Cardiac Troponin T as a Marker of Cardiac Dysfunction in Neonates with Respiratory Distress.

Thesis

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List of abbreviations

ACC	American College of Cardiology
ACS	Acute coronary syndrome
AI	Aortic insufficiency
AMI	Acute myocardial infarction
Ao	Aortic cross sectional area
ARF	Acute renal failure
AS	Aortic stenosis
ATP	Adenosine triphosphate
AV	Arteriovenous
Ca^{2+}	Calcium ions
CCAM	Congenital cystic adenomatoid malformation
CDH	Congenital diaphragmatic hernia
CHD	Congenital heart disease
CK	Creatine kinase
CK-MB	Creatine kinase myocardial bound
CLE	Congenital lobar emphysema
CMR	Cardiac magnetic resonance
CoA	Coarctation of the aorta
CPAP	Continuous positive airway pressure
cTn	Cardiac troponin
cTnI	Cardiac troponin I
cTnT	Cardiac troponin T
CV	Coefficient of variability
EA	Esophageal atresia
ECLIA	Electrochemilunescence immunoassay
ECMO	Extracorporeal membrane oxygenation
ESC	European Society of Cardiology
FiO_2	Fraction of inspired oxygen
GBS	Group B streptococci
HOCM	Hypertrophic obstructive cardiomyopathy
IDM	Infant of diabetic mother
JVH	Jugular venous hum
kDa	Kilodalton
LDH	Lactate dehydrogenase
LLSB	Left lower sternal border
LUSB	Left upper sternal border
LV_D	Left ventricular end-diastolic dimension

List of abbreviations (Cont.)

LVFS	Left ventricular fractional shortening
LVO	Left ventricular output
LV_S	Left ventricular end-systolic dimension
MAP	Mean airway pressure
MAS	Meconium aspiration syndrome
Mg^{2+}	Magnesium ions
MI	Myocardial infarction
MMP	Matrix metalloproteinases
MR	Mitral regurge
MS	Mitral stenosis
NO	Nitric oxide
OI	Oxygenation index
$PaCO_2$	Partial pressure of carbon dioxide
PaO_2	Partial pressure of oxygen
PDA	Patent ductus arteriosus
PEEP	Positive end expiratory pressure
PET	Pre-eclamptic toxemia
PI	Pulmonary insufficiency
PIE	Pulmonary interstitial emphysema
PIP	Peak inspiratory pressure
PO	Pulse oximetry
PPHN	Persistent pulmonary hypertension
PPROM	Preterm premature rupture of membranes
PROM	Premature rupture of membranes
PVR	Peripheral vascular resistance
RDS	Respiratory distress syndrome
RUSB	Right upper sternal border
SpO_2	Oxygen saturation
SPSS	Statistical package for social science
STAT	Short Turn Around Time
STEMI	ST-segment elevation myocardial infarction
sTnT	Skeletal Troponin T
SVR	Systemic vascular resistance
TCT	Total cycle time
TEF	Tracheo-esophageal fistula
Ti	Inspiratory time
TnC	Troponin C

List of abbreviations (Cont.)

TnI	Troponin I
TnT	Troponin T
TR	Tricuspid regurge
TS	Tricuspid stenosis
TTN	Transient tachypnea of the newborn
VACTERL	Vertebral-anal-cardiac-tracheoesophageal-rectal-limb anomalies
VTI	Velocity time integral

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Introduction

Cardiovascular compromise is common in sick term and preterm infants ***(Clark et al., 2004).*** Cardiac function has been demonstrated to be influenced by the severity of respiratory distress and its ventilatory management in this age group ***(Trevisanuto et al., 2006).***

Previous studies in neonates have used creatine kinase isoforms as biochemical markers of myocardial injury. However, these markers have been largely discarded because gestation, sex, mode of delivery, and birth weight all affect creatine kinase activity ***(Clark et al., 2004).***

Troponin is an inhibitory protein complex forming part of the contractile apparatus of all striated muscle, including the heart. Specific forms of the three troponin subunits T, C, and I exist in different muscle types ***(Clark et al., 2004).***

Cardiac troponin T (cTnT) structure is unique to the myocardium which allows assessment of cardiac injury even in the presence of skeletal one ***(Adamcova et al., 2000).***

Cardiac specific troponins T and I have become established as the best biochemical markers for screening and

diagnosis of myocardial necrosis ***(El-Khuffash and Molloy, 2008).***

Although wide consensus has been established on the clinical utility of troponins in adults with acute coronary syndrome (***Trevisanuto et al., 2006),*** troponins have not been used routinely in neonates.

Since 1995, relatively few studies have investigated the association between cTnT and respiratory distress without precising its role in ventilatory duration ***(Awada et al., 2007).***

Aim of the work

The aim of this study is to compare cardiac troponin T (cTnT) concentration among healthy neonates and those with respiratory distress and to detect whether any correlation could occur between severity of respiratory distress, need for inotropes and troponin concentrations.

Respiratory distress in the newborn

Introduction:

Respiratory distress in newborns is a challenging problem and accounts for significant morbidity and mortality. It occurs in approximately 7% of infants, and preparation is crucial for physicians providing neonatal care ***(Hermansen and Lorah, 2007).***

Respiratory distress in newborn infants is manifested by signs including tachypnea, nasal flaring, intercostal or subcostal retractions, audible grunting and cyanosis. This condition is common immediately after birth and is transient in most cases. However, persistent respiratory distress requires a rational diagnostic and therapeutic approach to optimize outcome and minimize morbidity ***(Welty, 2009).***

Perinatal adaptations:

With the first breath and cutting of the umbilical cord, the neonate begins the passage from intrauterine to extrauterine life. For this process to occur correctly, as it does in most cases, the fetus is prepared during the intrauterine period with normal physical development and neuromuscular control ***(Rohan and Golombek, 2009).***

In the fetus, systemic vascular resistance (SVR) normally is low, primarily because of the low-resistance placental vessels. Pulmonary vascular resistance (PVR) is high, resulting in diversion of blood from the pulmonary artery through the ductus arteriosus away from the lungs. After birth, SVR increases when the umbilical cord is clamped, and PVR decreases with the onset of regular breathing and increased alveolar oxygenation (figure 1) ***(Welty, 2009).***

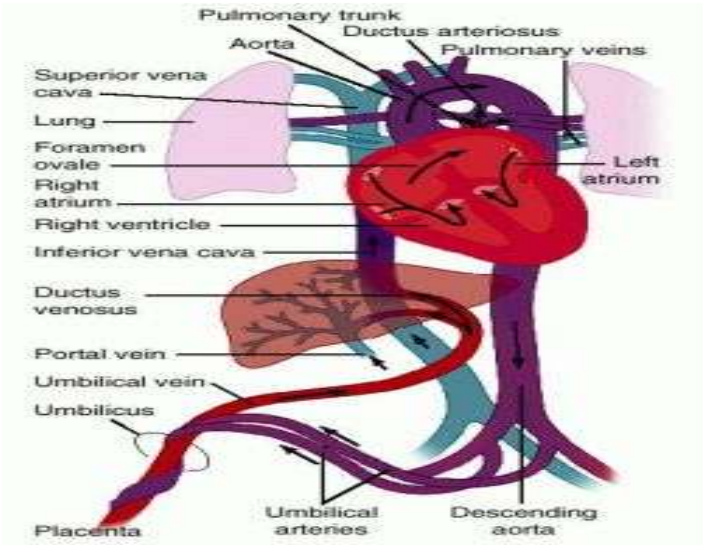

Figure (1): Schematic diagram of fetal circulation, with red indicating the highest level of oxygen saturation, blue the lowest, and purple an intermediate level ***(Saunders, 2007).***

The fetal lung is filled with fluid that must be cleared in order for adequate gas exchange to occur after birth. In late gestation and as labor ensues, the production of lung fluid decreases and transporters in the lung that increase lung fluid clearance are induced, so that lung fluid can be cleared rapidly. Synthesis of surfactant and antioxidant enzymes also increases during the latter part of gestation to prepare the lungs for air breathing. Surfactant lining the alveoli enhances the aeration of gas-free lungs by reducing surface tension, thereby lowering the pressure required to open the alveoli ***(Welty, 2009).***

During vaginal delivery, intermittent compression of the thorax facilitates removal of lung fluid. With initiation of breathing, alveolar surface tension is established, and as a result, pulmonary blood flow and volume are increased. Alveolar arterial oxygen rises, as does the partial pressure of oxygen in circulating systemic blood. In turn, the dusky color