**Benha Journal of Applied Sciences (BJAS)** **print: ISSN 2356–9751**
**Vol. (4) Issue (1) (2019), (17-21)** **online: ISSN 2356–976x**
**http://bjas.journals.ekb.eg**

# Importance of Preoperative Full Blood Count in Pediatric Patients Undergoing Surgeries

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**Abstract**

Paediatric patients undergoing surgical procedures commonly require some volume of blood or blood component replacement in the perioperative period. Paediatric patients undergoing major surgery associated with substantial blood loss should be evaluated pre-operatively. Pre-operative correction of anaemia may be done considering the age, plasma volume status, clinical status and comorbidities. Maximum allowable blood loss (MABL) for surgery must be calculated, and appropriate quantity of blood and blood components should be arranged. Intraoperative monitoring of blood loss should be done, and volume of transfusion should be calculated in a protocol based manner considering the volemia and the trigger threshold for transfusion for the patient and the MABL. Early haemostasis should be achieved by judicious administration of red blood cells, blood components and pharmacological agents.

**Key words:** Preoperative, Full blood count, Pediatric.

## 1. Introduction

Remifentanil is a μ-opioid receptor agonist with an analgesic potency similar to that of fentanyl [1]. Remifentanil is an analogue of fentanyl (4-piperi- dyl anilide) with a methyl-ester group that allows the molecule to be hydrolysed by non-specific tissue and plasma esterases [2]. Rapid biotransformation to minimally active metabolites should be associated with a short duration of action with no accumulation of effect on repeated dosing or with continuous infusion [3]. These pharmacokinetic properties could explain the rapid onset and short duration of action of remifentanil [4].

Remifentanil has a rapid onset, rapid offset, small volume of distribution, rapid clearance, and a short elimination half-life [5]. so, it may be a useful anaesthetic for paediatric outpatient surgery [6].

Opioids are often used in combination with propofol. The combination of these two drugs may be particularly useful for procedures of short duration [7].

Combining a hypnotic and an analgesic to produce sedation, analgesia and surgical immobility is more common than administration of a volatile anaesthetic alone, and response surface analyses demonstrate a synergistic interaction between remifentanil and sevoflurane for sedation and all analgesic endpoints [8].

This study was designed to compare the outcome of using fentanyl infusion versus remifentanil infusion in conjunction with a volatile anaesthetic during short-duration surgical procedures in children.

Emergence agitation (EA) in pediatrics is defined as a postoperative negative behavior that may be accompanied by symptoms as combative movements, excitability, thrashing, disorientation, and inconsolable crying1]. The definite cause and pathophysiology of EA are not fully elucidated but risk factors include preschool age, preoperative anxiety, postoperative pain, nausea, vomiting, otolaryngology procedures, and inhalational anesthetics specially sevoflurane. Due to its low blood/gas partition coefficient (0.68) and weak airway irritation, sevoflurane is the most popular anesthetic used for children [2]. However, it is associated with higher

They concluded that preoperative additional tests are excessively ordered, even for young patients with low surgical risk, with little or no interference in perioperative management. They stated that laboratory tests, besides generating high and unnecessary costs, are not good standardized screening instruments for diseases.

Although it was concluded in previous studies [3], [4] that preoperative laboratory test is not recommended routinely as it is not agood standardized screening instrument for disease this is not the case in Egypt . In a study done by Curtale [5], studied anemia and intestinal parasitic infections among school age children in Behera governorate in Egypt, and found that the prevalence of anemia in the area was high (90%).

### 1.1Aim of the study

To discuss the necessity of routine testing of full blood count in pediatrics prior to surgery and the anesthetic implications of abnormal tests.

## 2. Methods

This is a review article, The search was performed in MEDLINE, Embase, Pubmed and

CINAHL Plus in the same date range with the following mediacl terms: “preoperative; full blood count; pediatric; anemia”, including articles from 2000 to 2019, Excluded articles from review are those of langauge other than English.

## 3. Results

### 3.1 Hemoglobin

Haemoglobin (Hb) is the iron-containing oxygen-transport metalloprotein in the red blood cells of all vertebrates (with the exception of the fish family Channichthyidae) as well as the tissues of some invertebrates. Haemoglobin in the blood carries oxygen from the lungs) to the rest of the body (i.e. the tissues) where it releases the oxygen to burn nutrients to provide energy to power the functions of the organism in the process called metabolism.

Haemoglobin has an oxygen-binding capacity of 1.34 mL O2 per gram of haemoglobin, which increases the total blood oxygen capacity seventy-fold compared to dissolved oxygen in blood. The mammalian haemoglobin molecule can bind (carry) up to four oxygen molecules [6].

Haemoglobin is involved in the transport of other gases: It carries some of the body's respiratory carbon dioxide (about 10% of the total) as carbaminohemoglobin, in which CO2 is bound to the globin protein. The molecule also carries the important regulatory molecule nitric oxide bound to a globin protein thiol group, releasing it at the same time as oxygen [7].

Haemoglobin is also found outside red blood cells and their progenitor lines. Other cells that contain hemoglobin include the A9 dopaminergic neurons in the substantia nigra, macrophages, alveolar cells, and mesangial cells in the kidney. In these tissues, haemoglobin has a non-oxygen-carrying function as an antioxidant and a regulator of iron metabolism [8].

### 3.2 Anemia

Anaemia in childhood is defined as a haemoglobin (Hb) concentration below established cut-off levels. These levels vary depending on the age of the child and on the laboratory in which the blood sample is tested. Reference ranges for specific laboratories and age groups should always be referred to. The World Health Organization (WHO) has suggested levels of Hb below which anaemia is said to be present. These levels are <11 g/dL in children aged 1month-5years, <11.5 g/dL in children aged 5-11 years and 12 g/dL in older children (aged 12-14years).

### 3.3 Anemia and anesthesia

Physiologic response to acute anemia :

The maintenance of tissue oxygen delivery during an acute reduction in red blood cell concentration depends on both an increase in cardiac output and an increase in blood oxygen extraction [9].

1- The cardiac output response:

Cardiac output increases during isovolaemic anaemia and the extent of this response appears to be closely related to the decrease in haematocrit. The cardiac output response is usually due to an increase in stroke volume and to some extent, an increase in heart rate [9].

The decrease in blood viscosity plays a fundamental role in the rise in stroke volume by increasing venous return and decreasing total peripheral vascular resistance. These changes in cardiac loading conditions lead to improved myocardial functioning and a direct enhancement of myocardial contractility [10]

The decrease in total peripheral vascular resistance results, essentially, from reduced blood viscosity, but may also be related to the decreased scavenging capacity of blood to inactivate nitric oxide. The adequate cardiac output response to isovolaemic anemia also appears to be dependent on the presence of an intact autonomic nervous system and alpha-adrenergic tone[11]

2-The oxygen extraction response:

The aim of the second compensatory mechanism is to better match oxygen delivery to oxygen demand at the tissue level. This mechanism, which permits the extraction of blood oxygen to increase, involves physiologic alterations at both the systemic and the microcirculatory levels [9].

A-At the systemic level:

Matching oxygen delivery to tissue oxygen demand requires the redistribution of blood flow to areas of high demand (e.g. the brain and heart) in order to more effectively utilize oxygen held in venous blood [12]

This exceptional increase in blood flow to the brain and heart occurs because these organs are “flow-dependent” tissues, in contrast to other organs (e.g. the splanchnic area, kidneys, and skin) that are “flow independent” tissues. [13].

Coronary blood flow increases even more than cerebral blood flow as myocardial oxygen demand increases during anaemia. When the haematocrit is reduced to 10-12%, myocardial oxygen consumption more than doubles [14].

B-At the microcirculatory level:

Several physiological adjustments contribute markedly to providing a more efficient utilization of the remaining oxygen in the blood. The main effect of haemodilution on the microcirculation is an increase in red blood cell velocity that allows red blood cell flux in the capillaries to be maintained up to a systemic haematocrit of 20%. This increased flow velocity stimulates arterial vasomotor and provides a more homogeneous distribution of red cells in the capillary network [13].

Changes in the dynamics of the haemoglobin molecule can result in more efficient tissue oxygen delivery in anaemia. Indeed, a right shift of the oxyhaemoglobin dissociation curve which enhances oxygen release at a constant oxygen tension begins at a haemoglobin level of 9g dL-1 and becomes more prominent when levels are <6.5g dL-1 [15].

Anesthetic consideration:

1- Maximizing cardiac output

The efficacy of mechanisms to preserve tissue oxygen delivery when the oxygen-carrying capacity of the blood is reduced depends primarily on maintenance of an adequate blood volume. This is especially true for the cardiac output response to haemodilution. Indeed, hypovolaemia will blunt the effects of decreased blood viscosity on venous return [16].

Crystalloid solutions alone may be insufficient because of rapid extra vascular redistribution. Synthetic colloids may thus be required [17].

The critical haemoglobin level does not appear to be influenced by the type of synthetic colloid (e.g. 6% Hydroxyethyl starch or 3% modified fluid gelatin) [13].

2-Increasing oxygen content:

The inspired fraction of oxygen (FiO2) may also influence the critical haemoglobin level since dissolved oxygen in plasma increases markedly during haemodilution.

However, hyperoxemia reduces the cardiac output response occurring during isovolaemic anaemia and partially reverses the decrease in systemic vascular resistance [16]. However, high FiO2 (50%-100%) can be administered only for short periods of time. Indeed, increased FiO2 for long periods of time induces ongoing free radical formation in the lungs, with subsequent lung tissue damage [13].

3-Decreasing metabolic rate:

Moderate hypothermia:

Deliberate mild hypothermia has been used in the peri- and postoperative management of severe anaemic patients. Moderate hypothermia decreases tissue oxygen demand, but also increases the amount of oxygen dissolved in plasma and improves tissue affinity for oxygen [18].

**3.4 ASA guidlines**

ASA (American Society of Anesthesiologists) grades are a simple scale describing fitness to undergo an anesthetic.

***ASA Grade 1:** Normal healthy patient

***ASA Grade 2:** A patient with mild systemic disease

***ASA Grade 3:** A patient with severe systemic disease

***ASA Grade 4:** A patient with systemic disease that is a constant threat to life.

**The recommendations are:**

[No]: Test not recommended.

[Consider]: Test to be considered (the value of carrying out a preoperative test is not known, and may depend on specific patient characteristics).

[Yes]: Test recommended.

**Table (1)** Grade 1 surgery (minor) children < 16 years

| | **< 6 months** | **≥ 6 to < 12 months** | **≥ 1 to < 5 years** | **≥ 5 to < 12 years** | **≥ 12 to < 16 years** |
|---|---|---|---|---|---|
| **Full blood count** | NO | NO | NO | NO | NO |

**Table (2)** Grade 2 surgery (intermediate) children < 16 years

| | **< 6 Months** | **≥ 6 to < 12 months** | **≥ 1 to < 5 years** | **≥ 5 to < 12 years** | **≥ 12 to < 16 years** |
|---|---|---|---|---|---|
| **Full blood count** | NO | NO | NO | NO | NO |

**Table (3)** Grade 3 surgery (major) children < 16 years

| | **< 6 Months** | **≥ 6 to < 12 months** | **≥ 1 to < 5 years** | **≥ 5 to < 12 years** | **≥ 12 to < 16 years** |
|---|---|---|---|---|---|
| **Full blood count** | Consider | Consider | Consider | Consider | Consider |

**Table (4)** Grade 4 surgery (major+) children < 16 years

| | **< 6 months** | **≥ 6 to < 12 months** | **≥ 1 to < 5 years** | **≥ 5 to < 12 years** | **≥ 12 to < 16 years** |
|---|---|---|---|---|---|
| **Full blood Count** | Consider | Consider | Consider | Consider | Consider |

**Table (6)** Neurosurgery children < 16 years

| | **< 6 Months** | **≥ 6 to < 12 months** | **≥ 1 to < 5 years** | **≥ 5 to < 12 years** | **≥ 12 to < 16 years** |
|---|---|---|---|---|---|
| **Full blood count** | Consider | Consider | Consider | Consider | Consider |

**Table (7)** Cardiovascular surgery children < 16 years

| | **< 6 months** | **≥ 6 to < 12 months** | **≥ 1 to < 5 years** | **≥ 5 to < 12 years** | **≥ 12 to < 16 years** |
|---|---|---|---|---|---|
| **Full blood count** | Yes | Yes | Yes | Yes | Yes |

## 4.Disscussion

International guidelines recommend against routine preoperative testing of full blood count (FBC) in pediatrics before elective surgery. According to the NICE clinical guideline on preoperative laboratory testing in children less than 16 years, FBC is not recommended before grade 1 (minor) and grade 2 (intermediate) surgeries, and to be considered in grade 3 (major), grade 4(major+), and neurosurgeries and mandatory only in cardiac surgery.

This study designed to investigate whether a routine preoperative full blood count is of value or not in the context of high prevalence of anemia in Egypt.

The study was conducted on two hundred patients with age ranged from 1 month to 12 years in Cairo University specialized pediatric hospital, which revealed that there was no significant differences between anaemia and different age groups, gender and type of surgery.

Anaemia was significantly higher in residents of rural areas than urban areas. Also it was significantly higher in infants who were not breast fed than breast fed ones.

## 5.Conclusion

We concluded that a policy of “routine” blood testing before surgery in Cairo University Paediatric Specialized Hospital for children is not recommended for patients undergoing minor surgeries. Intermediate surgical procedures and major surgeries detect a considerable proportion of anaemic paediatrics, we suggest routine blood testing before surgeries to protect against intaoperative and postoperative blood transfusion.

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