HEMATOLOGICAL DERANGEMENTS IN CRITICALLY ILL PATIENTS

Essay

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In intensive care

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Contents

List of abbreviations

ICU	Intensive care unit
Hb	Hemoglobin
AI	Anemia of Inflammation
Fe^{3}	Ferrous Iron
Fe^{2}	Ferric Iron
TfR2	Transferrin receptor 2
DMT1	Divalent metal ion transporter 1
sTfR	Soluble transferrin receptors
DcytB	Duodenal cytochromeB
HCP	Heme carrier protein
IRE	Iron Responsive Elements
IRP1/IRP2	Iron Regulatory Proteins
LDH	Lactate dehydrogenase
DIC	Disseminated intravascular coagulation
NAT	Nucleic acid amplification testing
IDA	Iron-deficiency anemia
Anti-HBs	Antibodies against HBsAg
TRALI	Transfusion-related acute lung injury
HJV	Hemojuvelin
IL-1	Interleukin-1
TNF-ά	Tumor necrosis factor-ά
FDA	Food and Drug Administration
HUS	Hemolytic uremic syndrome
TTP	Thrombotic thrombocytopenic purpura
ITP	Idiopathic [immune] thrombocytopenia
CHO	Chinese hamster ovary
PAI-1	Plasminogen activator inhibitor type I
PTP	Post-transfusion purpura
anti-Xa	Factor X inhibitor

DTIs	Direct thrombin inhibitors
HIT	Heparin-induced thrombocytopenia
IV-IgG	Intravenous-immunoglobulin
IVH	Intraventricular hemorrhage
HIV	Human immunodeficiency virus
RBC	Red blood corpuscle
NIBI	Non-transferrin bound iron
PTH	Post-transfusion hepatitis
kDa	kilo Dalton
2, 3 DPG	2, 3 diphosphoglycerate
PO_2	Partial pressure of oxygen
ELISA	Enzyme-linked immunosorbent assay
SRA	Serotonin release assay
PRBCs	Packed red blood cells
FFP	Fresh frozen plasma
PTP	Post-transfusion purpura
HBsAg	Hepatitis B surface antigen
HAV	Hepatitis A virus
HBV	Hepatitis B virus
HBcAg	Hepatitis B core antigen
HCV	Hepatitis C virus
HEV	Hepatitis E virus
TRALI	Transfusion related acute lung injury
ARDS	Adult respiratory distress syndrome
DHTR	Delayed hemolytic transfusion reaction
GVHD	Graft versus host disease
TA-GVHD	Transfusion acquired graft versus host disease
rHB	Recombinant hemoglobin
EPO	Erythropoietin
rHuEPO	Recombinant human erythropoietin
ESA's	Erythropoietin-stimulating agents
BMP	Bone morphogenetic protein
DO_2	Oxygen delivery to tissues
CaO_2	Arterial oxygen content
HR	Heart rate
CCF	Congestive cardiac failure

SaO_2	Oxygen saturation
PaO_2	Arterial oxygen tension
TFPI	Tissue factor pathway inhibitor
FDP	Fibrin degradation products
PAI-1	plasminogen activator inhibitor type I
vWF	von Willebrand factor
FFP	Fresh frozen plasma
AICF	Accelerated intravascular coagulation and fibrinolysis
JMHW	Japanese Ministry of Health and Welfare
ISTH	International Society on Thrombosis and Haemostasis
SSC	Scientific Standardization Committee
MODS	multiple organ dysfunction syndrome
ACCP	American College of Chest Physicians
SCCM	Society of Critical Care Medicine
APACHE	Acute physiologic & chronic health evaluation
TRICC	Transfusion requirement in the critical care
NCI	National Cancer Institute
TO_2	Oxygen transport
SvO_2	Venous oxygen saturation
$ScvO_2$	Central venous oxygen saturation
VO_2	Tissue oxygen needs
CvO_2	Venous oxygen content
EO_2	Oxygen extraction
ECG	Electrocardography
SAP	Mean systolic blood pressure
MAP	Mean arterial blood pressure
CVP	Central venous pressure
BT	Blood transfusion
PBC	primary biliary cirrhosis
NO	Nitric oxide
RES	Reticuloendothelial system
SHOT	Serious hazards of transfusion
CRP	C reactive protein
Hct	Hematocrite
LMWH	Low molecular weight heparin
VKA	Vitamin k antagonist

AT-III	Antithrombin-III
PT	prothrombin time
CrCl	Creatinine clearance
DVT	Deep vein thrombosis

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Introduction

Introduction

Like any part of the body,blood can be affected with diseases and disorders that can compromise health.The majority of the blood is plasma.Plasma is mostly water and contains dissolved salts and proteins, as well as hormones, electrolytes, fats, sugars,minerals,and vitamins.The other components of blood include red blood cells,white blood cells and Platelets.Anemia, thrombocytopenia, and coagulopathy are commonly encountered when caring for critically ill patients ***(Vincent et al,2002).***

Anemia of critical illness is a deficiency of blood oxygen carrying capacity that is clinically characterized by diminished tissue oxygenation and complicated by end-organ dysfunction. The etiology may be categorized into blood loss and reduced red blood cells production,Trauma,surgery,hemorrhagic complications,and lab.draws compound the effects of functional iron deficiency and blunted erythropoietic response.Allogeneic RBCs transfusion is currently one of the principal interventions for acute treatment of anemia of critical illness.The severity of anemia and subsequent blood transfusion associated with higher risks of morbidity and mortality.Recombinant human erythropoietin (rHuEPO) is widely used to promote RBCs production and reduce blood transfusion in the ICU ***(Corwin et al, 2004).***Thrombocytopenia occurs when the platelets count fall too low.At levels of 20,000 to 30,000 platelets/μL.At platelets count less than 20,000/μL,spontaneous bleeding can occur,which increases the risk of bleeding that can result in shock and death ***(Drews and Weinberger, 2000).***

Many critically ill patients develop hemostatic abnormalities,ranging from isolated thrombocytopenia or prolonged global clotting tests to complex defects, such as disseminated intravascular coagulation.DIC may complicate a variety of underlying disease processes, including sepsis,trauma,cancer,or obstetrical conditions such as placental abruption ***(Davidson et al, 2007)***.

Chapter

I

Anemia in critically ill patients

Definition:

Anemia is defined as a reduction in the hemoglobin (Hb) concentration below the normal range for the age and sex of the patient with a resultant decrease in total oxygen carrying capacity of blood ***(Wiess and Goodnough, 2005*).**

Clinical features:

Symptoms and signs of anemia include: tiredness, lassitude, easy fatiguability, pallor, dyspnea on exertion and congestive heart failure in severe cases.***(Pieracci and Barie 2006).***

Causes:

1 - Blood loss: acute or chronic.

2 - Deficiency of: Iron, Vitamin B12, Folic acid and Vitamin C.

3 - Hemolysis:

- Membrane defects e.g. spherocytosis, elliptocytosis.
- Hemoglobin synthetic defects e.g. thalassemias, sickle cell anemia.
- Enzyme defects e.g. G6PD deficiency, pyruvate kinase deficiency.
- Extrinsic red cells damage e.g. hypersplenism,immunological causes, mechanical causes, chemical causes, parasitic infestation (malaria).

4 - Bone marrow failure: Aplastic anemia or bone marrow infiltration.

5 - Anemia of chronic disorder.

6 - Increased plasma volume: Splenomegaly or Pregnancy ***(Carson et al, 1988).***

Anemia of chronic disease versus anemia of acute illness

Anemia is a common problem in the intensive care unit (ICU), occurring frequently in critically ill patients.Observational studies indicate an incidence of approximately 95% in patients who have been in the ICU for 3 or more days.The presence of anemia has been associated with worse outcomes including increased lengths of stay and increased mortality.The etiology of anemia is multifactorial and includes the following:

- Frequent blood sampling; in one study, the average total volume of blood drawn was 41.1 mL per patient during a 24-hour period.The quantity of blood phlebotomized accounted for 49% variation in amount of blood transfused in an observational study by Corwin and colleagues ***(Corwin et al,2004).***
- Clinically apparent or occult blood loss through the gastrointestinal tract.
- Blood loss from preceding trauma.
- Blood loss as a result of surgical interventions.
- Impaired production of red cells secondary to a blunted erythropoietin response to anemia in critically ill patients.Erythropoietin (Epo) levels have been found to be inappropriately low in these patients, with a loss of the normal inverse correlation that exists between serum Epo levels and hematocrit levels.The blunted Epo response appears to be a result of suppression by inflammatory cytokines.These patients, however, retain their responsiveness to exogenously administered Epo.There is also a direct suppressive effect on erythroid