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Influence of pre-anaesthetic thoracic radiographs on ASA physical status classification and anaesthetic protocols in traumatized dogs and cats

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Summary

The purpose of this study was to evaluate if pre-anaesthetic thoracic radiographs contribute to the anaesthetic management of trauma patients by comparing American Society of Anesthesiologists Physical Status Classification (ASA grade) with and without information from thoracic radiography findings. Case records of 157 dogs and cats being anaesthetized with or without post-traumatic, pre-anaesthetic chest radiographs were retrospectively evaluated for clinical parameters, radiographic abnormalities and anaesthetic protocol. Animals were retrospectively assigned an ASA grade. ASA grades, clinical signs of respiratory abnormalities and anaesthesia protocols were compared between animals with and without chest radiographs. The group of animals without pre-anaesthetic radiographs was anaesthetized earlier after trauma and showed less respiratory abnormalities at presentation. The retrospectively evaluated ASA grade significantly increased with the information from thoracic radiography. Animals with a higher ASA grade were less frequently mechanically ventilated. Pre-anaesthetic radiographs may provide important information to assess the ASA grade in traumatized patients and may therefore influence the anesthesia protocol.

Keywords: chest trauma, ASA grade, anaesthesia, chest radiographs, dog, cat

Einfluss von prä-anästhetischen Thoraxröntgen auf die ASA Klassifizierung und das Anästhesie-Protokoll bei Hunden und Katzen mit Trauma

Die folgende retrospektive Studie hatte zum Ziel, den Einfluss von Thoraxröntgenbefunden auf das Anästhesieprotokoll bei Hunden und Katzen mit Trauma zu testen. 157 Katzen und Hunde mit Trauma-assozierter Anästhesie wurden untersucht. Die retrospektiv von 4 verschiedenen Personen durchgeführte ASA Klassifizierung wurde anhand der aus der Krankengeschichte vorhandenen klinischen Informationen und Laborwerten einmal mit und einmal ohne die Information der Röntgenbefunde vorgenommen. Zusätzlich wurde die retrospektiv vorgenommene ASA Klassifizierung, die klinischen Zeichen von Respirationsproblemen sowie das Anästhesieprotokoll zwischen Tieren mit und Tieren ohne Thoraxröntgen verglichen. Traumatiere ohne prä-anästhetische Thoraxröntgen wurden früher nach Trauma anästhesiert und zeigten weniger Respirationsabnormalitäten bei Präsentation. Die ASA Klassifizierung erhöhte sich signifikant unter Einbezug der Röntgenbefunde und Tiere mit einer höheren ASA Klassifizierung wurden signifikant weniger häufig mechanisch beatmet. Daraus wurde geschlossen, dass prä-anästhetische Thoraxröntgenbefunde wichtige Informationen zur ASA Klassifizierung bei Traumapatienten beitragen und dementsprechend einen Einfluss auf das Anästhesieprotokoll haben können.

Schlüsselwörter: Thoraxtrauma, Anästhesie, ASA Klassifizierung, Katze, Hund, Thoraxröntgen

Introduction

Chest injuries with or without concurrent fractures are very common abnormalities seen in veterinary trauma patients (Kolata and Johnston, 1975; Spackman et al., 1984; Gordon et al., 1993; Powell et al., 1999; Sigrist et al., 2004). Radiographic imaging plays an important role in the evaluation of human and veterinary trauma patients and thoracic radiographs are recommended in trauma patients, especially if anaesthesia is planned (Hackner, 1995; Zinck and Primack, 2000). However, the clinical usefulness of post-traumatic chest radiographs in patients

with a normal physical exam is controversial (Sigrist et al., 2004; Wisbach et al., 2007). No studies evaluating the clinical significance of pre-anaesthetic radiographs in veterinary trauma patients were found searching the literature.

The American Society of Anesthesiologists Physical Status Classification (ASA grade) is used as one of several variables determining the risk of anaesthesia and may aid in choosing the anaesthetic protocol (Keats, 1978; Hardie et al., 1995; Hosgood and Scholl, 2002). The ASA grade is an evaluation of the physical status and has been adapted for veterinary medicine (Tab. 1) (Thurmon et al., 1996). Patients with respiratory abnormalities are graded as patients with systemic disease (ASA grade III or IV). Thoracic radiographs may provide further information for more precise ASA grading and subsequently may influence the anaesthetic protocol.

The goals of this retrospective study were: 1) to compare the ASA grade and anaesthesia protocol in patients with and without post-traumatic, pre-anaesthetic chest radiographs, and 2) to investigate the association between thoracic radiography findings, ASA grading and anaesthetic technique.

Animals, Material and Methods

A computer search for Trauma was performed of the medical records of all dogs and cats presented to the Small Animal Clinic of the University of Berne, Switzerland, between September 2001 and May 2003. Only patients who underwent trauma-related anaesthesia were elected. Patients were excluded from the study if there were missing reports, if the trauma occurred more than one week prior to anaesthesia, and if treatment options were limited by financial concerns. Records were reviewed and the following data were extracted: age, sex, weight, and species (dog or cat) as well as heart rate (HR), respiratory rate (RR) and results of lung auscultation at the time of presentation. At time of the pre-anaesthetic evaluation, HR, RR, mucous membrane color, capillary refill time, heart auscultatory results, packed cell volume (PCV), total solids (TS) and albumin were extracted from the records. Patients with chest radiographs taken before anaesthesia were allocated in group RX and patients who underwent anaesthesia without pre-anaesthetic chest radiographs were allocated in group NRX. Thoracic radiography findings, time between trauma and radiographs, time between trauma and anaesthesia, anaesthetic protocol and mortality during anaesthesia were also extracted from the records.

Respiratory rate and auscultation findings

The respiratory rate at presentation and prior to anaesthesia was graded into normal (12-30 breath per minute (bpm) for dogs and 20-42 bpm for cats), moderately increased (32-56 bpm for dogs and 44-60 bpm for cats), severely increased (> 60 bpm for dogs and > 64 bpm for cats) or panting (Aldrich and Haskins, 1995). Presence of respiratory distress was also noted (including cats with open mouth breathing). Results of chest auscultation at presentation were categorized as normal, moderately or severely abnormal. Based on the initial respiratory examination findings (respiratory rate and chest auscultation findings) animals were categorized as having a „normal“ or „abnormal“ respiration. At the time of pre-anaesthetic patient evaluation, the respiratory rate was categorized as discussed above.

Thoracic radiography findings

Thoracic radiography findings were extracted from the written radiology reports. The thoracic abnormalities were categorized as normal, slight, moderate and severe as described previously (Sigrist et al., 2004).

ASA grading

Three blinded anaesthesia residents and an emergency and critical care resident reviewed all clinical information extracted from the records and retrospectively determined the ASA grade (Tab. 1) (Thurmon et al., 1996) of all patients once without and -in animals of group RX

Table 1: Classification of Physical Status (ASA grade) in animals*.

Category	physical status	Examples regarding respiration§
I	A normal healthy patient	Normal respiration
II	A patient with mild systemic disease	Tachypnea or panting without other signs of respiratory disease, Normal thoracic radiographs
III	A patient with severe systemic disease	Tachypnea and abnormal auscultation results, i.e. lung contusions Moderate radiographic abnormalities
IV	A patient with severe systemic disease that is a constant thread to life	Labored breathing, severe radiographic abnormalities
V	A moribund patient not expected to survive with or without operation	Tension pneumothorax

*Adopted by the American Society of Anesthesiologists (Thurmon 1996)

§ examples regarding the retrospective assignment of the ASA grade in this study

with the information from the radiographic report. The two retrospectively evaluated ASA grades were assessed on two different days and without the knowledge of the ASA grade evaluated on the previous day or the ASA grade the anaesthetist in charge had given. ASA grades IV and V were combined as ASA grade > III in order to increase group size.

Anaesthetic protocol

The anaesthetic technique was reviewed regarding the induction protocol, anaesthesia maintenance protocol and presence of mechanical ventilation. The induction protocol was categorized as induction without prior sedation (rapid sequence induction) or pre-medication leading to sedation followed by induction. Rapid sequence induction consisted of an opioid and a benzodiazepine followed immediately by propofol (Propofol 1%®, Fresenium Kabi) or etomidate (Etomidate-Lipuro®, Braun Medical AG). Fentanyl (Fentanyl-Janssen®, CuraMED Pharma GmbH) or methadone (MethadonStreuli®, Streuli AG) were the opioids used and diazepam (Valium®, Roche Pharma AG) or midazolam (Dormicum®, Roche Pharma AG) were the benzodiazepines used. Pre-medication consisted of different i.m. or i.v. combinations of an opioid (fentanyl or methadone) with either acepromazine (Prequillan®, FATRO S.p.A), medetomidine (Domitor®, Orion Corporation) or ketamine (Ketasol-100®, Gräub AG) followed by propofol or ketamine for induction after appropriate sedation. Maintenance of anaesthesia was classified as inhalation anaesthesia with isoflurane (Isofluran®, Abbott AG) or total intravenous anaesthesia (TIVA) with propofol or ketamine. If intubated, animals were categorized as being mechanically ventilated or spontaneously breathing. If indicated, intraoperative analgesia was achieved with either local / regional anaesthesia or fentanyl constant rate infusion. Anaesthesia time was recorded in minutes from induction to extubation.

Statistical methods

For the continuously measured variables, the median and range were reported as variables were not normally distributed. The frequency distributions of the categorical or ordinal (score) variables were derived. The association between categorical variables was evaluated using the Chi- Square test. When both variables were binary and expected cell frequencies were below 5, a two-sided Fisher's exact test was used. ASA grades prior and after radiographic evaluation were correlated using the non-parametric paired t-test. The mean ASA grade of all four observers was used for statistical analysis. All analyses were performed using the statistical software program NCSS (Number Cruncher Statistical Systems, Kaysville, Utah, USA). A value of $p < 0.05$ was considered significant.

Results

A total of 419 trauma patients were identified. Of these, 157 patients (90 cats and 67 dogs) met the inclusion criteria. Group RX consisted of 118 animals (47 dogs and 71 cats) and group NRX of 39 animals (20 dogs and 19 cats). There was no difference between groups regarding age and weight. Median age in cats was 3.1 years (range 0.2-13 years) and 4.3 years in dogs (range 0.5-14 years). Median weight in cats was 4.2 kg (range 1-7.5 kg) and 22.1 kg (range 2-72 kg) in dogs. Sixty-one percent of the animals were male whereas 39% were female.

Respiratory findings are summarized in Table 2. In the NRX group, significantly more animals showed normal auscultation findings ($p = 0.001$) and a „normal" respiration ($p = 0.007$) at presentation than the RX group, whereas the RR at presentation and prior to anaesthesia was not statistically different between groups.

In the RX group, 32 (27.4%) of the animals showed normal radiographs. Fifty-eight (49.6%) showed mild, 23 (19.7%) showed moderate and 4 (3.4%) showed severe radiographic chest abnormalities. Sixty-four of 118 (54.2%) animals showed radiographic signs of trauma on chest radiographs. All chest radiographs were taken within 100 hours (h) after trauma (median 20.3 h).

Results regarding anaesthesia are summarized in Table 3. Median time to anaesthesia was 37.8 h (range 3-160 h), with a median of 40.6 hours (range 4-160 h) in the RX group and 29.6 hours (range 3-120 h) in the NRX group. The difference between the two groups was not statistically different ($p = 0.06$). Median anaesthesia time was 145.5 minutes (range 15-410 minutes) with no statistically significant difference between the two groups. In both groups, the anaesthesia induction protocol was significantly associated with the ASA grade ($p = 0.03$). Animals with higher ASA grades were more often anaesthetized by rapid-sequence induction. The ASA grade without thoracic radiography findings was associated with the induction protocol ($p = 0.02$), but not with anaesthetic maintenance, ventilation mode, clinical respiratory findings at presentation, the respiratory rate prior to anaesthesia or the time between trauma and anaesthesia. After the information of radiographic findings was included in the ASA grading, the ASA grade was significantly associated with the induction protocol ($p = 0.02$), as well as the ventilation mode ($p = 0.04$), with more animals with a higher ASA grade not being ventilated. Animals with an ASA grade ≥ III were significantly less frequently mechanically ventilated (only 23 of 73 animals) whereas 17 of 38 animals with an ASA grade < III were mechanically ventilated ($p = 0.02$).

There was a significant association between the professional level of the anaesthetist and the induction protocol ($p = 0.05$). Emergency clinicians (interns and residents of different professional levels) preferred rapid-sequence induction in 9 of 10 animals, whereas anaesthesia residents had equal number in both induction protocols. No sig-

Table 2: Frequencies of the levels of categorical variables of animals with blunt trauma regarding clinical respiratory findings at presentation and prior to anesthesia.

	Total		Group RX (n = 118)		Group NRX (n = 39)	
	n	%	n	%	n	%
RR at presentation						
normal	55	35.48	39	33.33	16	42.11
abnormal	100	64.52	78	66.66	22	57.89
Moderate increase	45	29.03	34	29.06	11	28.95
Severe increase	29	18.71	25	21.37	4	10.53
Panting	26	16.77	19	16.24	7	18.42
Total§	155		117		38	
Respiratory distress	15	9.55	13	11.02	2	5.13
Auscultation*						
normal	90	57.32	58	49.15	32	82.05
abnormal	67	42.68	60	50.85	7	17.95
Moderately abnormal	51	32.48	45	38.14	6	15.38
Severely abnormal	16	10.19	15	12.71	1	2.56
Total	157		118		39	
Respiration at presentation*‖						
normal	43	27.74	26	22.22	17	44.74
abnormal	112	72.26	91	77.78	21	55.26
Total§	155		117		38	
RR prior to anesthesia						
normal	28	18.54	20	17.54	8	21.62
abnormal	123	81.46	94	82.46	29	78.38
Moderate increase	60	39.74	47	41.23	13	35.14
Severe increase	34	22.52	27	23.68	7	18.92
Panting	29	19.21	20	17.54	9	24.32
Total§	151		114		37	

Group RX: animals with pre-anesthetic thoracic radiographs, group NRX: animals without pre-anesthetic thoracic radiographs
RR: respiratory rate
*significantly different between groups ($p < 0.05$)
§ missing animals due to incomplete data
‖ respiratory rate and auscultation findings combined as Respiration

Table 3: Frequencies of the levels of categorical variables of animals with blunt trauma regarding anesthesia.

	Total		Group RX		Group NRX	
	n	%	n	%	n	%
Induction						
Rapid-sequence	72	45.86	54	45.76	18	46.15
Premedication‖	85	54.14	64	54.24	21	53.85
Total	157		118		39	
Anesthesia						
Inhalation	142	90.45	107	90.68	35	89.74
TIVA	15	9.55	11	9.32	4	10.26
Total	157		118		39	
Mechanical ventilation						
Not ventilated	92	60.53	69	61.06	23	58.97
Ventilated❡	60	39.47	44	38.94	16	41.03
Total§	152		113		39	

Group RX: animals with pre-anesthetic chest radiographs, group NRX: animals without pre-anesthetic chest radiographs.
TIVA: total intravenous anesthesia
§ missing animals due to incomplete data
‖ pre-medication leading to sedation followed by standard induction
❡ ventilation either pressure or volume controlled, as ventilation mode was not available for all 60 ventilated animals

nificant association between the anaesthetist and anaesthetic maintenance and mechanical ventilation protocol could be detected.

The ASA grade prior to chest radiographs was significantly associated with thoracic radiography findings ($p = 0.001$). However, clinical signs of respiratory abnormalities were not associated with the ASA grade. Time to radiography was not associated with the ASA grade. Time between trauma and anaesthesia was significantly associated with the ASA grade before radiographs ($p = 0.02$) as well as with the ASA grade after radiographs ($p = 0.04$). The ASA grade increased significantly ($p< 0.001$) after including the information from the chest radiographs. Twenty-one animals (17.8%) were assigned a lower (range 0.25 - 0.5), 42 animals (35.6%) the same and 55 animals (46.6%) a higher ASA grade (range 0.25 - 1.5). All four observers ranked the patients into a significantly higher ASA grade (range 0.08, 0.17, 0.18 and 0.23 points, respectively) after including the information provided by the chest radiographs.

Animals with an „abnormal“ respiration at presentation were significantly more likely to have radiographs taken before anaesthesia ($p = 0.01$). Twenty-one animals with an „abnormal“ respiration at presentation were anaesthetized without radiographs. Otherwise, no significantly different variables could be detected between animals with a „normal“ and animals with an „abnormal“ respiration.

Three cats died or were euthanized due to anaesthetic complications during anaesthesia. All three animals had pre-anaesthetic radiographs taken and showed chest abnormalities (one animal each with mild, moderate and severe chest abnormalities). The ASA grade was changed in only one of the three animals from 2.5 to 3 after the findings of the radiographic examination were included.

Discussion

Veterinary trauma patients have a high prevalence of thoracic trauma and chest radiographs have been recommended, as abnormalities seen on radiographs may influence time until anaesthesia, anaesthetic technique and mortality (Cuvelliez, 1995; Martin, 1996; Powell et al., 1999). In this study, the group that had chest radiographs taken showed more respiratory abnormalities at presentation. Human patients with predisposing clinical abnormalities, an incomplete case history, clinical signs of respiratory diseases, and an ASA grade > III may benefit from pre-anaesthetic chest radiographs (Tape and Mushlin, 1988; Escolano et al., 1994; Bouillot et al., 1996). Pre-anaesthetic chest radiographs proved to be useful in 15.5% of human patients with an ASA grade of III-V but not in patients with ASA grades I and II (Perez et al., 1995; Silvestri et al., 1999). On the other hand, a thorough clinical examination might be as informative as a radiographic evaluation (Sigrist et al., 2004). Also, a negative chest radiograph result does not significantly reduce the probability of chest complications and may be falsely reassuring (Tape and Mushlin, 1988).

Twenty-eight percent of the animals showed a normal respiration at presentation. In the NRX group, normal auscultation results were significantly more frequent than in the RX group, whereas there was no difference between RR at presentation or prior to anaesthesia. The clinically normal respiration might have been the reason for the clinician and the anaesthetist not to request a pre-anaesthetic radiograph. Animals in the NRX group were anaesthetized earlier after trauma than animals which had chest radiographs taken. This might be explained by the milder clinical signs as well. It was not possible to evaluate how many patients had surgery postponed due to radiographic chest abnormalities.

Evaluation of the patient prior to anaesthesia using the American Society of Anesthesiologists (ASA) physical status classification may influence the chosen anaesthetic technique. The ASA grade mainly depends on the severity of systemic disease and is commonly used to determine the clinical part of the evaluation of anaesthetic risk. There are other factors such as species, breed and temperament, as well as surgical factors that influence the risk of anaesthesia (Hardie et al., 1995; Hall et al., 2001). The ASA grading system has limitations. It depends on clinical signs which are subjective, as well as on available diagnostic tests. If the patient does not show clinical signs of disease and has no additional diagnostic tests performed, the ASA grade may be falsely low.

In the present study, none of the evaluated clinical respiratory parameters were significantly associated with the ASA grade. However, the pre-radiography ASA grade was significantly associated with the radiographic findings. This suggests that other factors than respiratory rate and auscultation results must have influenced the ASA grading in the same direction than the findings of the chest radiographs. On the other hand, the information provided by thoracic radiographs significantly increased the ASA grade. Most of the changes were seen between ASA grades II and III, i.e. animals with an ASA grade of II changed to ASA grade III after the information provided from the chest radiographs was included into the ASA grading. In the present study, the clinical evaluation of the respiratory system was not associated with the post-radiographic ASA grade, which underlines the importance of additional parameters influencing the ASA grade. Pre-anaesthetic chest radiographs might therefore provide valuable information completing clinical findings for determination of the ASA grade.

Thoracic trauma may lead to lung injuries as well as cardiovascular abnormalities and this should be considered in the anaesthetic management (Cuvelliez, 1995). In the present study, various anaesthetic protocols were used. Even though the choice of anaesthetic drugs may be influenced by preferences of the anaesthetist in charge, the induction and ventilation mode is mostly influenced by

the clinical findings and additional information regarding the patient and therefore the ASA grade. Only rapid sequence induction and pre-medication/induction protocols were therefore differentiated. The most frequent chest abnormalities in blunt trauma patients are pulmonary contusions followed by pneumothorax or pneumomediastinum (Tamas et al., 1984; Powell et al., 1999; Sigrist et al., 2004). Insufficient monitoring and an unrecognized or untreated respiratory depression seem to be the most common reasons for anaesthetic death in veterinary medicine (Alef and Oechtering, 1998). Differentiation of lung contusions and pneumothorax/pneumomediastinum as well as diaphragmatic hernia might be important because anaesthetic management, especially the intra-anaesthetic ventilation strategy, may be changed accordingly. For instance, a mild pneumothorax or traumatic bullae may progress under positive pressure ventilation and lead to severe respiratory distress, necessitating immediate thoracocentesis or emergency thoracotomy (Berkel, 1968; MacKenzie and Patterson, 1971; Ibrahim et al., 1999). In this study, animals with higher ASA grades were significantly more often anaesthetized with a rapid-sequence induction protocol. Animals with an ASA grade ≥ 3 were less frequently mechanically ventilated than animals with a lower ASA grade. Since after radiographic evaluation many animals change their ASA status from II to III, the anaesthetic protocol in these patients may change as well. Anaesthetist preferences cannot be excluded, however, most animals were anaesthetized by anaesthesia residents or diplomates with the same background and the ventilation mode was not influenced by the professional level of the anaesthetist. Emergency clinicians preferred rapid-sequence induction which probably reflects the consensus that in animals with trauma-related respiratory impairment a fast anaesthetic induction is chosen in order to obtain rapid control of the airway and animals should be endotracheally intubated and receive 100% oxygen regardless of the choice of maintenance protocol (Cuvelliez, 1995; Perkowski, 2000). When discussing anaesthetic risk, every trauma patient should be evaluated individually and other parameters such as peri-anaesthetic stabilization and monitoring during anaesthesia should be considered. Extensive peri-operative monitoring might decrease the need for pre-anaesthetic radiographs, but radiographic findings may also direct the extent of monitoring devices used peri-operatively (Alef and Oechtering, 1998).

The major limitation of the study is its retrospective manner. Due to inconsistent information regarding pre-anaesthetic auscultation results, only pre-anaesthetic respiratory rate but not overall respiration could be compared to the ASA grade. A prospective study would further be necessary to assess the influence of other factors such as the importance of the anaesthetic technique and monitoring during anaesthesia as well as influence on morbidity and mortality.

Conclusion

Pre-anaesthetic radiographs provide important information regarding anaesthesia management of trauma patients. In this study, additional findings from chest radiographs seem to be superior to clinical evaluation alone. Adaptation of the ASA grade after consideration of radiographic findings might change the anaesthetic protocol, since rapid sequence induction is more often used in traumatized animals with respiratory problems and patients with high ASA grades are less frequently mechanically ventilated. However, every trauma patient undergoing anaesthesia should be evaluated individually and other parameters such as peri-anaesthetic stabilization and monitoring during anaesthesia should be considered as well.

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Influence des radiographies thoraciques pré-anesthésiques sur la classification ASA et le protocole d'anesthésie des chiens et chats souffrant d'un traumatisme

La présente étude rétrospective avait pour but de tester l'influence des constatations faites sur des radiographies thoraciques quant au protocole d'anesthésie de chiens et chats souffrant d'un traumatisme. 157 chats et chiens ayant subit une anesthésie associées à un traumatisme ont été examinés. La classification ASA établie rétrospectivement par 4 personnes différentes à été effectuée sur la base des informations cliniques

Influenza prima di un'anestesia di una radiografia toracica per la classificazione ASA e protocollo di anestesia nei cani e gatti vittime di trauma

Questo studio retrospettivo ha lo scopo di controllare l'influenza di un'indagine radiologica dei torace sul protocollo di anestesia nei cani e gatti vittime di trauma. Sono stati esaminati 157 gatti e cani con anestesia associata ad un trauma. La classificazione ASA eseguita retrospettivamente da 4 persone diverse è stata effettuata sulla base delle informazioni cliniche e i valori di laboratorio ricavati dall'anamnesi, una volta

provenant du dossier ainsi que des valeurs de laboratoire, une fois avec et une fois sans les informations issues des radiographies. En outre, la classification ASA faite rétrospectivement ainsi que les signes cliniques de problème respiratoires et le protocole d'anesthésie ont été comparés entre les animaux avec et sans radiographies thoraciques. Les animaux traumatisées non radiographiés ont été anesthésiés plus rapidement après l'accident et ils montraient moins de troubles respiratoires lors de leur présentations. La classification ASA augmentaient de façon significative lorsqu'on tenait compte des résultats radiologiques et les animaux avec une classification plus élevée ont significativement moins souvent été ventilé mécaniquement. On peut en conclure que la radiographie thoracique préanesthésique peut apporter des informations importantes en vue de la classification ASA et donc avoir une influence sur le protocole d'anesthésie.

con le informazioni dell'indagine radiologica un'altra senza quest'ultima. Inoltre la classificazione ASA eseguita in retrospettiva è stata paragonata ai segni clinici di problemi respiratori e dei protocollo di anestesia tra animali con radiografia al torace o senza radiografia. In passato gli animali vittime di trauma venivano anestetizzati sempre prima della radiografia al torace e mostravano alla presentazione meno anormalità respiratorie. Con l'inclusione dell'indagine respiratoria, la classificazione ASA sí incrementò significativamente e gli animali con un alto valore ASA venivano sottoposti meno spesso a respirazione meccanica. Perciò si concluse che l'indagine radiologica dei torace prima dell'anestesia portava informazioni importanti per la classificazione ASA in pazienti vìttime di trauma e quindi comporta un'influenza dei protocollo di anestesia..

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