

Vital Signs Changes in Post-Operative Corrective Surgery for Cyanotic and Noncyanotic Congenital Heart Diseases

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Background: Post open cardiac surgery is associated with rises in fever, blood pressure and heart rate. The objective of the present study was to determine the changes in temperature, blood pressure and heart rate in first week after open cardiac surgery of non-complicated cyanotic and noncyanotic congenital heart diseases.

Patients and Methods: Temperature, blood pressure and heart rate were obtained from 100 patients with different congenital heart disease after open cardiac surgery. The patients divided in two groups, 40 cyanotic CHD and 60 noncyanotic CHD.

Result: Half of patients had fever in first day after surgery. Cyanotic patients became afebrile earlier than non-cyanotic group. Cyanotic patients had higher heart rate and lower blood pressure than noncyanotic group.

Conclusion: The study suggests that post open heart surgery body temperature, blood pressure and heart rate are different in patients with cyanotic and non cyanotic congenital heart diseases.

Keywords: Temperature, Blood Pressure, Heart Rate, Heart Disease

Introduction

Postoperative fever is one of the most common problems seen by both surgeons and medical consultants. Most cases of fever are self-limiting, but it is critical not to miss more serious etiologies.¹ Although postoperative fever is common after cardiac surgery, its etiology and significance are incompletely understood,² it may reflect an inflammatory response, initiated either in response to the surgical trauma itself, or to the interaction of blood with the foreign surfaces of the cardiopulmonary bypass (CPB) circuit.^{3,4} Alternatively, it may be a marker of cerebral injury with altered function of the ther-

moregulatory center in the hypothalamus.^{5,6}

Almost all patients have a marked elevation of temperature, blood pressure and heart rate in the first days after cardiac operation. However, there is no clear agreement on the significance of fever during the remainder of the first week.⁷⁻⁹ Fever cannot be regarded as either a sensitive or specific index of infection,⁷ and yet discharge from hospital may be delayed on this basis. The objective of the present study was to determine the changes in temperature, blood pressure and heart rate in first week after open cardiac surgery of non-complicated cyanotic and noncyanotic congenital heart diseases.

Patients and Methods

The fever, blood pressure and heart rate were obtained from 100 patients with different congenital heart diseases that had open

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heart surgery under cardiopulmonary bypass in Shiraz University of Medical University affiliated (Faghihi) hospital (Shiraz, Iran). The study was approved by the ethics committee of the University. Forty patients had cyanotic congenital heart disease and 60 patients had non-cyanotic congenital heart disease (table 1). Patients with more than one week admission, acute infection, and patients older than 18 years of age were excluded. All patients received therapeutic doses of antibiotic (Amikacin 15 mg/kg/24hr and Keflin 100 mg/kg/24hr). Fever was defined as a temperature higher than 38 °C orally. All patients were cooled to a core temperature of 28 °C during cardiopulmonary bypass and for the first 24 hours after operation. The core temperatures were measured by a rectal thermocouple. Patients were usually extubated 1±3 days after operation. Subsequent oral temperatures, blood pressure and heart rate were taken orally every 6 hours. In addition, regimen of anti-microbial prophylaxis as well as pump and cross-clamp times were recorded. For anesthesia most of the patients received sodium thiopental (3-5 mg/kg), pavlon (0.03-0.1 mg/kg/h), morphine (0.1 mg/kg) , midazolam (0.05-0.10 mg/kg) and fentanyl (1-3 µg/kg/h).

Results

Age, sex, weight, diagnosis and type of operation of the patients (59 male and 41 female) are shown in table 1. The age of the children at the time of operation was 5.75 ± 6.2 years (range 1-17), and the weight was 17.3 ± 12.5 kg (range 5-49). Forty patients had cyanotic heart diseases and 60 had non cyanotic congenital heart diseases (CHD). Forty four percent of patients had fever more than 38 °C in first 6 hours after open cardiac surgery. Fifty and 95 percentile of fever were 38 and 39.5 38 °C, respectively during such a period. Ninety five percent of the patients were afebrile at 54th hours after surgery. There was statistically significant difference between cyanotic and non cyanotic group after 24 hours post operation . Cyanotic patients were afebrile earlier than noncyanotic group (24 ± 14 hours and 48 ± 23 hours respectively, $P=0.03$). (Fig. 1-3)

Eighty percent of the patients had a heart rate more than 120/min in the first 6 hours after surgery. Fifty and 95 percentile of heart rate in first 6 hours post operation were 156/min and 190/min, respectively. There was statistically significant higher heart rate in cyanotic patients (150 ± 21 beat/min) than that of non-

Table 1. Patients characteristics

	Number	Mean	Range	SD
Age(years)	50	5.75	1-17	11.85
Weight(kg)	50	17.3	5-49	5
Aortic cross Clamp time(min)	50	44.16	5-118	29.2
Pump-time(min)	50	73.86	12-180	41.6
Male	59	-	-	-
Female	41	-	-	-
Cyanotic heart disease	40	-	-	-
Non cyanotic heart disease	60	-	-	-

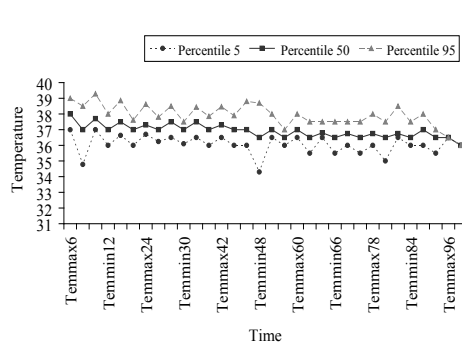


Figure 1: Change in temperature of the patients

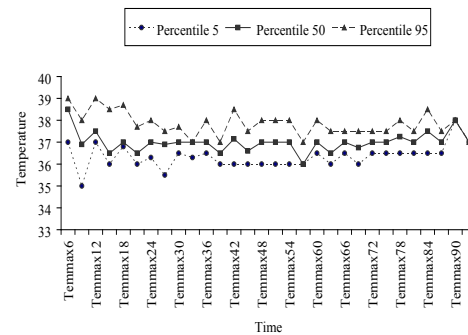


Figure 2: Change in temperature of the patients (cyanotic)

cyanotic patients (110 ± 26 beat/min). In the first 12 hours post operation

The 50 and 95 percentile of blood pressure in the first 6 hour were 105 and 134 mmHg, respectively. The blood pressure of cyanotic group (81 ± 23 mmHg) was lower than that of non cyanotic group (100 ± 15 mmHg).

Discussion

The most frequently misunderstood phenomena after cardiac surgery are abnormalities in body temperature. Most normally convalescing patients are febrile for at least 4 to 5 days after operation, and in some the hyperthermia persists 2 weeks or longer.^{7,10} During this period, those unfamiliar with cardiac surgical patients frequently order numerous blood, sputum and urine cultures, white blood cell (WBC) counts and other special studies without any indication other than fever. The expense of such studies is rarely justified, because the probability is low that the cause of fever is anything other than a usual manifestation of the damaging effects of CPB.¹¹ A number of hypotheses have been advanced as to the etiology of the fever, including the possibility that elevated levels of interleukin are responsible.¹²

CPB is associated with an inflammatory

systemic reaction. In its most severe form, this inflammatory reaction, also called post pump perfusion syndrome, is characterized by increased capillary permeability, increased interstitial fluid, peripheral vasoconstriction, fever, myocardial edema, diffuse cerebral edema, and a diffuse bleeding diathesis.¹³ Although most patients convalesce normally after cardiac surgery, all patients are thought to experience these damaging effects to some degree.¹³

The pathogenic mechanism responsible for the post pump perfusion syndrome has not been elucidated fully. Generation of complements, specifically C3a, C4a, and C5a, has been demonstrated by several investigators.^{14,15-18} Both C3a and C5a anaphylatoxins can induce a systemic inflammatory reaction manifested by increased capillary permeability, histamine release from mast cells, and organ dysfunction.

Injury or trauma to the body triggers this cascade of events, known as the acute phase reaction.^{19,20} The nature of this noxious stimulus is not well known, and the cells subsequently activated include monocytes, macrophages, fibroblasts, endothelial cells, T lymphocytes, and epithelial cells. It has been shown that the acute phase response is mediated by cytokines

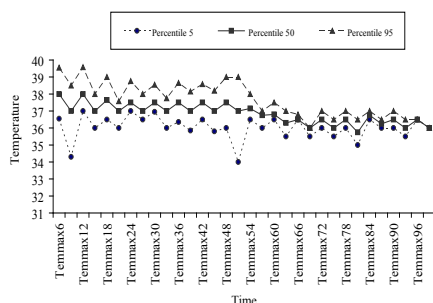


Figure 3: Change in temperature of the patients (Acyanotic)

derived from these activated cells. The cytokines include tumor necrosis factor (TNF), interleukin (IL)-1, and IL-6.¹⁹ It has been shown in animal models that ischemic reperfusion injury in the liver is followed by the release of TNF and subsequently by a systemic inflammatory reaction.

When the patient continues to be febrile at the time of hospital discharge, blood cultures are drawn, but discharge is allowed. Blood cultures in this setting are nearly always negative, but the patient and responsible physicians are warned that hyperthermia may continue or episodically disappear and reappear. Fever may occasionally be accompanied by chills.²¹ Further blood cultures are prudent during these subsequent episodes, but the probability is high that infection is not present and that the fever will gradually disappear spontaneously.

Lim et al. studied 219 patients undergoing cardiac surgery, screening daily for wound, respiratory, urinary tract, and other infections. Pyrexia was defined as temperature above 37.5°C that pyrexia is common after cardiac surgery and resolves in the majority of patients by day 5. Because there is no association between early pyrexia and infection, diagnosis of early postoperative infection by pyrexia alone is

insufficient and is better established by clinical assessment with microbiological evidence.²² In a study by Pien et al. the occurrence of fever (daily maximal temperature greater than or equal to 38 °C) was analyzed in 123 patients after open-heart operation. A statistical difference was found in the incidence of fever after the third postoperative day between patients without infection and patients with bacteremia, wound infection, or pneumonia. Fever after the third day should prompt a diligent search for deep-seated infection.⁸ Bell et al. showed unreliability of fever and leukocytosis in the diagnosis of infection after cardiac valve surgery.⁷

There are few studies in evaluation fever in post operative congenital heart diseases. This study showed almost half of the patient had fever in first day after open cardiac surgery and 95% of patients became afebrile at 54th hour after surgery and so cyanotic patients became afebrile earlier than non cyanotic group.

Sinus rhythm is optimal postoperatively, and with this rhythm a wide range of heart rates at various ages is compatible with survival. The normal compensatory response to increased O₂ demand is increased heart rate. Often in the elderly and also in patients with diseased myocardium, this response is absent. It is prudent to manipulate heart rate in otherwise normally convalescing patients with slow sinus (or junctional) rhythm to improve cardiac output. For this, atrial pacing via two temporary atrial leads placed at operation is used. In these situations, atrial pacing is also helpful to suppress premature beats (both atrial and ventricular). This study showed more than half of patients had heart rate more than 120/min and so cyanotic patients had statistically significant higher

heart rate than non cyanotic group.¹²

Arterial blood pressure is an insensitive method of estimating the adequacy of cardiac output early postoperatively, primarily because systemic vascular resistance is usually elevated.²³ This may be related to increased levels of circulating catecholamines, plasma renin, angiotensin II, or other mechanisms.^{24,25} This high resistance may result in normal or high arterial blood pressure even when cardiac output is low. Some patients tend early postoperatively to have low systemic arterial resistance and arterial blood pressure, even when cardiac performance is good. They may occur more frequently in children with cyanotic heart disease, adults with diabetes, and patients with sepsis drug interactions (especially preoperative use of AC inhibitors).^{26,27} Arterial hypotension is an indication for thoughtful evaluation. Children cannot be considered to be convalescing normally when mean arterial blood pressure is lower than about 10% below normal for the patient's age. For adults, particularly the elderly, arterial blood pressure may mandate maintenance at or above common, accepted normal values, to ensure adequate perfusion of various organs, such as the brain, viscera, and kidneys.¹² Estafanous et al. showed that significant hypertension can develop in 15 to 40 percent of patients undergoing various types of cardiac surgery. These hypertensive episodes can occur at almost any time before, during or after open or closed chest operations. The various hypertensions encountered in this context do not form a homogeneous entity; they are not due to the same causes and do not necessarily develop by the same

mechanisms. Their frequency and seriousness have been demonstrated by reports from many centers: hence, the urgent need for accurate definition of their various types to allow correct identification and therapy. A classification based on well defined clinical events is therefore proposed and possible mechanisms for the more common types of hypertension are reviewed. Prophylactic measures include reassurance, attention to details of anesthesia and maintenance of preoperative antihypertensive therapy when indicated.²⁸

This study showed blood pressure increasing after open cardiac surgery and cyanotic patients had statistically significant lower blood pressure than non cyanotic patients.

Almost all patients had an appreciable febrile response, rise in blood pressure and heart rate following the operation, even though infection was ruled out in our patients. Cyanotic patients became afebrile earlier, had higher heart rate and lower blood pressure than non-cyanotic group.

In conclusion there are differences in vital sign changes post operatively in cyanotic and non cyanotic congenital heart disease as mentioned above that should be keep in mind for physician who care this patients.

The relatively small sample size may be a limitation of this study, and, hopefully, this might initiate more research in this field that why there are such differences between cyanotic and non cyanotic congenital heart diseases.

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of Medical Sciences. The authors declare that they have no Conflicts of Interest.

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