Update in Perioperative Fluid Management

Essay

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Anesthesia

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تحديث في ادارة استخدام السوائل الوريديـــة في الفتـــرة المتعلقـــة بالجراحـــة

رسالة

توطئة للحصول على درجة الماجستير في التخدير

مقدمة من

طبيب / مينـــا نشـــأت سامــــي عبد الله

بكالوريوس الطب والجراحة

كلية الطب – جامعة عين شمس

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استاذ التخدير والعناية المركزة

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٢٠١٥

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Dedication

✍ To

Family for their warm affection, patience, encouragement, and for always being there when I needed them

Contents

List of Figures

List of Abbreviations

Å	Angstrom, 1^{-10} m
AC	Alternating current
ADH	Antidiuretic hormone
ADRS	Adult respiratory distress syndrome
ANP	Atrial natriuretic peptide
APA	Association of pediatric anesthetists
ASA	American society of anesthesia
BAC	Blood Albumin Concentration
BP	Blood pressure
CBV	Cerebral blood volume
CI	Cardiac index, confidence interval
CMV	Cytomegalovirus
CO	Cardiac output
COP	Colloid osmotic pressure
CPP	Cerebral perfusion pressure
CSA	Cross sectional area
CVP	Central venous pressure
D5%	Dextrose 5%
DC	Direct current
DEX	Dextran
ECF	Extracellular fluid
ECV	Extracellular volume
EDM	Esophageal Doppler monitoring
EF	Ejection fraction
EGL	Endothelial glycocalyx
EGDT	Early goal-directed therapy
EMA	European Medicines Agency
ERAS	Enhanced recovery after surgery
ESL	Endothelial surface layer
FDA	Food & Drug Administration (US)
FFP	Fresh frozen plasma

FTc	Corrected flow time
GA	General anesthesia
GDT	Goal directed therapy
GEL	Gelatin
Hb	Hemoglobin
Hct	Hematocrite
HES	Hydroxyethyl starch
HLA	Human leukocyte antigen
HS	Hypertonic Saline
HSD	Hypertonic Saline Dextrose
HUT	Head-up tilt
ICP	Intracranial pressure
ICU	Intensive care unit
ICV	Intracellular volume
Kd	Kilo Dalton
Kcal	Kilo calorie
LBNV	Lower body negative pressure
LOS	Length of hospital stay
LR	Lactated Ringer
LV	Left ventricle
LVEDA	Left ventricular end-diastolic area
LVEDP	Left ventricular end-diastolic pressure
MAP	Mean arterial blood pressure
MHC	Major histocompatibility complex
MHRA	Medicines and Healthcare Products Regulatory Agency
MW	Molecular weight
NHS	National health service
NS	Normal Saline
PA	Pulmonary artery
PCWP	Pulmonary capillary wedge pressure
PEEP	Peak end expiratory pressure
PI	Perfusion index
POP	Pulse oximeter plethmograph
PPV	Pulse pressure variation

PLR	Passive leg raising
PRAC	Pharmacovigilance Risk Assessment Committee
PRBCs	Packed red blood cells
PVI	Pleth variability index
RA	Right atrium
RBCs	Red blood cells
RV	Right ventricle
RR	Risk ratio
SAFE	Saline vs Albumin fluid evaluation
$ScvO_2$	Central venous oxygen saturation
ScO_2	Cerebral oxygen saturation
SIRS	Systemic inflammatory response syndrome
SPV	Systolic pressure variation
SV	Stroke volume
SVC	Superior vena cava
SVO_2	Venous oxygen saturation
SVV	Stroke volume variation
SVRI	Systemic vascular resistance index
TAGVD	Transfusion associated graft versus host disease
TBW	Total body water
TEE	Trans-esophogeal echo
TER	Transcapillary escape rate
TPI	Traumatic brain injury
TPN	Total parentral nutrition
TRALI	Transfusion related acute lung injury
TTE	Trans-thoracic echo
Vo_2	Volume of oxygen consumption
VTI	Velocity time integral

List of Tables

Introduction

Perioperative fluid management is a daily therapeutic challenge which may profoundly influence the outcome of each patient. Despite being a fundamental component of surgical and perioperative care, fluid management remains suboptimal ***(Doherty & Buggy, 2012).***

Basically three questions are intrinsically tied to fluid administration perioperatively and in critically ill patients: 1) What happens to intravascular fluid in health and disease? 2) How do different intravenous fluids behave on application? 3) What are the goals for volume administration and how can they be assessed and reached? ***(Strunden et al., 2011)***.

Perioperative fluid management has historically generated controversy, with little compelling data to address the conflict between the extreme approaches of "keep them dry" and "aggressively hydrate them" ***(Robert et al., 2007)***.

The debate over colloid versus crystalloid as the best solution for intraoperative fluid resuscitation is not resolved. Both types of fluids replenish a different part of the extracellular compartment. The controversy does not only include colloid vs crystalloid but also what kind of colloid and crystalloid should be used in the intraoperative period according to type of surgery and state of patient ***(Peng & Kellum, 2013).***

New findings concerning the vascular barrier, its physiological functions, and its role regarding vascular leakage have lead to a new view of fluid and volume administration ***(Michard & Biais, 2012).***

More recently, fluid restriction had been used as part of fast-track surgery aiming at reducing postoperative complications, length of stay and mortality compared to liberal use of fluid ***(Corcoran et al., 2012).***

Further improvement of the postoperative course was demonstrated by a goal-directed fluid management to optimize stroke volume measured with the oesophageal Doppler ***(Kuper et al., 2011).***

Aim of Essay

Review of updated knowledge about fluid kinetics in the perioperative period, and how to apply them clinically to achieve optimum perioperative fluid therapy.

Physics and Mechanics of Perioperative Fluid Handling

Body water distribution

In normal, healthy people, the total body water constitutes 50–60% of lean bodyweight in men and 45–50% in women. In a healthy 70 kg male, total body water is approximately 42 liters. Of this, about two-thirds are intracellular (28 litres); therefore, extracellular volume (ECV) comprises 14 litres. The extracellular compartment can be further divided into interstitial (11 litres) and plasma (3 litres). With small amounts of transcellular fluids, for example, intraocular, gastrointestinal secretion, and cerebrospinal fluid completing the distribution (Fig.1). These transcellular fluids are considered anatomically separate and not available for water and solute exchange ***(Kaye & Riopelle, 2009).***

Total body water (TBW) can be estimated by using dilution tracer techniques. Isotopically labelled water using deuterium or tritium diffuses through the TBW compartment. Extra cellular fluid (ECF) measurement requires that the marker used must cross capillaries but not cell membranes. Radiolabelled sulphate ($^{35}so_4^{2-}$) or bromide