RESEARCH ARTICLE

Comparison the Effects of Different Temperatures on the Core Temperature and the Concentrations of Lactate in Patients Who Were Candidate for Posterior Spine Fusion Surgery Under General Intravenous Anesthesia

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Background: Long surgery causes hypothermia and increased bleeding and can increase the arterial blood lactate levels during anesthesia. It causes cellular hypoxia and its complications. Considering the core temperature of the patient during surgery it can prevent hypoxia. This study aimed to compare the effects of different temperatures on the core temperature and the concentrations of lactate in patients who were candidate for posterior spine fusion surgery under general intravenous anesthesia.

Methods: In this clinical trial study, 60 patients with ASA II risk undergoing spine fusion surgery referred to Rasoul Akram hospital from 2015 were studied. Patients were divided in two groups of receiving temperature of 36 ° and 40 ° C during operation. Demographic data as well as information before anesthesia, after surgery, as well as recovery was gathered in the check list. Data then were entered to the statistical software SPSS v. 16 and analyzed.

Results: The mean age of patients was 49.14 (SD= 12.97) years. Pre-operation O2 Saturation had significant difference between the two groups (p value = 0.015). Trend of Hb, HCT, HR, SBP, O2 Sat, operating room temperature, pH, arterial HCO3, arterial O2 pressure, arterial blood lactate, degree of arterial blood saturation and arterial access base in 36ºC group (p value <0.05). Trend of Hb, HCT, HR, SBP, O2 Sat, operating room temperature, pH, HCO3 level of arterial pressure, arterial O2, arterial CO2 pressure, degree of saturation of arterial blood and arterial access was statistically significant in 40ºC group (p value <0.05).

Conclusion: In bleeding and low blood pressure and hypothermia, the level of serum lactate is more than 3.5 meq/L, which is caused by cellular hypoxia. In our study in two temperatures during operation lactate level was low because of longer time of operation that shows loss of hypoxia and high level of consciousness and less complication. Also time of waking up was more rapid. So as lactate level was low, prophylaxis of hypoxia is more.

Keywords: hypothermia; hypoxia; blood lactate arterial; intravenous anesthesia; posterior spine fusion

Core body temperature less than 35°C is called hypothermia, which is one of the most important problems of patients after surgery in the recovery. In the cold, metabolism is reduced, and a small amount of oxygen is needed, so that, for every 7°C, temperature reduction of 50% and at 23°C, the need to 25% oxygen, will be normal rate [1].

Most chemical processes of the body, in normal body temperature, especially the nervous system will be impaired simply by altering the abnormal temperature. Extreme temperature changes enter the permanent damage to the cells [2].

Patients who are under monitoring of lung and heart, hypothermia prevents tissue damage, but extreme temperature changes cause failure of self-regulation system of the brain, and brain blood flow dependents on device perfusion [3]. Intentional reduction in body temperature, before removing the patient from cardiopulmonary machine is continued, then, reheating is started, so that, in the end, cardiopulmonary bypass of core body temperature of most patients reaches to normal level. However, there is peripheral vasoconstriction and environmental hypothermia after surgery. In the early hours after surgery, blood moves to the environmental tissues, and by expanding the blood, peripheral artery quickly spread to the center, resulting in core body temperature drop a few degrees after surgery [4].

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Unintentional loss of body temperature before surgery, about 2 degrees Celsius, is widely seen heavy during surgery. The reduction of moderate temperature is associated with numerous metabolic complications suddenly after surgery such as a chill, which is responsible for raising sympathoadrenal and increasing need to oxygen [5-6]. The cascade of events could lead to create wider myocardial ischemia that in some cases have also been reported [7]. Hypothermia during long surgical procedures, more than three hours, causes cellular hypoxia and anaerobic metabolism and an increase in arterial blood serum lactate. It seems that, there are hypothermia complications before surgery until immediately after surgery with impairment of operation until the dysfunction of immune function [8], and increases the risk of wound infection [9] and breaking muscle proteins. One way to prevent is the use of heating patients during surgery [10]. Local anesthetic agents lead to relieve post-operative pain, and reduce the exaggerated response of the metabolic and endocrine related to surgery [11], and causes peripheral vascular vasodilatation [12]. Epidural block is responsible for reducing core temperatures and heat distribution from the center to the surface, and there is interference between it and temperature sensors in the muscles and skin [13]. Epidural block is created with anesthetic agents before surgery and aimed to weaken metabolic response as much as the average Hypothermia, which causes significant suppression in the concentration of plasma catecholamines and changes in the oxygen consumption [5,14].

Hypothermia has many benefits and applications and the prevention and treatment of ischemic syndromes is considered as its biggest benefit. On the other hand, if cooling and heating of the patient is not done with care, complications of this technique may appear more severe [15]. If hypothermia after surgery is not diagnosed and not treated quickly, it can cause a threatening complications, the most important ones are: increased mortality after surgery resulting in a heart-stopping, and ventricular fibrillation, conduction disturbances, and heart rhythm, increased blood pressure, weakened central nervous system, coagulopathy, metabolic acidosis and decrease in serum potassium [16].

Given that a large number of patients each day are undergoing different surgeries and general anesthesia, cause hypothermia that increase serum lactate level and its effects, we decided to carry out this study aimed to evaluate and compare the effects of different temperatures of heating on the core temperature, and the serum level of lactate in patients undergoing intravenous anesthesia, and in the posterior spine fusion surgery, in Rasoul Akram Hospital, Iran University of Medical Sciences.

Methods

In this study, which was conducted as clinical trial, 60 patients with the risk of ASA I, II were studied, they were candidate for spine fusion surgery and referred to Rasoul Akram Hospital. Iran University of Medical Sciences from 2016 and received heater temperature during surgery in the two different groups at 36 ° and 40 ° C.

Patients with ischemic heart, diabetes disease, old age, blood pressure, kidney infections, sepsis and coagulation disorders under anticoagulant therapy were excluded from the sample. Patients after preparation with establishment of intravenous cannulation, and Arterial line and pulse oximetry and electrocardiography and foley's catheter, and measuring the temperature of the operating room with the preparation of body temperature esophageal to monitoring device and Non-invasive blood pressure, was performed. Anesthesia was begun with with 3 micro-kg fentanyl, and midazolam 0.04 micrograms per kilogram, with induction of thiopental 5 mg kg, and 0.3 mg kg of cisatracurium, as well as maintenance of anesthesia with propofol 100 micrograms per kilogram per minute, and cis-atracurium 0.03 mg per kg of every 45 minutes, and remifentanil 0.1 micrograms per kilogram per minute, and a gas mixture of oxygen, nitrous oxide and with a share of oxygen 55 percent with analyzer gas of anesthesia machine. Starting and finishing received temperature by patients during reducing core temperatures has been less than 36 degrees and is continued up to 37 degrees.

The gathered data were analyzed by SPSS V22. First, the normality of quantitative variables was assessed based on Kolmogorov-Smirnov test. Therefore, to compare quantitative variables, independent-samples T test or U_Mann-whithney test was used and to compare qualitative variables, chi-square test was used. $p<0.05$ was considered significant.

Results

There was no significant difference between age, BMI, sex and ASA two groups ($P>0.05$) (Table 1).

There was no significant difference between BS, NA, K, BUN, Cr, PLT, Time of Prothrombin and INR in two groups ($P>0.05$) (Table 2).

There was no significant difference between time of extubation, full wake-up time, recovery time, rate of discharge, bloodshed, volume of fluid intake, inhaled gas and amount of blood transfusion in the two groups ($P>0.05$) (Table 3).

In the heating temperature of 36 degrees, the trend of Hb, Hct, HR, RR, SBP and O2 Sat were statistically significant ($P<0.05$). In the heating temperature of 40 degrees, the trend of Hb, Hct, HR, RR, SBP and O2 Sat were statistically significant ($P<0.05$) (Table 4).

In the heating temperature of 36 degrees, the trend of temperature of operating room was statistically significant ($P<0.05$). In the heating temperature of 40 degrees, the trend of temperature of operating room was statistically significant ($P<0.05$) (Table 5).

In the heating temperature of 36 degrees, the trend of pH, the arterial HCO3, pressure of arterial O2, pressure of arterial CO2, arterial lactate, degree of arterial saturated blood, the arterial access open and end-tidal CO2 were statistically significant ($P<0.05$). In the heating temperature of 40 degrees, the trend of PH, the arterial HCO3, pressure of arterial O2, pressure of arterial CO2, arterial lactate, degree of arterial saturated blood, the arterial access open and end-tidal CO2 were statistically significant ($P<0.05$) (Table 6).

Table 1- Comparison of Age, BMI, Sex and ASA between two Group

Variable	Group 36ºC	Group 40ºC	p-value
Age (year) Mean±SD	51.54±10.97	46.56±14.56	0.1
BMI (kg/m2) Mean±SD	28.85±2.39	24.86±2.53	0.1
Sex			
Male	10 (33.3%)	12 (40%)	0.59
Female	20 (66.7%)	18 (60%)	
ASA			
I	6 (20%)	7 (23.3%)	0.75
II	24 (80%)	23 (76.7%)	

Table 2- Comparison of Laboratory results between two Group

Variable	Group 36 ºC Mean±SD	Group 40 ºC Mean±SD	p-value
BS	101.23±15.53	98.96±13.71	0.55
Na	138.53±2.56	139.63±2.28	0.085
K	3.85±0.35	3.76±0.57	0.45
BUN	13.8±3.23	13.63±3.78	0.85
Cr	0.94±0.12	0.95±0.18	0.97
PLT	271933.3±66121.5	251033.3±58796.8	0.20
Time of Prothrombin	12.21±1.24	12.41±0.81	0.44
INR	1.04±0.047	1.04±0.057	0.93

Table 3- Comparison of variables of recovery between two Group

Variable	Group 36 ºC Mean±SD	Group 40 ºC Mean±SD	p-value
Time extubation	5.45±1.99	5.88±1.82	0.39
Full wake-up time	5.76±1.76	5.99±1.82	0.62
Recovery time	40.7±11.28	41.66±9.67	0.72
Rate of discharge	9.96±0.18	10±0	0.32
Bloodshed	950±485.3	970±511.69	0.87
Volume of fluid intake	5.04±0.93	5.3±0.96	0.28
Inhaled gas	40.53±3.71	39.33±3.65	0.21
Amount of blood transfusion	1.9±1.44	1.9±1.15	1

Table 4- Comparison of vital signs between two Group

Variable	Group	Time: Preoperative	Onset	Anesthetic	Rrecovery	p-value
Hb	36 ºC	13.85±1.54	12.75±2.21	11.43±1.69	12.86±1.51	<0.05
	40 ºC	13.7±1.6	12±1.86	11.04±1.67	12.29±1.41	
Hct	36 ºC	41.72±4.49	39.13±6.01		38.88±4.47	<0.05
	40 ºC	40.94±4.91	36.6±5.3		37.17±4.4	
HR	36 ºC	79.16±11.97	76.63±10.99	77.33±10.35	84.83±6.85	<0.05
	40 ºC	77.43±9.1	72.66±9.87	74.96±10.12	80.36±10.51	
RR	36 ºC	12±0				<0.05
	40 ºC	12±0				
SBP	36 ºC	101.14±21.41	79.6±6.47	77.53±6.48	91.1±10.23	<0.05
	40 ºC	105.56±8.43	79.46±6.67	79.23±7.5	90.6±7.52	
O2 Sat	36 ºC	94.7±0.87	100±0	100±0	98.7±1.29	<0.05
	40 ºC	95.36±1.15	99.83±0.64	99.93±0.36	99.03±1.12	

Table 5- Comparison of vital signs between two Group

Variable	Group	Time: Preoperative	Onset	Anesthetic	Rrecovery	p-value
Temperature of Core body	36 ºC	36.14±1.06	36.02±0.68	36.31±0.33	36.42±0.29	<0.05
	40 ºC	35.9±0.85	36.25±1.29	36.42±0.32	36.46±0.29	
Temperature of Operating room	36 ºC	23.21±0.74	23.14±0.61	23.21±0.67	26.42±0.43	>0.05
	40 ºC	22.9±0.63	22.99±0.57	23.13±0.6	26.54±0.47	
Time of released heated to patient	36 ºC		4.33±5.1	3.54±1.53		>0.05
	40 ºC		3.21±1.15	3.31±1.15		
Amount of urine	36 ºC			1471.66±649.89	1398.33±543.69	>0.05
	40 ºC			1410±785.47	1533.33±817.09	

Table 6- Comparison of Blood Gases between two Group

Variable	Group	Time Preoperative	Anesthetic	Rrecovery	p-value
PH	36 °C	7.45±0.044		7.38±0.049	<0.05
	40 °C	7.45±0.05		7.38±0.07	
Arterial HCO3	36 °C	23.19±2.45		20.32±4.47	<0.05
	40 °C	22.33±1.96		20.48±1.78	
Pressure of arterial CO2	36 °C	33.7±5.51		33.73±7.52	<0.05
	40 °C	31.6±3.86		35.7±5.97	
Pressure of arterial O2	36 °C	254.53±59.3		156.83±56.2	<0.05
	40 °C	271.01±72.83		176±65.64	
Arterial lactate	36 °C	1.1±0.54	1.88±1.84	1.97±1.41	<0.05
	40 °C	1.22±1.13	1.25±0.61	1.67±1.18	
Degree of arterial saturated blood	36 °C	99.8±0.66		98.33±1.42	<0.05
	40 °C	99.86±0.57		98.66±1.37	
Arterial access open	36 °C	0.3±2.81		-3.96±2.57	<0.05
	40 °C	-0.88±2.43		-4.01±3	
End-tidal CO2	36 °C	28.23±3.32	28.63±3.48		<0.05
	40 °C	27.96±3.44	28.59±4.47		

Discussion

This study was carried out aimed to evaluate and compare the effects of different temperatures levels of the heater on core temperature and the concentrations of lactate in patients undergoing intravenous anesthesia and posterolateral spine fusion surgery. General anesthesia is associated with a uniform distribution of heat in the body, and reduces core body temperature which depends on the minimum material used for anesthesia [17].

Most chemical processes of the body, especially the nervous system is impaired simply by altering the abnormal temperature [2]. The incidence of hypothermia, in addition to surgery after anesthesia is common, and it is because of preventing body heat regulation system activity associated with heat dissipation from the skin due to exposure to cold in the operating room. Thermoregulator system dysfunction is created by induction. Complications of hypothermia include shivering, blood coagulation disorders, and decreased resistance to surgery infections [18].

Body temperature during surgery, before removing the patient from cardiopulmonary machine decreases intentionally, and then reheating starts, so that, at the end of cardiopulmonary bypass core temperature is normal for most patients [4]. Unintentional loss of body temperature by about 2 degrees Celsius since before the surgery is commonly seen during heavy surgical procedures [5-6]. Hypothermia during long surgical procedures causes cellular hypoxia and anaerobic metabolism, resulting in increased serum lactate and arterial blood [8] and wound infection [9] and enhance breaking muscle proteins [10].

In hypoxia, carbohydrates are metabolized through aerobic and anaerobic metabolism to carbon dioxide and water. Pyruvate is formed of glycolysis anaerobic glucose, and amino acid metabolism and fatty acid. Pyruvate which is normally present in small quantities in the blood indicates the rapid metabolism of acetyl-CoA through aerobic metabolism of pyruvate to lactate via the citric acid cycle or converted under the effect of reducing nucleotide adenine diphosphate and lactate dehydrogenase. Increased production of pyruvate and lactate production again increased its consumption through aerobic metabolism. Both mechanisms of cellular hypoxia caused increased lactate production [19-20].

Three diagnosis are raised in chronic metabolic acidosis: 1. Lactic acidosis, 2. Secondary diabetic ketoacidosis and 3. Hunger and acute renal failure

Lactic acidosis is created when production of lactate in the body exceeds the capacity of the liver to eliminate it. The problem is overproduction and inadequate disposal.

Lactic acid is one of the components of the glucose metabolism physiologically. Production of pyruvate is catalyzed by lactate dehydrogenase. Under normal conditions, the ratio of lactate to Pyruvate is less than 1: 20. In anaerobic conditions, for example, after extreme sports, the lactate levels are increased dramatically. In addition, lactate can also be produced under aerobic conditions [21].

Serum lactate and arterial pH can be measured in ill patients. Lactate concentrations greater than 2 mEq/L are high clinically significantly and the level of 5 mEq/L in the presence of metabolic acidosis is considered as severe mode. Isolated hypernatremia in the absence of acidosis is also one of the important and unclear clinical symptoms. Two types of lactic acids are known. Type A, in Hypovolemic or shock resulting from loss of fluids and type B is seen despite normal oxygenation and suitable tissue perfusion.

Conclusion

In terms of bleeding and low blood pressure and hypothermia, according to Miller's algorithm in 2015, the amount of serum lactate is more than 3.5 m Equivalent/liter, which is caused by cellular hypoxia, which in our study in two auxiliary temperature levels during surgery lactate level has been low due to long time, and indicates a lack of hypoxia and high level of consciousness and without complication after surgery and fast wake-up time.

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