Department of Preventive Cardiology and Lipidology

International Doctoral School
Medical University of Lodz

PhD student: **Andrzej Wittczak MD**
Supervisor: **Prof. Agata Bielecka-Dąbrowa MD, PhD, FESC, FHFA**

Fontan circulation- comparison of the systemic ventricle with left and right ventricular morphology

INTRODUCTION

The Fontan operation was introduced in 1968 and has become the definitive, palliative treatment for patients with functionally univentricular heart. The surgery separates pulmonary and systemic circulation by the creation of a venous-to-pulmonary connection for the passive delivery of deoxygenated blood into the lungs and utilization of the single functional ventricle to maintain systemic circulation.

The aim of this subproject was to retrospectively compare the clinical data of patients with the Fontan circulation and the single functional ventricle with right and left ventricular morphology (**Figure 1**).

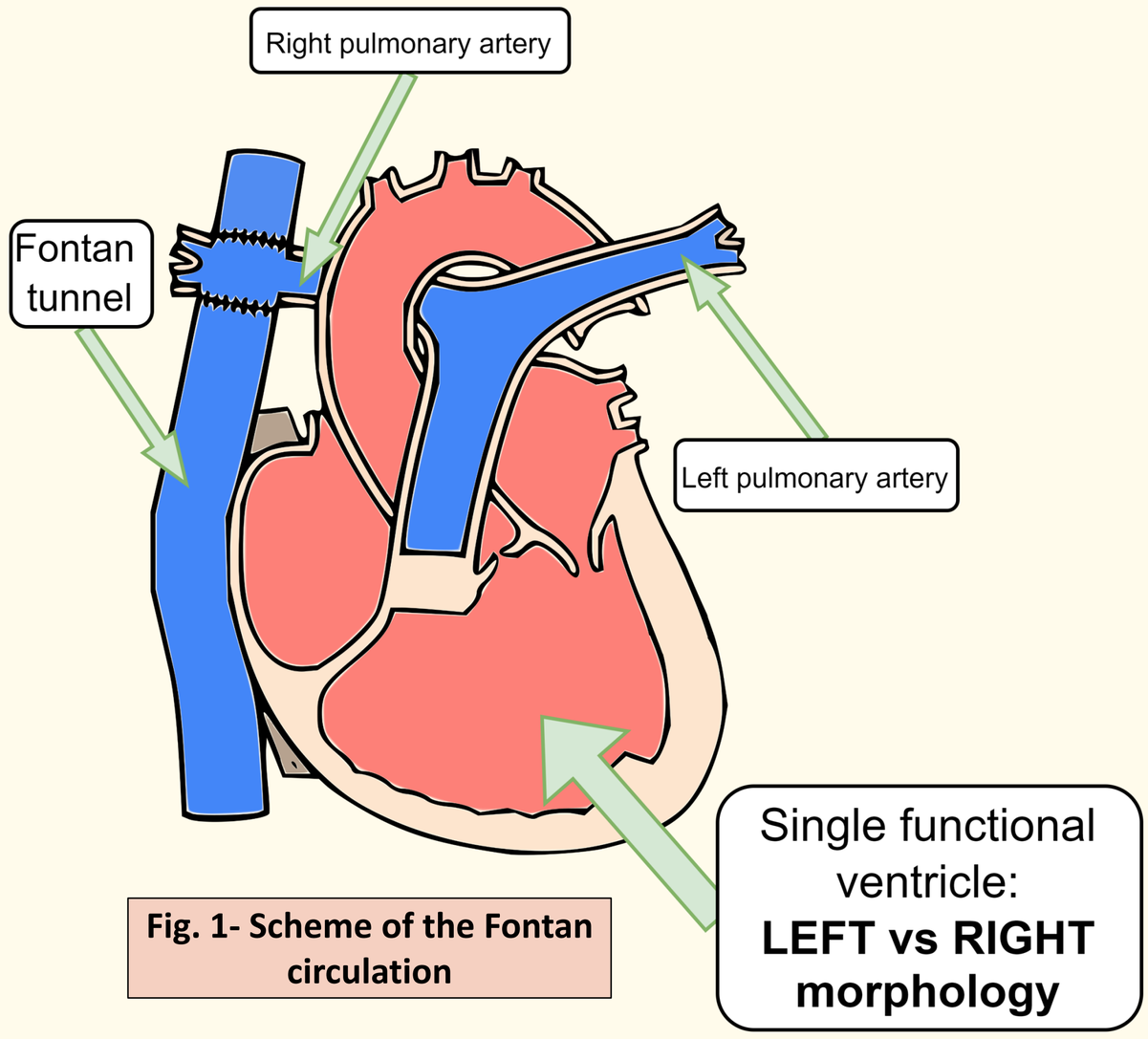


Fig. 1- Scheme of the Fontan circulation

MATERIALS AND METHODS

I included 20 patients with the Fontan circulation hospitalized in the years 2019-2024 in the Department of Cardiology and Congenital Diseases of Adults, Polish Mother's Memorial Hospital Research Institute in Lodz. 10 patients had the single functional ventricle of left ventricular morphology (LV group) and 10 patients had the single functional ventricle of right ventricular morphology (RV group). All data were collected from the medical records.

I subjected the obtained data to statistical analysis. The STATISTICA 13.1 software package (StatSoft, USA) was used.

RESULTS

In the group of all 20 patients, the mean age was 21.95 ± 2.04 years; 9 (45%) of these patients were female. The median age at Fontan operation was 61 months (IQR 48-86.5). All patients underwent an extracardiac conduit total cavopulmonary connection type of the Fontan operation.

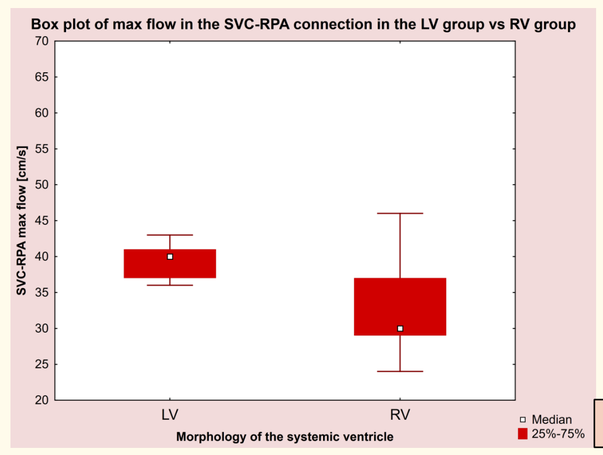
The characteristics of the study group and selected parameters from the medical tests are presented in the **Table 1**.

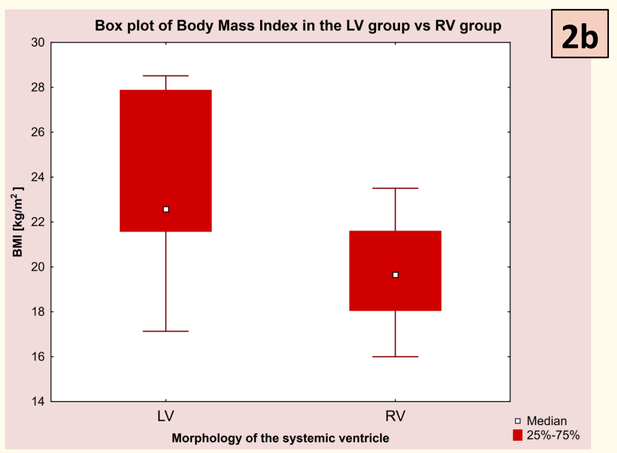
The variables for which the differences between groups were statistically significant are presented in box plots in the **Figure 2a-c**.

	LV group (N=10)	RV group (N=10)	p value
Age [years]	21,8 ± 1,75	22,1 ± 2,38	0,75
Gender (female) [N, %]	6 (60%)	3 (30%)	0,37
BMI [kg/m^2]	23,22 ± 4,08	19,7 ± 2,21	**0,027**
Age at Fontan operation [months]	64 (IQR 53-114)	57,5 (IQR 41-73)	0,41
Fenestration [N, %]	7 (70%)	8 (80%)	>0,99
FALD [N, %]	6 (60%)	7 (70%)	>0,99
Arrhythmia [N, %]	4 (40%)	5 (50%)	>0,99
Fontan tunnel stenting [N, %]	5 (50%)	3 (30%)	0,65
Pulmonary artery stenting [N, %]	2 (20%)	7 (70%)	0,07
SVC-RPA max flow [cm/s]	40 (IQR 37-41)	30 (IQR 29-37)	**0,03**
IVC-RPA max flow [cm/s]	44,5 (IQR 28-68)	33,5 (IQR 27-39)	0,08
Average HR in 24h Holter ECG [beats/min]	72 ± 8	69,5 ± 10	0,55
ExSV [N]	16 (IQR 3-168)	2 (IQR 0-10)	0,16
ExV [N]	8 (IQR 0-128)	49 (IQR 5-522)	0,24
Mean SBP in ABMP [mmHg]	113,6 ± 14,58	114,7 ± 9,02	0,84
Mean DBP in ABPM [mmHg]	66,8 ± 7,55	67,1 ± 4,23	0,91
Serum urea concentration [mg/dl]	24,58 ± 6,23	33,65 ± 7,12	**0,007**
NT-proBNP [pg/ml]	68,5 (IQR 26-145)	119 (IQR 35-210)	0,62
hsTnT [pg/ml]	3,9 (IQR 3,4-5,1)	5,35 (IQR 3,9-7,7)	0,15
Exercise time in CPET [s]	492 (IQR 407-712)	629 (IQR 605-723)	0,27
O_2pulse [ml/beat]	10,4 ± 2,67	9,91 ± 1,84	0,64
VO_2peak [ml/kg/min]	20,5 (IQR 19-29)	27 (IQR 25-31)	0,068
%VO_2pred [%]	62,6 ± 9,83	64,7 ± 12,04	0,67
RER	1,105 (IQR 1,08-1,14)	1,075 (IQR 1,07-1,08)	0,13
%VO_2AT [%]	41 (IQR 33-55)	47 (IQR 44-57)	0,38

Table 1- The characteristics of the study group and selected parameters from the medical tests

Abbreviations: IQR- interquartile range; LV- left ventricle; RV- right ventricle, BMI- body mass index; FALD- Fontan-associated liver disease; SVC- superior vena cava; RPA- right pulmonary artery; IVC- inferior vena cava; HR- heart rate; ExSV- supraventricular extrasystolic beats; ExV- ventricular extrasystolic beats; SBP- systolic blood pressure; DBP- diastolic blood pressure; ABPM- ambulatory blood pressure monitoring; NT-proBNP- N-terminal prohormone of brain natriuretic peptide; hsTnT- high-sensitivity troponin T; CPET- cardiopulmonary exercise testing; O_2pulse- oxygen pulse; VO_2peak -peak oxygen consumption; %VO_2pred- predicted peak oxygen consumption; RER- respiratory exchange ratio; %VO_2AT- anaerobic threshold.





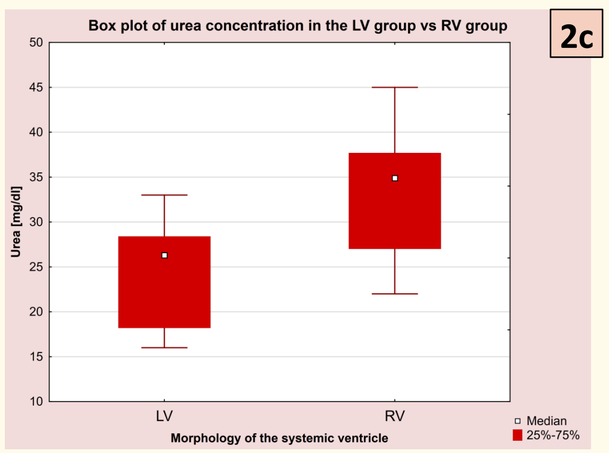


Fig. 2- Box plots of the variables for which the differences between groups were statistically significant

2a- Body Mass Index; 2b- maximal flow in the superior vena cava (SVC)- right pulmonary artery (RPA) connection (Glenn shunt); 2c- serum urea concentration

CONCLUSIONS

1. The body mass index of patients with right ventricular morphology was significantly lower. This may be correlated with lower lean muscle mass in these patients. I will be measuring this parameter using bioelectrical impedance analysis in the prospective part of my project. This will allow for an accurate analysis of the differences in body composition between the groups.
2. Left pulmonary artery stenting was more frequent in patients with right ventricular morphology, almost reaching statistical significance. This is consistent with the literature, as left pulmonary artery stenosis is a well-recognized complication following surgical palliation of hypoplastic left heart syndrome.
3. The analysis was limited by the small number of patients. Comparisons of several variables may reach statistical significance with the inclusion of a larger number of participants. I plan to continue these analyses as my project continues.