Anaesthetic Considerations for Congenital Neonatal Surgical Emergencies

ESSAY

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بسم الله الرحمن الرحيم

﴿... وَمَا أُوتِيتُم مِّنَ العِلمِ إلاَّ قَلِيلاً﴾

صدق الله العظيم

سورة الإسراء ... من الآية ٨٥

بسم الله الرحمن الرحيم

To The Soul of My Father And All of My Family Members For Their Continuous Support And Encouragement,

And To My Wife For Her Encouragement, Consideration And Endless Patience

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2,3 DPG	2,3 Diphosphoglycerate
ABG	Arterial Blood Gases
BBB	Blood Brain Barrier
bpm	beat per minute
BSS	Balanced Salt Solution
BW	Body Weight
CBF	Cerebral Blood Flow
CDH	Congenital Diaphragmatic Hernia
CHD	Congenital Heart Disease
CHF	Congestive Heart Failure
CO	Cardiac Output
CPB	Cardiopulmonary Bypass
CSF	Cerebrospinal Fluid
CVP	Central Venous Pressure
DA	Ductus Arteriosus
ECF	Extracellular Fluid
ECMO	Extracorporeal Membrane Oxygenation
ETT	Endotracheal Tube
F_E/F_I	Expiratory to Inspiratory Fraction
Fig.	Figure
Fio_2	Inspired Fraction of Oxygen
FO	Foramen Ovale
FRC	Functional Residual Capacity
GA	Gestational Age
GFR	Glomerular Filtration Rate
GIT	Gastrointestinal Tract
Hb	Haemoglobin

List of Abbreviations

HMD	Hyaline Membrane Disease
HR	Heart Rate
IA	Inhalation Agents
im.	Intramuscular
iv.	Intravenous
IVC	Inferior Vena Cava
IVH	Intra-ventricular Haemorrhage
LMA	Laryngeal Mask Airway
MAC	Minimum Alveolar Concentration
MAP	Mean Arterial Pressure
min	minute(s)
N_2O	Nitrous Oxide
NEC	Necrotizing Enterocolitis
NGT	Nasogastric Tube
NICU	Neonatal Intensive Care Unit
PACU	Post Anaesthesia Care Unit
PBF	Pulmonary Blood Flow
PDA	Patent Ductus Arteriosus
PEEP	Positive End Expiratory Pressure
PPHN	Persistent Pulmonary Hypertension of the Newborn
PVR	Pulmonary Vascular Resistance
RBCs	Red Blood Corpuscles
RBF	Renal Blood Flow
ROP	Retinopathy Of Prematurity
RVR	Renal Vascular Resistance
SA	Surface Area

List of Abbreviations

sec	second (s)
SVR	Systemic Vascular Resistance
TBW	Total Body Water
TGA	Transposition of the Great Arteries
T_mG	Tubular maximum for Reabsorption of Glucose
T_mPAH	Tubular Transport of Para-aminohippuric Acid
TOF	Tracheo-oesophageal Fistula
VA	Alveolar Ventilation
VD	Dead Space Volume
VSD	Ventricular Septal Defect
V_T	Tidal Volume

Neonatal Physiology

NEONATAL PHYSIOLOGY

The newborn infant is an infant in the first 24 hours of life, while the neonatal period is defined as the first 30 days of extrauterine life and includes the newborn period ***(Berry, 1997).***

This chapter presents the physiological differences between neonates and older children, and adults. It also highlights the drastic changes which the newborn infant undergoes to render it capable of extrauterine existence, starting from the moment of separation between the placenta and the newborn.

PHYSIOLOGY OF THE RESPIRATORY SYSTEM :

I. Prenatal Development of the Lungs :

The foetal lungs start their development in the first few weeks of embryonic life as a ventral bud from the primitive foregut. By the 17 weeks gestation, preacinar branching of the airways (down to the terminal bronchioles) is complete. Interruption of development at this stage, as occurs in CDH, leads to pulmonary hypoplasia at birth, the severity of which depends upon how early this interruption occurs. At about 24 weeks' GA, the terminal sac period is reached, being characterized by appearance of clusters of air sacs. During the 26-28 weeks' GA, capillary networks around the terminal air sacs become relatively extensive, and the air space wall thickness decreases markedly. By 36 weeks' GA alveoli are uniformly present, but most alveolar formation, however, occurs after birth. At 24 weeks' GA, "immature" surfactant appears (secreted by type II alveolar epithelial cells), while fully functional surfactant appears at 34-36 weeks of gestation.

Therefore, it's concluded that the respiratory device of the human foetus is capable of a relatively adequate gas exchange at 26-28 weeks of gestations, although it has been reported that premature infants of 24-25 weeks gestation or less have actually survived suggesting occasional earlier development of the respiratory system ***(Murray, 1986)***.

II. The First Extrauterine Breaths :

The normal human foetus is known to perform respiratory movements in utero. This intrauterine "breathing" starts in the human foetus at 30 weeks GA, and the mechanism and significance of which have not clarified yet, but it may represent some sort of training for the respiratory system ***(Murray, 1986)***.

Squeezing of the thoracic cage during vaginal delivery and often in cesarean section expells about 5-10 mls of tracheal fluid. Subsequent recoil of the rib cage after its passage passively introduces air into the proximal airways, but the first active breath requires the contraction of the diaphragm to generate a negative intrathoracic pressure in a range of 40-60cm H_2o. Various factors are claimed to initiate the first diaphragmatic contraction e.g. exposure to cold environment, and rubbing of the baby's skin. Additionally, the inevitable mixed acidaemia resulting during the process of labor was claimed to initiate the first breath via activation of the chemoreceptors, but this remains controversial as in experimental animals respiration will start with the peripheral chemoreceptors denervated. Soon after the first breath has been taken, maintenance of adequate normal ventilation depends upon many factors e.g. integrated central control, alveolar stability provided by adequate surfactant, muscle power of the