

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

Essay

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In anesthesia*

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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
D₅W	.....	5% dextrose
ECF	.....	Extra-cellular fluid
ECHO	...	Echocardiography
ECV	.....	Extra-cellular volume
EDV	.....	End diastolic volume

EFEjection fraction
ELBWExtremely low birth weight
FFPFresh frozen plasma
GFRGlomerular filtration rate
HESHydroxyethyl starch
HFHeart failure
HgHemoglobin
HMEHeat and moisture exchange filter
HPA axis Hypothalamic-pituitary-adrenal axis
HRHeart rate
ICFIntra-cellular fluid
ICPIntra-cerebral pressure
IVIntra-venous
IVFIntravascular fluid
LRLactated Ringer "Ringer`s lactate"
MWMolecular weight
NHSNational Health Service
NPONil per os
NSNormal saline "0.9% NaCl"
OROperating room

ORT **O**ral rehydration therapy
PAOP **P**ulmonary artery occlusion pressure
PPF **P**lasma protein fraction
PTT **P**artial thromboplastin time
RAS **R**eticular activating system
RF **R**enal failure
RPP **R**enal perfusion pressure
SV **S**troke volume
RVEDV .. **R**ight ventricular end diastolic volume
TBW **T**otal body water
UK **U**nited 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).

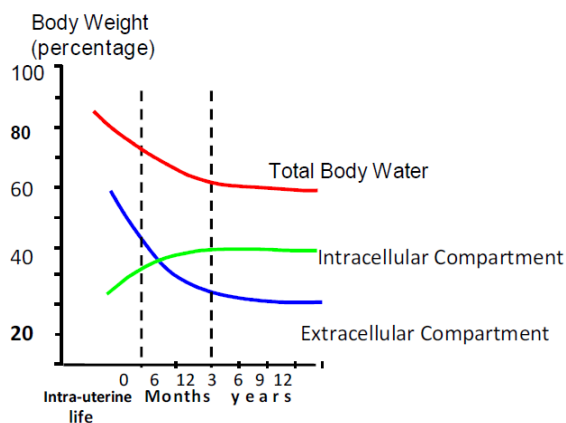


Figure (1): Winters diagram with the subdivision of TBW, ICF and ECF as a function of age (Ruth and Wassner, 2006).

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%