Recent concepts of intra-operative fluid management in Pediatrics and neonates

Essay

Submitted for partial fulfillment of master degree
In anesthesia

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2013

Acknowledgment

First of all, all gratitude is due to Allah for this work, until it has reached its end, as part of his generous help throughout my life.

I can hardly find the words to express my gratitude to **Prof.Dr.Bahaa ALdin Ewees Hassan Ali,** professor of anesthesia and intensive care, faculty of Medicine, Ain Shams University, for his close supervision, continuous help and encouragement throughout the whole work. It is agreat honor to work under his guidance and supervision.

I'm also indebted to **Dr.Ahmed Nagah EL-Shaer,** assistant professor of anesthesia and intensive care, faculty of medicine, Ain Shams University, for his guidance and continuous assistance.

I'd like also to express my sincere appreciation and gratitude to **Dr. Mahmoud Hassan Mohamed Hassan** Lecturer of anesthesia and intensive care, faculty of medicine, Ain Shams University, for his continuous support, close supervision and tremendous effort he has done in the meticulous revision of the whole work.

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List of Abbreviations

ACE .....Angiotensin converting enzyme

ADH .....Antidiuretic hormone

ALT .....Alanine amino transferase

ARF .....Acute renal failure

ASA .....American Society of Anesthesiologists

AST .....Asparate amino transferase

Bl.pr .....Blood pressure

BW .....Body weight

COP .....Cardiac output

CSF .....Cerebro-spinal fluid

CPP .....Cerebral perfusion pressure

CVP .....Cerebral venous pressure

CVS .....Cardiovascular system

(d) .....Dalton

D_5W .....5% dextrose

ECF .....Extra-cellular fluid

ECHO ....Echocardiography

ECV .....Extra-cellular volume

EDV .....End diastolic volume

EF .....Ejection fraction

ELBW ....Extremely low birth weight

FFP .....Fresh frozen plasma

GFR .....Glomerular filtration rate

HES .....Hydroxyethyl starch

HF .....Heart failure

Hg .....Hemoglobin

HME .....Heat and moisture exchange filter

HPA axis Hypothalamic-pituitary-adrenal axis

HR .....Heart rate

ICF .....Intra-cellular fluid

ICP .....Intra-cerebral pressure

IV .....Intra-venous

IVF .....Intravascular fluid

LR .....Lactated Ringer "Ringer`s lactate"

MW .....Molecular weight

NHS .....National Health Service

NPO .....Nil per os

NS .....Normal saline "0.9% NaCl"

OR .....Operating room

ORT .....Oral rehydration therapy

PAOP .....Pulmonary artery occlusion pressure

PPF .....Plasma protein fraction

PTT .....Partial thromboplastin time

RAS .....Reticular activating system

RF .....Renal failure

RPP .....Renal perfusion pressure

SV .....Stroke volume

RVEDV ..Right ventricular end diastolic volume

TBW .....Total body water

UK .....United Kingdom

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Introduction

Perioperative fluid management in pediatrics has been the subject of many controversies in recent years, but fluid management in the neonatal period has not been considered in most reviews and guidelines. The literature regarding neonatal fluid management mainly appears in the pediatric textbooks and few recent data are available, except for resuscitation and fluid loading during shock and major surgery. In the context of anesthesia, many neonates requiring surgery within the first month of life have organ malformation and/or dysfunction **(Murat et al., 2010).**

It has been more than 50 yr since the landmark article in which Holliday and Segar proposed the rate and composition of parenteral maintenance fluids for hospitalized children. Much of our practice of fluid administration in the perioperative period is based on this article. The glucose, electrolyte, and intravascular volume requirements of the pediatric surgical patient may be quite different than the original population described, and consequently, use of traditional hypotonic fluids proposed by Holliday and Segar may cause complications, such as hyperglycemia and hyponatremia, in the postoperative surgical patient. There is significant controversy regarding the

choice of isotonic versus hypotonic fluids in the postoperative period **(Bailey et al., 2010).**

A volume replacement therapy compensates a reduced intravascular volume to stabilize and maintain hemodynamics and vital signs. For this therapy, a physiologically-based solution comprising both, osmotic and colloid osmotic components, should be administered. The basic requirement for a sufficient fluid replacement and volume resuscitation therapy in children are the profound and special knowledge of the physiological and pathophysiological interactions in water balance and electrolyte metabolism in childhood, the pharmacology of the applied solutions and the adequate monitoring of this fluid and volume replacement therapy. Wrong dosages and side effects are reasons for a negative postoperative outcome in children **(Winter and Sablotzki, 2010).**

Aim of the Work

to highlight the basic and advanced means of intra-operative fluid management in pediatrics and neonates for proper postoperative outcome in pediatrics and neonates.

Chapter (1)

Physiological considerations:

Neonates are not just small adults, major physiological changes occur within the first days and months of life. They mainly concern body composition, renal function and changes in the cardiovascular system **(Murat et al., 2010).**

Body fluid composition

Water makes up 50-75 % of the body mass. The most important determinants of the wide range in water content are age and gender: a. the water content of a newborn, an adolescent and an elderly man are approximately 75, 60 and 50 %; b. after puberty males generally have 2 to 10 % higher water content than females **(Figure 1) (Ruth and Wassner, 2006).**

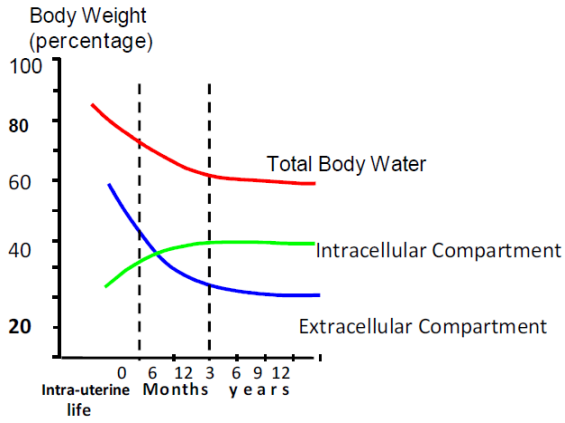

Figure (1): **Winters diagram with the subdivision of TBW, ICF and ECF as a function of age (Ruth and Wassner, 2006).**

Throughout fetal life and during the first 2 years of life the distribution of body fluid undergoes a gradual but significant change. TBW represents as much as 80% of body weight in premature infants, 78% in full-term newborns and 65% in infants of 12 months of age compared to 60% in adults show in table(1) **(Murat et al., 2010).**

Table (1): Relation of body fluids to age (Murat et al., 2010)

	Premature	Full-term	1 yr.	3 yr.	9 yr.	Adult
Body weight BW(kg)	1.5	3	10	15	30	70
Body surface area BSA(m2)	0.15	0.2	0.5	0.6	1	1.7
BSA/BW	0.1	0.07	0.05	0.04	0.03	0.02
TBW(%BW)	80	78	65	60	-	-
ECF(% BW)	50	45	25	20	-	-
ICF (% BW)	30	33	40	40	-	-

Body fluid compartment

These age-related changes in TBW are mainly reflect changes in ECF with growth. As the body cells proliferate and organ development progresses, the ECF volume decreases proportionally. It represents 50% of BW in premature infants, 45% in full-term newborns and 25% in infants of 12 months of age compared to 20% in adults. The ICF compartment increases only moderately during the first year of life, representing 33%