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REVIEW OF THE EFFECT OF PULMONARY VENTILATION ON THE BLOOD FLOW VELOCITY OF ABDOMINAL AORTA AT THE TIME OF INHALATIONAL ANESTHESIA WITH THE ISOFLURANE GAS IN DOGS

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ABSTRACT

Echocardiography is one of the branches of the diagnosis imaging science in which the size of heart chambers, the shape of valves and the blood flow velocity in the valves and other vessels can be assessed. Today, the science of surgery is one of the important sciences in treating various sicknesses; a requirement for many of these surgeries is anesthesia for it to be painless. One of the most important anesthesia medicines is Isoflurane which has been prescribed for inhalational anesthesia with a specific dose. Before the induction of anesthesia, the animals were clinically treated and they were treated with electrocardiographic treatment so that we would be sure of the health of their heart. Then the velocity of the blood flow of pulmonary artery was measured through echocardiography with MHZ 2.5-5 transistor. After the induction of anesthesia and connection to the Isoflurane gas, the effect of pulmonary ventilation through ventilator on the maximum of the blood flow velocity was assessed through Doppler echocardiography in the pulmonary artery. Ten dogs were divided into two groups of five dogs and their blood flow velocity was measured with/without a ventilator at the times of 0, 15, 30, 45 and 60 minutes. After gathering the data and statistically analyzing it, it was specified that the velocity of the blood flow in the pulmonary artery significantly increases when ventilator is used in comparison with the times when it is done without pulmonary ventilation.

Transmission of more oxygen to the trachea leads to an increase of the pulmonary ventilation and consequently, it increases the hematopoiesis of lungs through increasing the velocity of

blood flow of the right ventricle and, subsequent to it, the pulmonary artery. A significant increase of the blood flow velocity with pulmonary ventilation, in this study, will be very effective and useful regarding decision makings about patients who suffer from respiratory failure at the time of anesthesia or before it and also in patients in whom more blood flow to the lungs will have dangerous consequences due to pulmonary edema.

Keywords: Echocardiography, Isoflurane, Ventilation, Abdominal Aorta, Dog

INTRODUCTION

Echocardiography is a safe, non-aggressive, available and accurate method of cardiovascular assessment. Measuring the maximum of blood flow velocity is a useful method for treating these structures. The natural indexes in healthy animals, such as maximum of blood flow velocity in various vessels, the size of heart chambers at the time of systole and diastole, the diameter of the free wall of the left ventricle and the diameter of the wall between the ventricles at the time of systole and diastole in animals, have been recorded and specified as the reference indexes. Therefore, after measuring the mentioned rates and comparing them with the natural mode, the cardiovascular consequences will be specified. In this study, all of the animals were treated with echocardiography before the prescription of anesthesia so that the change in the maximum of the blood flow velocity in a natural and healthy animal would be assessed.

As we know, the inhalational anesthesia medicines are widely used for anesthesia in humans and animals. Anesthesia medicines generally have suppressing effects on the cardiovascular system which can have negative effects on the organs of the body in lengthy surgeries. Reviewing the performance of the cardiovascular system during the time of anesthesia is crucially important. This issue becomes more significant when the patient suffers from cardio failure or when a lengthy surgery is being operated on elder people and the staff of the operation room is present in the operation room for a long time or constantly. One of the most important vital arteries of the body is abdominal aorta and it flows blood to several organs of the body. A defect in the function of this vital artery leads to harmful damages in the body.

MATERIALS AND METHOD

In this research, a number of ten dogs were kept in the hospital of the faculty for two weeks before the implementation of the

project after it was made sure that they are physically healthy and their parasites were eliminated. At the day of research, firstly, they were anesthetized with Ketamine 5% with a dose of 0.1 mg/kg and then, after induction and intubation, they were put under the anesthesia device with Isoflurane 5.1%. Then, the anesthesia continues by using a ventilator with the speed of two times of pure oxygen in one minute for five dogs and for the other five, it continues without the ventilation. In order to do the echocardiography, the BKMedical device and multi-frequency transistor with a frequency of 5.5 to 7 Hz made in Netherland have been used. The velocity of blood flow in the artery of abdominal aorta was measured by using the pulse Doppler echocardiography at the times of 0, 15, 30 and 45 minutes after anesthesia and the obtained data were statistically analyzed by using the statistical test.

RESULT

Table 1: the standard deviation and mean of the scores of the descriptive items, the scores of the blood flow velocity of the abdominal aorta artery, testees in two control and experimental groups and 5 stages of measurement have been shown in table 1.

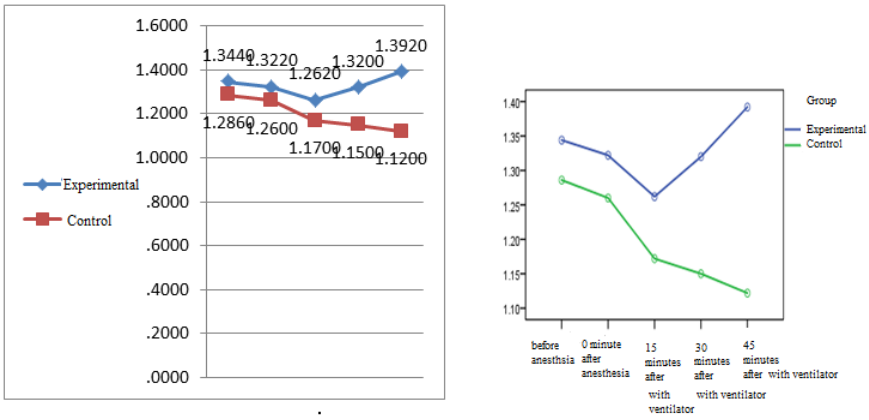
Table 1: table of data in two control and experimental groups

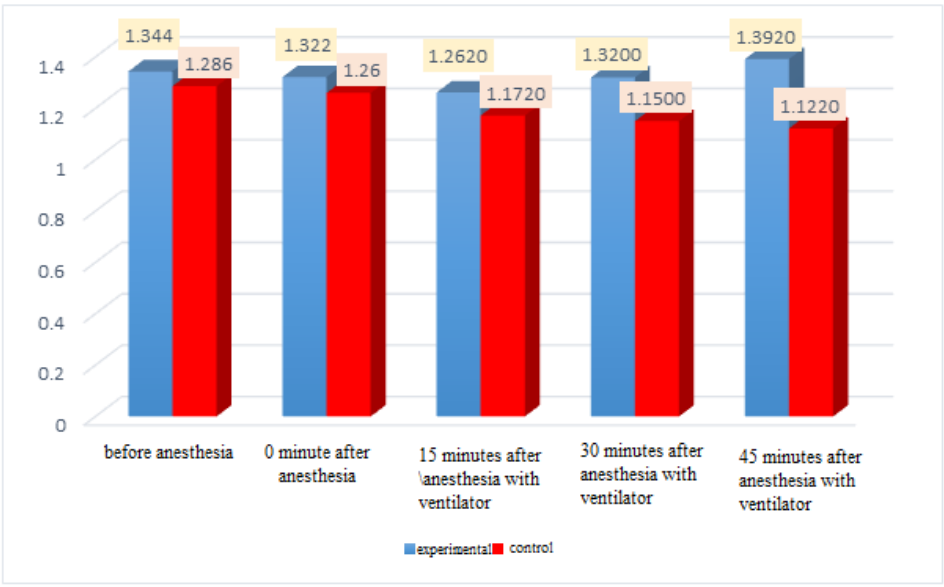
Row	Group	Before anesthesia	0 minute after anesthesia	15 minutes after anesthesia	30 minutes after anesthesia	45 minutes after anesthesia	15 minutes after anesthesia with ventilator	30 minutes after anesthesia with ventilator	45 minutes after anesthesia with ventilator
1	experiment	1/46	1/44	1/4	1/38	1/3	1/32	1/39	1/45
2	Experiment	1/32	1/3	1/25	1/22	½	1/23	1/27	1/32
3	Experiment	1/2	1/19	1/17	1/17	1/15	1/15	1/16	1/19
4	Experiment	1/7	1/66	1/65	1/63	1/59	1/61	1/68	1/7
5	Experiment	1/04	1/02	1/02	1/02	0/99	1	1/1	1/3
6	Control	0/98	0/96	0/93	0/95	0/95	0/93	0/9	0/87
7	Control	1/13	1/1	1/08	1/08	1/05	1/02	1/01	0/99
8	Control	1/52	1/5	1/5	1/45	1/38	1/35	1/32	1/29
9	Control	1/68	1/65	1/65	1/6	1/58	1/55	1/53	1/5
10	Control	1/12	1/09	1/09	1/08	1/05	1/01	0/99	0/96

Table 2: mean and standard deviation of the scores of the numbers obtained from the blood flow velocity of abdominal aorta in two experimental and control group in five stages of measurement

	Group	Before anesthesia		0 minute after anesthesia		15 minutes after anesthesia		30 minutes after anesthesia		45 minutes after anesthesia	
		M	SD	M	SD	M	SD	M	SD	M	SD
Blood flow velocity of pulmonary artery	Experimental	1.3440	0.25195	1.3220	0.24356	1.2980	0.23994	1.2840	0.23223	1.2460	0.22255
	Control	1.2860	0.29813	1.2600	0.29757	1.2500	0.30798	1.2320	0.27779	1.2020	0.26659

Table 3: linear graph obtained from the velocity of the blood flow of abdominal aorta in two experimental and control groups





Graph 1: column graph obtained from the velocity of the blood flow of abdominal aorta in two experimental and control groups

The rate of blood flow velocity of pulmonary artery has had a considerable reduction from the stage before anesthesia onwards in the two groups. In order to analyze the data, firstly, the Levene's test has been used for reviewing the homogeneity of the variances. As it can be seen in table 2, the P-value for the dependent variable is more than 0.05 in the measurement stages which means that P is not significant. Therefore, the assumption of the homogeneity of the variances has not been violated and we shall seek the further analyses which have been provided in table 2.

Table 4 shows the results of the Levene's test regarding the rate of blood flow velocity of the abdominal aorta in various stages of measurement.

Table 4: the results of the Levene's test regarding the rate of blood flow velocity of the abdominal aorta in various stages of measurement

Blood flow velocity of the pulmonary artery				
Time of measurement	F	df1	df2	Sig
Before anesthesia	0.673	1	8	0.436
0 minute after anesthesia	0.900	1	8	0.370
15 minutes after anesthesia	1.151	1	8	0.315
30 minutes after anesthesia	0.711	1	8	0.424
45 minutes after anesthesia	0.737	1	8	0.416

The results of the combined variance analysis test for reviewing the primary effect of time and the effect of interaction on the variable of the velocity of flow have been provided in table 5. As seen, the Wilk's Lambada value for the primary effect of measurement of the velocity of flow is equal to 0.003 which is less than the P-value (0.05) and it can be concluded that the effect of time is statistically significant; which means that there has been a significant change in the rate of the velocity of flow in testees in various intervals.

Table 5 shows the results of the combined variance analysis test for reviewing the primary effect of time and the effect of interaction on the variable of the blood flow velocity of the abdominal aorta.

Table 5: the results of the combined variance analysis test for reviewing the primary effect of time and the effect of interaction on the variable of the blood flow velocity of the abdominal aorta

Blood flow velocity of pulmonary artery	Effect	Value	F	Sig	ETA
	The effect of the time of measurement (Lambada Value)	0.058	20.124	0.003	0.942
	The effect of the interaction of time and group (Lambada Value)	0.777	0.359	0.829	0.223

In order to evaluate the effect of the independent variable on the testees of the control and experimental group, the intergroup effects test has been used. The results of the combined variance analysis test for reviewing the intergroup effects on the rate of blood flow velocity of the abdominal aorta have been provided in table. Since the F-value for the blood flow velocity of the abdominal aorta is equal to 0.099 which is more than the corresponding value of P in a 0.05 level; therefore, it can be concluded that no significant difference has been seen in terms of blood flow velocity of the abdominal aorta of the testees and it has had similar effects on the blood flow velocity of the abdominal aorta in control and experimental groups.

Table 6 shows a summary of the results of the combined variance analysis test in comparison with the interfering methods for the blood flow velocity of the abdominal aorta.

Table 6: a summary of the results of the combined variance analysis test in comparison with the interfering methods for the blood flow velocity of the abdominal aorta

Source	SS	df	ms	F	p	Eta
Group	0.035	1	0.035	0.099	0.761	0.012
Error	2.803	8	0.35			

Table 7 shows the mean and standard deviation of the scores of the descriptive items, the scores of the blood flow velocity of the abdominal aorta with a ventilator, testees in two experimental and control groups and five stages of measurement.

Table 8: the mean and standard deviation of the scores of the descriptive items, the scores of the blood flow velocity of the abdominal aorta with a ventilator, testees in two experimental and control groups and five stages of measurement.

	Group	Before anesthesia		0 minute after anesthesia		15 minutes after anesthesia		30 minutes after anesthesia		45 minutes after anesthesia	
		M	SD	M	SD	M	SD	M	SD	M	SD
Blood flow velocity of abdominal aorta with a ventilator	Experimental	0.25195	1.344	0.24356	1.322	0.22731	1.2620	0.22967	1.3200	0.19537	1.3920

	Group	Before anesthesia		0 minute after anesthesia		15 minutes after anesthesia		30 minutes after anesthesia		45 minutes after anesthesia	
		M	SD	M	SD	M	SD	M	SD	M	SD
Blood flow velocity of abdominal aorta without a ventilator	Control	0.29813	1.286	0.29757	1.26	0.26574	1.1720	0.26505	1.1500	0.26376	1.1220

As it is seen, the rates of the blood flow velocity of the abdominal aorta with ventilator have had a considerable reduction from the stage before anesthesia onwards in both groups. In order to analyze the data, firstly, the Levene's test has been used for reviewing the homogeneity of the variances. As it can be seen in table 6, the P-value for the dependent variable is more than 0.05 in the measurement stages which means that P is not significant. Therefore, the assumption of the homogeneity of the variances has not been violated and we shall seek the further analyses.

Table 3-9 shows the results of the Levene's test regarding the rate of blood flow velocity of the abdominal aorta with ventilator in various stages of measurement.

Table 9: the results of the Levene's test regarding the rate of blood flow velocity of the abdominal aorta with ventilator in various stages of measurement

Blood flow velocity of the pulmonary artery				
Time of measurement	F	df1	df2	Sig
Before anesthesia	0.673	1	8	0.436
0 minute after anesthesia	0.9	1	8	0.37
15 minutes after anesthesia with ventilator	0.655	1	8	0.442
30 minutes after anesthesiawith ventilator	0.451	1	8	0.521
45 minutes after anesthesiawith ventilator	1.215	1	8	0.302

The results of the combined variance analysis test for reviewing the primary effect of time and the effect of interaction on the variable of the velocity of flow with ventilator have been provided in table 5. As seen, the Wilk's Lambada value for the primary effect of measurement of the velocity of flow is equal to 0.003 which is

less than the P-value (0.05) and it can be concluded that the effect of time is statistically significant; which means that there has been a significant change in the rate of the velocity of flow in testees in various intervals.

Table 3-10 shows the results of the combined variance analysis test for reviewing the primary effect of time and the effect of interaction on the variable of the blood flow velocity of the abdominal aorta with ventilator.

Table 10: the results of the combined variance analysis test for reviewing the primary effect of time and the effect of interaction on the variable of the blood flow velocity of the abdominal aorta with ventilator

Blood flow velocity of pulmonary artery	Effect	Value	F	Sig	ETA
	The effect of the time of measurement (Lambada Value)	0.016	76.475[a]	0	0.984
	The effect of the interaction of time and group (Lambada Value)	0.062	18.830[a]	0.003	0.938

In order to evaluate the effect of the independent variable on the testees of the control and experimental group, the intergroup effects test has been used. The results of the combined variance analysis test for reviewing the intergroup effects on the rate of blood flow velocity of the abdominal aorta with ventilator have been provided in table 8. Since the F-value for the blood flow velocity of the abdominal aorta is equal to 0.066 which is more than the corresponding value of P in a 0.05 level; therefore, it can be concluded that no significant difference has been seen in terms of blood flow velocity of the abdominal aorta with ventilator of the testees and it has had similar effects on the blood flow velocity of the abdominal aorta with ventilator in control and experimental groups.

Table 11 shows a summary of the results of the combined variance analysis test in comparison with the interfering methods for the blood flow velocity of the abdominal aorta with ventilator.

Table 11: a summary of the results of the combined variance analysis test in comparison with the interfering methods for the blood flow velocity of the abdominal aorta with ventilator

Source	SS	df	Ms	F	p	Eta
Group	0.211	1	0.211	0.660	0.440	0.076
Error	2.561	8	0.320			

DISCUSSION AND CONCLUSION

Anesthesia medicines generally have suppressing effects on the cardiovascular system which can have negative effects on the organs of the body in lengthy surgeries. In 2011, Alphos, *et al.* reported that the blood pressure reduces after injecting Ketamine. Dehghan, *et al.*, in 2015, reported that the

blood flow velocity of the pulmonary artery and aorta reduces after the Acetylpromazine medicine is prescribed. In this study, it was specified that at the times of 15, 30 and 45 minutes after anesthesia without ventilator, the blood flow velocity reduces which means that pulmonary ventilation and exchange of oxygen and CO_2 occur less frequently; but after using a ventilator, at the time of 30 and 45 minutes after anesthesia, the velocity of pulmonary blood flow increases which indicates that the gas exchange between blood and air sacs in the lungs has increases at the time of using the ventilator of the anesthesia device.

In operating surgery on small animals, especially in places other than hospitals which are equipped with veterinary equipment such as farms and small clinics, it is not possible to anesthetize animals with inhalational anesthesia and also to use ventilators. In this study, it was attempted to assess the velocity of pulmonary blood flow for pulmonary ventilation. After a statistical analysis, it was specified that the blood flow velocity increased after the pulmonary ventilation. Of course, in the initial steps of the research, due to the effect of Isoflurane, the blood flow velocity slightly reduced which seems logical because most of the anesthesia medicines – whether injected or inhaled – have suppressing effects on the cardio and respiratory systems. In a similar study done by Dehghan, *et al*. in 2015, it was specified that after injecting acperomazine, the blood flow velocity was significantly reduced in pulmonary artery and aorta. Also Alphos reported the reduction of blood pressure after the injection of Ketamine in 2011; when the pulmonary ventilation was done by tracheal tube and oxygen.

After 30 minutes from the beginning of the research, the blood flow velocity slowly increases in the pulmonary artery. The location of measuring the velocity was the pulmonary valve of the pulmonary artery which is indicative of the output of the right ventricle. An increase of the blood supplied to the lungs is more due to the presence of more oxygen in the air sacs and on the other hand, the increase of the hematopoiesis of the capillary retinal surrounding the air sacs resulting in more and better pulmonary – blood ventilation.

Most sedative, narcotic, and anesthesia medicines lead to the slowness of the respiratory movements. Using pulmonary ventilation and entrance of oxygen is mostly a respiratory risk in the patients which reduces the effects of the sedative, narcotic, and anesthesia medicines. In surgeries that consume more time than others, predicting

the pulmonary ventilation device seems crucially; because the increase in the duration of anesthesia at the time of prescribing the anesthesia medicine is mostly for the patient not to be in pain and an increase of the rate of the medicine in blood can more have suppressing effects on the respiratory organ. Given the fact that the effects of the pulmonary ventilation on the increase of the blood flow velocity of the pulmonary artery have been proved; thus using pulmonary ventilation in lengthy surgeries will be very helpful.

Also patients whose respiratory system has been damaged due to various infectious, metabolic, parasitic, edema and hemorrhage reasons, can face various problems in simple surgeries and even when the patient needs a pain killer; therefore pulmonary ventilation will be very helpful in these patients in quick and outpatient surgeries.

One of the sicknesses which can trouble dogs is dirofilariaimmitis. This parasite lives in the right ventricle – pulmonary artery and pulmonary vessels and can cause the pulmonary vessels to be deformed and rotated. Using pulmonary ventilation in such patients can increase the velocity of blood flow at the time of surgery and reduce the problems caused by the parasite in flowing blood to the lungs to some extent.

Echocardiography is a safe, non-aggressive, available and accurate method of cardiovascular assessment. Measuring the maximum of blood flow velocity is a useful method for treating these structures. The natural indexes in healthy animals, such as maximum of blood flow velocity in various vessels, the size of heart chambers at the time of systole and diastole, the diameter of the free wall of the left ventricle and the diameter of the wall between the ventricles at the time of systole and diastole in animals, have been recorded and specified as the reference indexes. Therefore, after measuring the mentioned rates and comparing them with the natural mode, the cardiovascular consequences will be specified. In this study, all of the animals were treated with echocardiography before the prescription of anesthesia so that the change in the maximum of the blood flow velocity in a natural and healthy animal would be assessed.

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