

Sun. Nov 22, 2020

Track1

AEPC-YIA Session

AEPC-YIA Session ( I-YIA)

座長:小野 博 (国立成育医療研究センター 循環器科)

9:30 AM - 10:00 AM Track1

[I-YIA-1] Hepatic Venous Oxygen Saturation As a Novel  
Marker for Fontan Associated Liver Disorder

○Kanchi Saito, Hirofumi Saiki, Yurie Takizawa,  
Satoshi Nakano, Shin Takahashi, Kotaro Oyama  
(Department of Pediatrics, Iwate Medical  
University School of Medicine)

[I-YIA-2] Exercise-Induced Peripheral Venous  
Hypertension inversely correlates to peak  
VO2 in Fontan patients

○Shin Ono, Takuya Wakamiya, Yuuta Mizuno, Ken  
Ikegawa, Takaaki Sugiyama, Shun Kawai, Ki-sung  
Kim, Sadamitsu Yanagi, Hideaki Ueda (Kanagawa  
Children's Medical Center, Pediatric  
Cardiology (神奈川県立こども医療センター循環器内  
科) )

[I-YIA-3] Influence of bronchus on the growth of major  
aortopulmonary collateral arteries after  
unifocalization

○Yujiro Ide (井出 雄二郎) (Kyoto University  
Hospital, Department of Cardiovascular  
Surgery (京都大学医学部附属病院心臓血管外科) )

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### [I-YIA-2] Exercise-Induced Peripheral Venous Hypertension inversely correlates to peak V02 in Fontan patients

○Shin Ono, Takuya Wakamiya, Yuuta Mizuno, Ken Ikegawa, Takaaki Sugiyama, Shun Kawai, Ki-sung Kim, Sadamitsu Yanagi, Hideaki Ueda (Kanagawa Children's Medical Center, Pediatric Cardiology (神奈川県立こども医療センター循環器内科))

### [I-YIA-3] Influence of bronchus on the growth of major aortopulmonary collateral arteries after unifocalization

○Yujiro Ide (井出 雄二郎) (Kyoto University Hospital, Department of Cardiovascular Surgery (京都大学医学部附属病院心臓血管外科))

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## [I-YIA-1] Hepatic Venous Oxygen Saturation As a Novel Marker for Fontan Associated Liver Disorder

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(Department of Pediatrics, Iwate Medical University School of Medicine)

### Introduction

Fontan associated liver disorder (FALD) is one of critical complications after Fontan procedure. Despite advancement of imaging and molecular technologies, prospective studies failed to identify sensitive biomarker to detect subclinical FALD, where its prevalence is estimated more than 80% in 10 years. As the main source of liver blood supply changes from portal vein (low oxygen saturation:SO<sub>2</sub>) to hepatic artery (high SO<sub>2</sub>) with the progression of hepatic fibrosis, we hypothesized that the hepatic venous SO<sub>2</sub> increased with the development of liver fibrosis.

### Methods

During catheterization, hemodynamics as well as hepatic circulation property including transhepatic pressure were assessed in consecutive 117 Fontan and 86 non-Fontan patients. Multiple markers for liver fibrosis were measured and their relationship with hemodynamic properties was analyzed.

### Results

As compared with non-Fontan patients, Fontan patients had low cardiac output (CI), high central venous, hepatic venous, and hepatic wedge pressures (p values for all, <0.001), whereas transhepatic pressure was similar. As hepatic venous (HV) as well as inferior vena cava (IVC) SO<sub>2</sub> were dependent on arterial SO<sub>2</sub> and CI, SO<sub>2</sub> ratio of HV/IVC (SR-HV/IVC), which was independent of them, was analyzed. The SR-HV/IVC in the Fontan patients was markedly lower than non-Fontan patients, suggesting unfavorable liver perfusion in the Fontan patients. Interestingly, although the SR-HV/IVC in the non-Fontan patients was consistent regardless of their age (SO<sub>2</sub> HV/IVC= 0.90-0.001\*age, p=0.83), it became markedly low at 1year of Fontan procedure in the Fontan patients, with subsequent increase to the level of non-Fontan patients after 10 years of Fontan procedure (SO<sub>2</sub> HV/IVC= 0.67+0.01\*age, p=0.0023), in compliance with the reported prevalence of subclinical FALD. Importantly, SRHV/IVC in the Fontan patients was negatively correlated with platelet counts (p=0.026) and albumin/IgG ratio (p=0.0035), and positively correlated with serum levels of total-bilirubin (p=0.037) and hyaluronic acid (p=0.055).

### Conclusions

SR-HV/IVC, which supposed to reflect pathological feature of hepatic vascular remodeling, is a novel biomarker for subclinical FALD. Prospective studies to investigate utility of SR-HV/IVC to guide prevention of FALD would be warranted.

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## [I-YIA-2] Exercise-Induced Peripheral Venous Hypertension inversely correlates to peak V0<sub>2</sub> in Fontan patients

○Shin Ono, Takuya Wakamiya, Yuuta Mizuno, Ken Ikegawa, Takaaki Sugiyama, Shun Kawai, Ki-sung Kim, Sadamitsu Yanagi, Hideaki Ueda (Kanagawa Children's Medical Center, Pediatric Cardiology (神奈川県立こども医療センター循環器内科) )

**Introductions:** Fontan patients have a reduced exercise capacity due to limitation in the ability to augment cardiac output. Central venous pressure (CVP) rises to increase systemic ventricular preload because of the absence of subpulmonary ventricular in Fontan patients. We performed a prospective trial of cardiopulmonary exercise test (CPET) while monitoring peripheral venous pressure (PVP) which strongly correlates to CVP to investigate the correlation between PVP and exercise capacity.

**Methods:** Seventeen patients with Fontan circulation (9 males, median age: 12 years) underwent ramp-like progressive exercise test on a treadmill. A 22-gauge venous cannula was inserted into the peripheral vein in the upper extremities before CPET. PVP (mmHg) was monitored at rest and during exercise. We checked correlation between PVP at peak exercise and exercise-related hemodynamic indices including peak  $\dot{V}O_2$  (l/min/kg), HR reserve (bpm) (HRR) and peak oxygen pulse (l/m<sup>2</sup>) respectively. We also performed catheterization and blood examination to measure CVP (mmHg), ventricular end-diastolic pressure (mmHg), ventricular ejection fraction (%), cardiac index (l/min/m<sup>2</sup>), pulmonary vascular resistance (unit·m<sup>2</sup>), pulmonary artery index and brain natriuretic peptide (pg/mL). We also checked correlation between these indices and peak  $\dot{V}O_2$ .

**Results:** PVP rose in concert with exercise intensity in all subjects. PVPs at peak exercise was significantly higher than those at rest ( $23.5 \pm 4.4$  vs  $12 \pm 1.7$ ,  $p < 0.01$ ). Peak PVP inversely correlated to peak  $\dot{V}O_2$ , HRR and peak oxygen pulse ( $r = -0.66$ ,  $p < 0.01$ ,  $r = -0.6$ ,  $p < 0.05$ ,  $r = -0.5$ ,  $p < 0.05$ ). No static hemodynamic indices from catheterization or blood examination correlated to Peak  $\dot{V}O_2$ .

**Conclusions:** In Fontan patients, exercise induced peripheral venous hypertension means inefficiency of pulmonary flow augmentation during exercise, causing insufficient ventricular filling which induces not only insufficient cardiac output and insufficient stroke volume but also attenuated HR increase.

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## [I-YIA-3] Influence of bronchus on the growth of major aortopulmonary collateral arteries after unifocalization

○Yujiro Ide (井出 雄二郎) (Kyoto University Hospital, Department of Cardiovascular Surgery (京都大学医学部附属病院心臓血管外科))

### Objectives

MAPCAに対する乳児期の Unifocalization(UF) は標準的な外科治療となっている。しかし、UF後の MAPCAの中には、狭窄や低成長のために追加のカテーテル治療や手術が必要となるものが少なくない。我々は、UFのデザイン自体が血管成長に影響を及ぼす可能性を考え、MAPCAと気管支の位置関係に注目して、MAPCAの血管成長を検証した。

### Methods

2001年から2019年までに、当院で9人の PA/VSD/MAPCAの患者が、UFを施行された。全例で手術介入前に血管造影検査と造影 CT検査を行い、肺血流分布の詳細と、MAPCAと気管支の位置関係を確認した。この術前検査で、気管支背側を走行し肺門部へ向かう MAPCA(retro-bronchial MAPCA; rbMAPCAと定義)が、4人の患者で確認された。rbMAPCA(s)、non-rbMAPCA(s)、native pulmonary artery(PA)の血管径を、UF前後の血管造影画像上で計測し、血管成長の経時的変化を検証した。

## Results

UF前の血管造影検査(日齢; 34 (24-76)日, 体重; 2.8 (2.7-3.6) kg)で、MAPCAは16本確認された。その内 6本 (37.5%)が rbMAPCAsであった。全4例で、native PA(1例で non-confluent left PA)が確認され、UF前の original unilateral PA、rbMAPCA、non-rbMAPCAの径(mm/m<sup>2</sup>)は、それぞれ $21.5 \pm 6.78$ ,  $22.4 \pm 3.76$ ,  $21.1 \pm 5.74$  (One-Way ANOVA,  $p=0.9232$ )であった。全4例で、UFは正中切開で一期的に完成し、肺血流源は modified BT shuntとした。手術時年齢は1.6(1.0-2.5)ヶ月、手術時体重は2.9(2.7-3.3)kgであった。直近の血管造影検査は、UF完成後5.5 (2.0 -10.0)年で行い、全例が根治手術到達後であった。気管周囲部での rbMAPCAの径( $5.38 \pm 1.34$ mm/m<sup>2</sup>)は、native unilateral PAs( $15.22 \pm 5.88$ mm/m<sup>2</sup>,  $p=0.0016$ ) や non-rbMAPCA( $10.40 \pm 4.91$ mm/m<sup>2</sup>,  $p=0.0292$ )と比較すると、有意に小さかった。

## Conclusions

rbMAPCAは、その位置のまま UFを行った場合、気管支を交差し中縦隔に出現する部分で狭窄となる傾向が確認された。rbMAPCAの UFの際には、気管支前方に translocateすることで、正常の肺動脈と同様の配置となり、将来的な狭窄発生を未然に防ぐことが可能となると考えられる。