management of rectocutaneous fistulas in dogs appears to be feasible; end-on or loop jejunostomy may also be an option for the treatment of other diseases of the distal portion of the gastrointestinal tract.

Kudnig, S. T., E. Monnet, et al. (2004). "Cardiopulmonary effects of thoracoscopy in anesthetized normal dogs." *Vet Anaesth Analg* 31(2): 121-8. 1467-2987

OBJECTIVE: To evaluate the effect of an open-chest condition on oxygen delivery in anesthetized dogs. STUDY DESIGN: Prospective, controlled experimental study. ANIMALS: Eight clinically normal adult Walker Hound dogs weighing 25.6-29.2 kg. METHODS: Eight anesthetized dogs underwent an open-chest operation after the insertion of thoracoscopy cannulae in the lateral chest walls. A Swan Ganz catheter was used to both measure hemodynamic parameters and obtain mixed venous blood samples for blood gas analysis. A dorsal pedal catheter was placed to both measure arterial blood pressure and obtain blood samples for blood gas analysis. Oxygen delivery index and oxygen extraction ratio were calculated. A randomized block anova for repeated measures was used to evaluate the effect of the treatment on hemodynamic and pulmonary parameters. RESULTS: Creation of an open chest did not significantly affect oxygen delivery index (DO(2)I;  $p = 0.545$ ). It induced a significant decrease in arterial oxygen partial pressure (PaO(2);  $p = 0.018$ ) and arterial oxygen content (CaO(2);  $p = 0.025$ ). It induced a significant increase in shunt fraction ( $p = 0.023$ ), physiologic dead space ( $p = 0.015$ ), and alveolar-arterial oxygen difference ( $p = 0.019$ ). Arterial partial pressure of carbon dioxide (PaCO(2);  $p = 0.766$ ) and arterial hemoglobin oxygen saturation (SaO(2);  $p = 0.178$ ) were not significantly affected. Diastolic (DPAP;  $p = 0.050$ ) and mean (MPAP;  $p = 0.033$ ) pulmonary arterial pressures were significantly increased by opening the chest. Other hemodynamic parameters were not significantly affected. CONCLUSIONS: Opening the thoracic cavity is not detrimental to hemodynamic function and oxygen delivery in normal dogs, although impaired gas exchange does occur. CLINICAL RELEVANCE: Close monitoring of patients is recommended during open-chest thoracoscopy as adverse effects on gas exchange can contribute to hypoxemia.

Kudnig ST, Fitch RB. Trans-iliac and trans-sacral brace fixation of sacral fractures and sacroiliac luxations (7 cases). *Vet Comp Orthop Traumatol* 2004; 17: 210-215.

Fitch, R. B., T. C. Hogan, Kudnig S.T., et al. (2003). "Hematogenous septic arthritis in the dog: results of five patients treated nonsurgically with antibiotics." *J Am Anim Hosp Assoc* 39(6): 563-6.

This retrospective study evaluates the effectiveness of nonsurgical treatment using antibiotics to treat hematogenous septic arthritis in five dogs. Giant-breed dogs were over-represented, with all dogs <1 year of age. Synovial fluid cultures were positive in all cases, with common bacterial species isolated that included *Streptococcus B-haemolytic* spp., *Pasteurella multocida*, and *Staphylococcus intermedius*. Dogs treated with appropriate duration and selection of antibiotics had clinical resolution with no residual deficits. This report and a previous clinical report demonstrate that hematogenous septic arthritis can be successfully treated nonsurgically with antibiotic therapy.

Kudnig, S. T., E. Monnet, et al. (2003). "Effect of one-lung ventilation on oxygen delivery in anesthetized dogs with an open thoracic cavity." *Am J Vet Res* 64(4): 443-8.

**OBJECTIVE:** To evaluate effects of one-lung ventilation on oxygen delivery in anesthetized dogs with an open thoracic cavity. **ANIMALS:** 8 clinically normal adult Walker Hound dogs. **PROCEDURE:** Each dog was anesthetized and subjected to one-lung ventilation during a period when it had an open thoracic cavity. A Swan-Ganz catheter was used to measure hemodynamic variables and obtain mixed-venous blood samples. A catheter was inserted in the dorsal pedal artery to measure arterial pressure and obtain arterial blood samples. Oxygen delivery index was calculated and used to assess effects of one-lung ventilation on cardiopulmonary function. Effects on hemodynamic and pulmonary variables were analyzed. **RESULTS:** One-lung ventilation caused significant decreases in PaO<sub>2</sub>, arterial oxygen saturation (SaO<sub>2</sub>), mixed-venous oxygen saturation, and arterial oxygen content (CaO<sub>2</sub>). One-lung ventilation caused significant increases in PaCO<sub>2</sub>, physiologic dead space, and alveolar-arterial oxygen difference. Changes in SaO<sub>2</sub>, CaO<sub>2</sub>, and PaCO<sub>2</sub>, although significantly different, were not considered to be of clinical importance. One-lung ventilation induced a significant increase in pulmonary arterial wedge pressure, mean pulmonary artery pressure, and shunt fraction. One-lung ventilation did not have a significant effect on cardiac index, systemic vascular resistance index, pulmonary vascular resistance index, and oxygen delivery index. **CONCLUSIONS AND CLINICAL RELEVANCE:** One-lung ventilation affected gas exchange and hemodynamic function, although oxygen delivery in clinically normal dogs was not affected during a period with an open thoracic cavity. One-lung ventilation can be used safely in healthy dogs with an open thoracic cavity during surgery.

Kudnig ST, Mama K. Guidelines for perioperative fluid therapy. *Comp Contin Educ Pract Vet* 2003; 25(2): 102-111

Fluid therapy is an important component of hemodynamic stabilization, to minimize drug-exacerbated hypotension in the hypovolemic patient and to minimize anesthetic risk.

Resuscitation of the intravascular compartment is of prime importance preoperatively to improve stroke volume and cardiac output, both of which will be further suppressed by most anesthetic drugs.

Colloids can be added to the resuscitation fluids to reduce the required volume of crystalloids, to replace intravascular volume more rapidly and when decreased plasma oncotic pressure causes a rapid loss of the administered crystalloid from the intravascular compartment.

Monitoring fluid therapy is important to ensure adequate fluid replacement and oxygen delivery, to prevent overhydration/hypervolemia and to ensure that the appropriate fluid type is given to the patient.

The fluid therapy plan should be tailored to the requirements of each surgical patient and encompasses the preoperative, the intraoperative and the postoperative periods. Fluid therapy plans differ widely between compromised patients and healthy patients, and also with the nature of surgical intervention. This article provides guidelines for fluid therapy, outlines the methods for fluid administration and discusses the monitoring techniques used for blood volume replacement in the surgical patient. Specific suggestions for many different patient scenarios are also presented in tabular form.

*Kudnig, S. T. (2002). "Nasopharyngeal polyps in cats." Clin Tech Small Anim Pract 17(4): 174-7.1096-2867*

Nasopharyngeal polyps are non-neoplastic, inflammatory growths that arise from the middle ear or the eustachian tube and extend into the pharynx. The exact etiology of nasopharyngeal polyps is unclear; proposed etiologies include a response to chronic upper respiratory tract infection, chronic otitis media, ascending infection from the nasopharynx, or a congenital origin. Clinical signs usually relate to obstruction of the nasopharynx, with Horner's syndrome and head tilt being consistent with otitis media and otitis interna, respectively. Diagnostic tools include digital or visual examination above the soft palate, flexible fiberoptic caudal rhinoscopy, radiography, computed tomography, and magnetic resonance imaging. Ventral bulla osteotomy combined with traction removal of the polyp is the recommended treatment, although traction only followed by prednisolone therapy can be considered in some cases, especially when there is no evidence of otitis media.

*Kudnig, S. T. and K. Mama (2002). "Perioperative fluid therapy." J Am Vet Med Assoc 221(8): 1112-21.*

*Kudnig ST, Fitch RB, et al. (2002). "In vitro comparison of the holding power of 1.2 mm, 1.5 mm and 2.0 mm orthopaedic screws in canine radii." Vet Comp Orthop Traumatol 15: 78-84.*

The holding power of miniscrews in canine bone has not been investigated. This report compares the holding power of four different miniscrew types. The screw types tested were: 1.2 mm self-tapping screws, 1.5 mm tapped screws, 2.0 mm self-tapping screws and 2.0 mm tapped screws.

They were randomly allocated to canine radius screw sites and screw pull-out strength was determined using a Mechanical Testing System (MTS) machine. Screw pullout performed at 0.04 mm/sec.

The 1.2 mm self-tapping screw had a significantly weaker holding power than the other three screw types. Also 3 screw breakages occurred- subjectively higher insertional torque with application. Based upon these findings, the use of the 1.2 mm self-tapping screw cannot be recommended for use in thick cortical bone. There were not any significant differences in holding power of the other three screw types. The performance of the 1.5 mm tapped screws, versus the 2.0 mm tapped screws, was comparable and suggests that the 1.5 mm tapped screw can provide adequate holding power in miniscrew applications. The results were consistent with a linear relationship between the external thread diameter and the holding power.

No significant difference in holding power between 1.5mm tapped and 2.0mm tapped- may be an effect of low power but comparable pullout strength provides confidence in the 1.5mm screw application. Furthermore, reported N/mm of these screws: 1.5mm 50% of reported N/mm of 4.0mm cancellous screws and 2.0mm 60% of reported N/mm of 4.0mm cancellous screws.

*R.B. Fitch, S. Kerwin, G. Hosgood, R.D. Marquis, S.T. Kudnig. Treatment of mechanically failed triple pelvic osteotomies in four dogs- part 2. Vet Comp Orthop Traumatol 2002; 15: 172-176.*

*Monnet E, Kudnig ST. Hepatic neoplasia. In: Slatter D, Textbook of Small Animal Surgery, 3rd ed, Saunders, Philadelphia, PA, 2002, pp 2378-2382.*

*R.B. Fitch, L. Breshears, A. Staatz, S. Kudnig. Clinical evaluation of prosthetic medial glenohumeral ligament repair in the dog (ten cases). Vet Comp Orthop Traumatol 2001; 14: 222-228.*

*Kudnig, S. T. (2000). "Intra-articular replacement." Aust Vet J 78(6): 384-5.*