

# Intellectual outcome in children after complex cardiac surgery: Arterial switch operation vs. total cavopulmonary connection

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## 1. Introduction

Due to declining mortality rates in children with a congenital heart disease, the scientific focus shifts towards their morbidity, neuro-developmental outcome and quality of life.

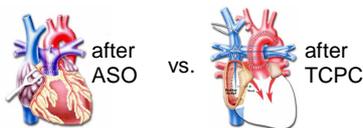
For both groups, patients after arterial switch operation (ASO) for d-transposition of the great arteries (d-TGA) and children with functional single ventricle after total cavopulmonary connection (TCPC), a lower intellectual function compared to the general population has been reported (e.g. ASO: Bellinger et al., 1999, Karl et al., 2004; TCPC: Forbess et al., 2001, Sarajuuri et al., 2007).

The *purpose* of the present study was to **compare intellectual outcome** of these two groups. Since children with functional single ventricle are in most cases exposed to substantially more medical and psychosocial risk factors for an impaired neurodevelopment than children with d-TGA, a lower intellectual function was expected in these patients.

## 2. Methods

### Participants

- 29 patients after ASO for d-TGA; aged 4 to 12 years, mean age 7.5 ± 2.5 years; 26 boys (90%)
  - 89 patients with functional single ventricle after TCPC; aged 3 to 12 years, mean age 7.5 ± 2.5 years; 55 boys (62%)
- all patients were operated in the German Children's Heart Centre Sankt Augustin, Germany.



### Cognitive Testing

Kaufman-Assessment Battery for Children; K-ABC  
(German version)

The K-ABC measures two aspects of intellectual function on different scales:

- *fluid intelligence* = the ability to think logically and solve problems in new situations, independent of acquired knowledge (e.g. logical reasoning) → "mental processing scale" with two processing subscales (sequential processing vs. simultaneous processing).
- *crystallized intelligence* = a product of educational and cultural experience, cognitive skills that are acquired through a learning process (e.g. reading skills, arithmetic skills) → "achievement scale".

For analysis, the mean test scores of the groups were compared to each other.

## 3. Results

Tab. 1: Mental processing scale: Subtests

Subtest		Mean(±SD) <sup>a</sup>	p
Hand movements	TCPC	9.4 (±2.3) <sup>a</sup>	.15
	ASO	9.9 (±2.3)	
Gestalt closure	TCPC	8.7 (±2.8)	.32
	ASO	8.5 (±2.0)	
Number recall	TCPC	9.1 (±2.1)	.28
	ASO	8.8 (±2.2)	
Triangles	TCPC	8.2 (±3.2)	.08
	ASO	9.1 (±3.2)	
Word order	TCPC	9.1 (±2.7)	.20
	ASO	9.6 (±2.2)	
Matrix analogies	TCPC	8.6 (±2.5)	.32
	ASO	8.9 (±2.1)	
Spatial memory	TCPC	9.9 (±3.1)	.09
	ASO	10.9 (±2.6)	
Photo series	TCPC	7.9 (±2.4)	<.01*
	ASO	9.6 (±2.5)	

<sup>a</sup>general population 10 (± 3)

\*significant difference between groups

Tab. 2: Achievement scale: Subtests

Subtest		Mean(±SD)	p
Faces & Places	TCPC	88.8 (±14.7) <sup>a</sup>	.31
	ASO	90.5 (±15.8)	
Arithmetic	TCPC	96.0 (±14.6)	.08
	ASO	100.6 (±13.7)	
Riddle	TCPC	95.5 (±14.2)	< .05*
	ASO	101.1 (±15.2)	
Reading/Understanding	TCPC	93.1 (±13.2)	.06
	ASO	99.3 (±9.5)	

<sup>a</sup>general population 100 (± 15)

\* significant difference between groups

Tab. 3: Composite scores

Score		Mean(±SD)	p
Sequential processing scale	TCPC	95.6 (±12.9) <sup>a</sup>	.32
	ASO	96.9 (±11.2)	
Simultaneous processing scale	TCPC	91.7 (±15.3)	.10
	ASO	95.9 (±12.8)	
Mental processing scale	TCPC	93.2 (±12.2)	.13
	ASO	96.1 (±10.1)	
Achievement scale	TCPC	92.1 (±14.8)	<.05*
	ASO	97.3 (±11.6)	

<sup>a</sup>general population 100 (± 15)

\* significant difference between groups

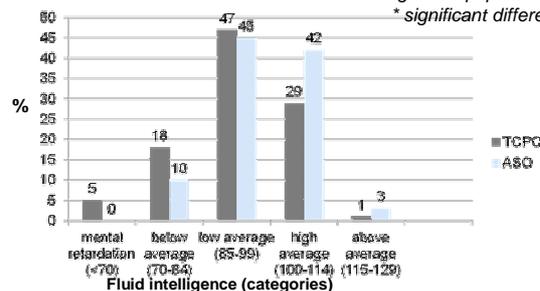


Fig. 1: Number of patients in fluid intelligence categories (mental processing scale)

## 4. Conclusions

Overall, patients with functional single ventricle after TCPC achieved **lower mean scores** on all (sub-)scales of the K-ABC than children after ASO for d-TGA.

On the fluid intelligence scale ("mental processing scale"), they scored descriptively but not significantly lower than patients after ASO (93.2 vs. 96.1; see tab. 3). Aside from two subtests – "gestalt closure" and "number recall" –, they scored descriptively or significantly lower on all subtests of this scale (see tab. 1).

On the crystallized intelligence scale ("achievement scale"), they achieved a significantly lower mean score than children after ASO (92.1 vs. 97.3; see tab. 3). They showed a descriptively or significantly worse performance on all subtests of this scale (see tab. 2).

These findings are consistent with the report of Brosig et al. (2007). Especially patients after TCPC require careful observation of neurodevelopmental outcome and appropriate interventions when indicated.

## 5. References

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