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ATTEMPT TO USE THE ANAESTHETIC CONSERVING DEVICE AS A NEW METHOD OF ADMINISTRATING INHALATION ANAESTHETICS IN DOGS (3 CASES).

Abstract

We report the first clinical application of the anaesthetic conserving device (AnaConDa) in dogs. Anaesthetic conserving device presents new method of administration the inhalative anaesthetics. Observation was performed on three dogs. The goal of our study was to establish the minimal dose of isoflurane (ml/kg/h), needed for keeping the dog under general anaesthesia. Furthermore we tried to compare the classical machine for inhalation anaesthesia with the anaesthetic conserving device. We evaluated the time, needed for changing the end-tidal isoflurane concentration in relation with infusion rate on the syringe pump, the effectiveness of AnaConDa in gass recirculation aspect and the patient recovery time.

Key words: *inhalation anaesthesia, dog, isoflurane, anaesthetic conserving device*

Introduction

In 2004 a new device was develop and introduce for intensive care units patients (5). It's called, because of it's unique properties the "Anaesthetic conserving device". It represents a new system of administrating inhalation anaestetics. The goal for the producer, which for sure has been achieved, was simplifying work with patients in intensive care units. In order to understand the objective to create such a device we need to imagine what work in ICU looks like and what the problems associated with anaestesia in this kind of patients are.

In ICU there are unique patients, who need very specific care. They are people with serious respiratory problems and cardiac or neurological disorders. They need to be under deep sedation or even anaesthesia for a long period of time. Up to 2004 such treatment was possible only by using intavenous anaesthetic drugs or a big, immobile anaesthetic machine. Both solutions are far from ideal. The use of an inhalation machine is expensiveand inconvenient and it is possible only in a surgery room. One the other hand recent years investigations bring knowledge and make us more aware of the side effects of using intravenous drugs. In 1992 Parke et all described for the first time the "propofol infusion syndrome PRIS", which occurred in children who were treated in intensive care units and received long continuous infusion of propofol (>48hours) in high doses (>4mg/kg) (1). The characteristic symptoms of this syndrome, very often fatal in their results, were: rhabdomyolysis, acute metabolic acidosis, cardial and renal dissfunction. Besides, cardio-, reno- and neuroprotective properties of inhalation anaestetics, which have been proven well

recently, are very desired for ICU patients (2). Those were two main incentives for creation the anaesthetic conserving device. They combine many useful properties like small, mobile, economic and its enable to use inhalative anaesthetics without an anaesthetic machine.

Anaesthetic conserving device - construction and mechanism of action

AnaConDa was used for the first time in clinical practice by Enlund and his co-workers in 2001 (1). One year later Sackey proved his usefulness to intensive care unit patients (5).

Its small vaporizer, which most frequently is located between Y element and andotracheal tube.

AnaConDa consist of the following:

a) Heat and moisture exchanger, which reduce the heat and water loss and create proper thermal conditions for exchanging anaesthetic drug from liquid state to gaseous state - this is done at the evaporation rod level.
b) Activated carbon lipofilic filter- the device's very important part, responsible for absorbing, storing and subsequently releasing inhalation gas.
c) Waste materials absorbing filter,
d) Evaporation rod.

Anaestetic (Isofluran or sevofluran) in liquid state is administrated to a miniature vaporizer (AnaConDa) through a tube from a specially calibrated syringe pump. While refilling the syringe we should avoid air bubbles getting inside, as otherwise the risk of overdosing increases. Storing of the anaestetics at room temperature decreases such a risk. The minimal volume of inhalation drug needed for filling the system is 1.2 ml. When the first value is screened on a gas monitor, we can start adjusting the anaesthetic dose in the syringe pump (ml/kg/h) to the desired level of sedation. During inspiration, gas is being released from the evaporation rod and transported to the respiratory tract of the patient. The expiratory fraction goes through two filters located inside AnaConDa. One of them purifies the air, the other (activated carbon filter) absorbs, stores and releases the gas during a following breath. In this way anaestetic gas undergoes recirculation in 90%. This fact offers at least three advantages: decreases consumption of anaestetic, reduces the costs and atmospheric pollution (3). The manufacturer recommends that AnaConDa should be used for administrating isoflurane or sevoflurane only. It is not recommended for desflurane. Besides, it must be used with a ventilator, a syringe pump, an anaesthetic gas monitor and a gas scavenging system. It's worth mentioning that dead space of this device reaches 100 ml, which makes it unsuitable for pediatric patients. We didn't use it on dogs whose weight is smaller than 20 kg. It's a disposable device, and for hygienic reasons it should be exchanged when used for 24 hours The beneficial fact is that AnaConDA doesn't need any CO2 absorbent, which helps avoid accumulation of highly nefrotoxic A compound .

Task, the aim of the article.

According to our knowledge, English and Polish literature, AnaConDa has been studied and described only in humans and swines (5, 6, 7) We wish to present

the results of the first trial of AnaConDa in dogs. The main objectives of our study were as follows:

- to establish an isoflurane dose, essential for maintaining general anaesthesia and a surgical tolerance,
- to establish the time that is needed for changing the expiratory isoflurane concentration in relation with the isoflurane infusion rate set on syringe pump,
- to confirm the effectiveness of AnaConDa in gas recirculation,
- and to verify if a simple inhalation anaesthetic machine can be replaced by the anaesthetic conserving device.

Materials and methods

At this moment our research is based on a small group of three clinical patients. Based on the history, the clinical status of every dog and its morphological and biochemical blood examination, the patients were classified to ASA second grade. (table 1, 2).

Table. 1

Anamnesis	Dog nr 1	Dog nr 2	Dog nr 3
Breed	American Staffordshire Terrier	Polish lowland sheepdog	German Shepherd Dog
Age	9,5	7	7
Gender	Male	female	Female
Weigh	41	23,5	35
ASA Classification	II	II	II
Type of surgical procedure.	Anterior cruciate ligament reconstruction	Anterior cruciate ligament reconstruction	metatarsal fistula.
Dose of medetomidine	1,6ml	0,94ml	1,4 ml
Dose of propofol	4,1ml	2,4ml	3,5ml
Dose of lignocaine administrated to the epidural space	5ml	4ml	5ml

Dogs received medetomidine (Domitor) intramuscularly in the dose of 0.04 mg/kg. Because the entire surgical procedure was associated with hindlimbs, analgesia in this region was achieved by epidural administration of lignocaine.
Anasestesia was inducted with propofol in a very low dose of 1mg/kg. The first15 minutes of propofol operation were used for conecting AnaConDa to the breathing circuit, pre-filling the system and adjusting the infusion rate to a desired end-tidal isofluran concentration. We used a pressure controlled ventilator, which was set to 18-20cm H_20 inspiration flow, 12 respiratory rates, and 2:1 inspiratory-respiratory ratio. We measured gas concentration on two sampling ports: one was located at the

endotracheal tube level (in the pre-AnaConDa region), the other at the Y element level (the post-AnaConDa region).

Table.2

Results of preoperative clinical examination and biochemiacal and morfological blood examination

Parametrs	Dog 1	Dog 2	Dog 3
HR beats/min	**80**	**68**	**87**
RR breaths/min	**10**	**47**	**12**
CMM	**pink**	**pink**	**Pink**
CRT	**< 2**	**< 2**	**< 2**
Temperature	**38,9**	**38,5**	**38,3**
Leu. (m/mm^3)	**7,16**	**9,60**	**12,47**
Lim. (%)	**19,9**	**25,6**	**20,3**
Mon. (%)	**2,5**	**2,8**	**3,3**
Gra. (%)	**77,6**	**71,6**	**76,4**
Ery. (M/mm^3)	**6,89**	**7,17**	**7,64**
Ht (%)	**50,2**	**52,6**	**55,0**
MCHC (g/dl)	**31,8**	**32,3**	**31,6**
RDW (g/dl)	**9,1**	**9,4**	**9,6**
Hb (g/dl)	**16,0**	**17,0**	**17,4**
Tro (m/mm^3)	**363**	**267**	**200**
ALP (U/l)	**123,2**	**161,2**	**100,1**
Urea (mg/dl)	**40,29**	**34,7**	**29,67**
AST (U/L)	**38,53**	**21,33**	**30,58**
ALT (U/L)	**41**	**33**	**38**
Creatynine(mg/dl)	**1,319**	**1,279**	**1,351**
Glucose (mg/dl)	**90,23**	**97,99**	**79,53**
Albumins (g/dl)	**3,647**	**3,320**	**2,937**

This was essential for establishing the effectiveness of the device in the aspect of gas re-circulation. Two sampling ports were connected to different gas monitors (5330 Agent Monitor OHMEDA, Capnoagent V9400). We collected the following data: systolic arterial pressure (SBP), diastolic arterial pressure (DAP), mean arterial pressure (MAP), heart rate (HR), respiratory rate (RR), blood oxygenation (SpO2), end-tidal carbon dioxide concentration (ET CO2), isofluran infusion rate (IIR),

expiratory isofluran concentration on the first(Exp Izo 1) and second port (Exp Izo 2). Arterial pressure was measured with the oscillometric method. Besides, we evaluated the anaesthesia level according to Guedel. classification and observed the electrocardiogram curve. Data was collected every 0 2, 4, 8, 10,15, 20, 25, 30, 35, 40, 45, 50, 55 and 60 minutes.

At the beginning of the surgery, the infusion rate of isoflurane was set to 0.2 ml/kg/h, and when the last sutures were applied, we decreased the infusion rate to 1ml/h and observed how the sedation level was changing.

During our EKG-based observations, we tried to evaluate the relation between isoflurane administration and heart action and we mostly focussed on its cardioprotective properties. The dogs were under continuous observation over the entire postoperative period, and in the meantime extubation time was measured.

Results of researches

Table. 3 Dog nr 1

Intraoperative parameters collection	**0**	**2**	**4**	**8**	**10**	**15**	**20**	**25**	**30**	**35**	**40**	**45**	**50**	**55**	**60**
(IRI) ml/h	0	8	8	8	5	5	5	5	3	3	3	3	3	not	not
Exp ISO ETT (%)	0	0,90	1,19	1,55	1,43	0,94	0,89	1,15	1,13	1,12	1,10	0,93	0,92	0,84	0,68
EXP Iso Y (%)	0	0,2	0,8	0,7	0,5	0,4	0,4	0,5	0,5	0,4	0,4	0,4	0,4	0,3	0,3
ET CO2 (mm Hg)	45	44	44	44	44	43	43	43	43	43	43	44	43	42	42
SpO2 (%)	98	98	98	97	98	99	99	99	99	98	98	98	99	98	98
HR (beats/min)	90	87	85	90	96	107	100	96	90	100	106	108	107	79	75
RR (Breaths/min)	11	11	11	11	12	12	12	12	12	12	12	12	12	12	12
SAP (mm Hg)	137	138	139	134	136	132	131	133	121	124	120	116	114	120	116
DAP (mm Hg)	116	102	104	105	100	101	101	98	96	94	90	86	87	89	90
MAP (mm Hg)	84	95	89	90	90	84	86	84	79	77	76	74	69	75	80
Sedation level	2/III	2/III	2/III	2/III	2/III	2/III	2/III	2/III	2/III	2/III	2/III	2/III	2/III	2/III	2/III

CIC - 4,1 ml, Extubation time – 30 min after AnaConDa disconnection.

IRI - Infusion rate of Isofluran on the syringe pump, Exp ISO ETT – end-tidal isoflurane concentration sampling at the endotracheal tube level, EXP Iso Y – end-tidal isoflurane concentration, sampling at the Y piece level, ET CO2 – end-tidal carbon dioxide concentration, SpO2 – blood oxygenation, SAP, DAP, MAP –systolic, diastolic, mean arterial pressure, CIC - complet isoflurane consumption.

Table. 4 Dog nr 2

Intraoperative parameters collection	**0**	**2**	**4**	**8**	**10**	**15**	**20**	**25**	**30**	**35**	**40**	**45**	**50**	**55**	**60**
(IRI) ml/h	0	4	4	4	4	4	4	4	4	4	4	1	1	1	1
Exp ISO ETT (%)	0	1,78	1,24	1,21	1,15	1,15	1,17	1,20	1,25	1,37	1,50	1,07	0,92	0,81	0,77
EXP Iso Y (%)	0	0,6	0,6	0,6	0,7	0,8	0,8	0,8	0,8	0,7	0,7	0,6	0,5	0,4	0,3
ET CO2 (mm Hg)	45	45	42	42	38	35	36	35	35	35	35	35	35	35	35
SpO2 (%)	96	94	94	94	94	93	94	95	94	94	93	94	94	94	94
HR (beats/min)	99	98	97	83	83	107	105	99	100	101	87	80	74	71	65
RR (Breaths/min)	9	11	11	11	11	11	11	11	11	11	11	11	11	11	11
SAP (mm Hg)	131	141	139	139	142	144	141	136	136	140	136	129	132	126	125
DAP (mm Hg)	107	115	115	117	118	117	117	114	115	113	112	107	108	107	99
MAP (mm Hg)	94	105	105	107	108	109	108	102	103	102	102	99	98	97	89
Sedation level	2/III	2/III	2/III	2/III	2/III	2/III	2/III	2/III	2/III	2/III	2/III	2/III	2/III	2/III	2/III

CIC - 3 ml, Extubation time – 10 min after AnaConDa disconnection.

Table. 5 Dog nr 3

Intraoperative parameters collection	**0**	**2**	**4**	**8**	**10**	**15**	**20**	**25**	**30**	**35**	**40**	**45**	**50**	**55**	**60**
(IRI) ml/h	0	7	7	7	7	3,5	3,5	3,5	3,5	3,5	3,5	1	1	1	1
Exp ISO ETT (%)	0	Not	1,40	1,46	1,56	1,23	1,15	1,11	1,09	1,07	1,05	0,85	0,7	0,6	057
EXP Iso Y (%)	0	Not	0,4	0,4	0,4	0,3	0,3	0,2	0,2	0,2	0,2	0,2	0,2	0,1	0,1
ET CO2 (mm Hg)	39	39	40	42	43	41	42	43	43	45	45	46	46	47	47
SpO2 (%)	94	94	95	95	96	95	95	94	94	93	93	94	94	93	93
HR (beats/min)	85	84	82	82	81	75	74	70	69	67	66	68	65	70	76
RR (Breaths/min)	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
SAP (mm Hg)	126	152	145	155	151	149	154	150	149	140	139	144	143	135	149
DAP (mm Hg)	112	110	120	116	118	121	119	119	121	116	113	110	112	115	114
MAP (mm Hg)	103	105	109	105	108	101	113	109	105	109	109	98	97	98	98
Sedation level	2/III	2/III	2/III	2/III	2/III	2/III	2/III	2/III	2/III	2/III	2/III	2/III	2/III	2/III	2/III

CIC - 3 ml

Extubation time – 10 min after AnaConDa disconnection

Conclusions

All the results and are presented in tables. One of our aims was to establish the isoflurane dose that is needed for maintaining the general anaestesia. The dose of 0.2 ml/kg/h meets this criteria, although we discovered that in this kind of anaestesia model (medetomidine, propofol, epidural injection of lidocaine) the dose of 0.1 ml/kg/g is also is sufficient. Another conclusion is that a 40 minutes' observation period is insufficient to stabilise the end-tidal isofluran concentration in relation to

infusion rate. In comparison with the inhalation anaesthetic machine, AnaConDa is less flexible in the dose determination aspect and a longer period of time is required to adjust an anaesthetic dose to the desired anaesthesia level. After AnaConDa has been disconnected, , arytmias appeared in two out of three dogs, which may indicate that isoflurane has got some cardioprotective properties.

More studies in this area are required to confirm our results. There is no doubts that AnaConDa is a useful device, which can be considered as an alternative to the inhalation machine. If it were possible to use it only to achieve mean sedation, which was our second target, the device could be an irreplaceable system for veterinary intensive care patients, who for the safety reason should be kept under sedation for a longer period of time. Hypothetically to this kind of patients could belongs: dogs after complicated cardiothoracic surgeries, animals with upper airway obstruction or subjected to a procedure in laryngeal area, after which a great risk of oedema and subsequent respiratory disfunction occurs or neurological , epileptic or posttraumatic patients.

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