Pressure record analytical method monitoring ventricular efficiency in children with tetralogy of Fallot undergoing surgical correction

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Objective

Energy-based endpoints are proved to be superior indicators in accessing hemodynamic status. Cardiac cycle efficiency (CCE) and ventricular-arterial coupling (VAC) derived from pressure record analytical method (PRAM) are parameters related with ventricular efficiency. We aim to compare tetralogy of Fallot children (TOF) with control ventricular septal defect (VSD) children undergoing correction surgery on profile of ventricular efficiency.

Methods

50 children (1.3±1.0 year） with VSD and 46 with TOF (1.0±0.8 year) scheduled for complete repair, were enrolled. In operation room, a radial arterial catheter were inserted to allow clinical routine monitoring and the use of PRAM. HR, dicrotic arterial pressure, indexed stroke volume (SVI), cardiac index (CI), and CCE were recorded before surgical incision (T0), after pericardium cut (T1), after removal of aortic cannula (T2), and end of operation (T3). Left ventricular end-systolic elastance (Ees), effective arterial elastance（Ea）and VAC were calculated.

Results

Intra VSD group comparison, CCE was lower at T2 and T3 compared with T0 ($P<0.01$), higher at T3 compared with T2 ($P<0.01$). Ees was higher at T1, T2 and T3 compared with T0 ($P<0.01$), higher at T3 compared with T2 ($P<0.01$). Ea was higher at T1, T2 and T3 compared with T0 ($P<0.01$), lower at T3 compared with T2 ($P<0.05$). Intra TOF group comparison, CCE was lower at T2 compared with T0 ($P<0.05$), VAC was lower at T2 and T3 compared with T0 ($P<0.01$). Ees was higher at T1 ($P<0.05$), T2 and T3 ($P<0.01$) compared with T0. Ea was higher at T2 and T3 compared with T0 ($P<0.01$). As compared with VSD group, in TOF group CCE was lower at T0, T1 ($P<0.01$) and T3 ($P<0.05$), VAC was lower at T3($P<0.01$), Ees was lower at T0, T1, T2 ($P<0.05$) and T3($P<0.01$). CCE was significantly correlated with VAC at T0, T1, T2 and T3 ($P<0.001$).

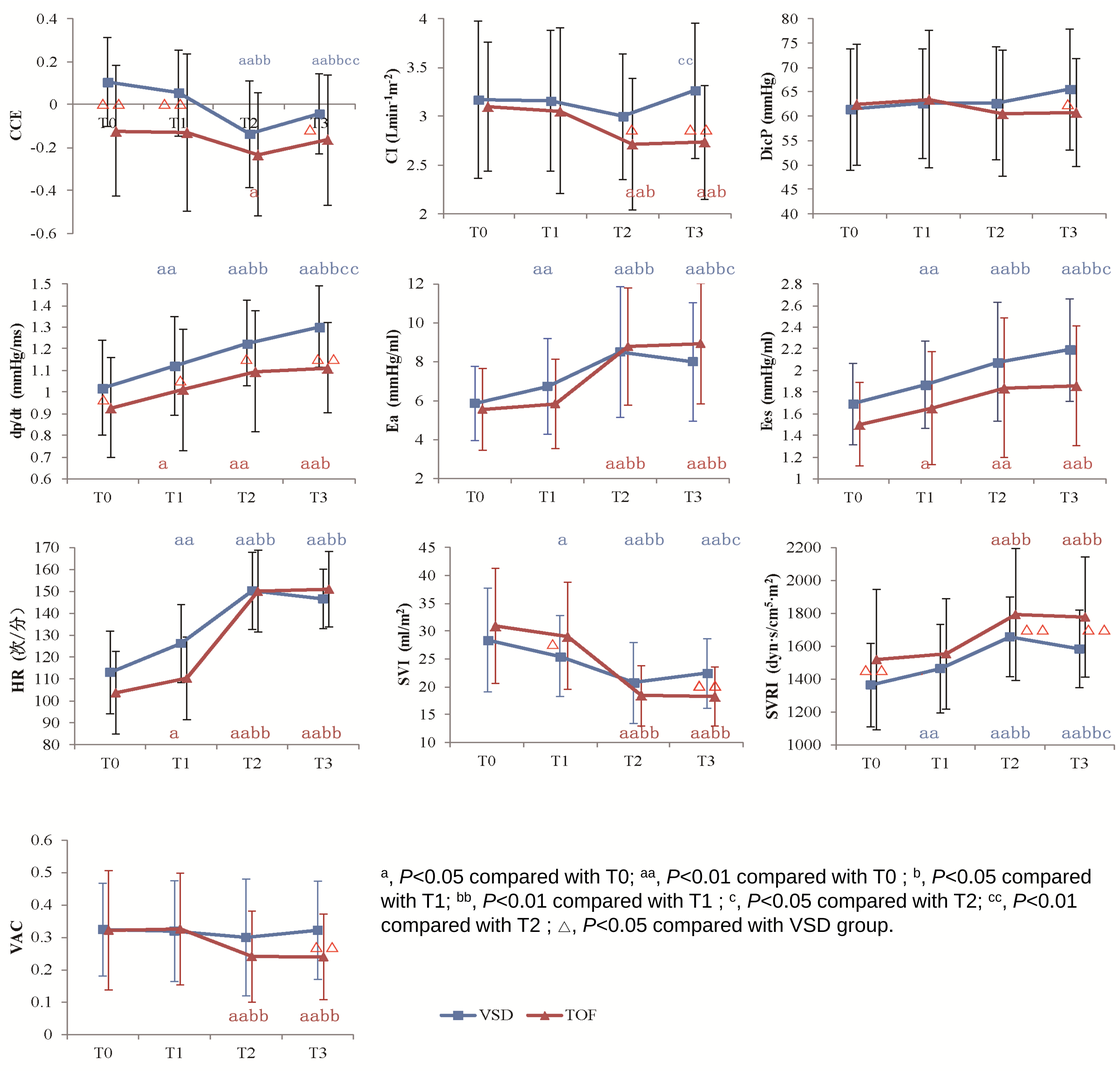
Table 1. Demographic variables

Group	Age/year	Weight/kg	Height/cm	BSA/m^2	F/M	CPB /min	ACC /min
VSD	1.3±1.0	9.1±3.4	76±14	0.42±0.12	25/25	43.7±10.2	28.2±5.9
TOF	1.1±0.8	9.0±2.7	74±9	0.41±0.09	22/24	71.5±16.7	49.5±15.4

Table 2. The relationship between CCE and other hemodynamic parameters

parameters	T0		T1		T2		T3	
	R	*P*	*R*	*P*	*R*	*P*	*R*	*P*
CI/(L min^{-1} m^{-2})	0.117	0.076	0.04	0. 69	0.18	0.067	0.102	0.315
DicP/(mmHg)	-0.054	0.59	-0.230	0.02	-0.326	0.001	-0.312	0.002
dp/dt /(mmHg/ms)	0.390	0.001	0.377	0.001	0.556	0.001	0.489	0.001
HR/(次/分）	-0.293	0.003	0.07	0.491	-0.105	0.297	-0.021	0.834
SVI/(mL/m^2)	0.266	0.007	0.012	0.905	0.226	0.024	0.128	0.203
SVRI/(dyne s/cm^5•m^2)	-0.393	0.001	-0.321	0.001	-0.231	0.021	-0.279	0.005
VAC	0.563	0.001	0.449	0.001	0.629	0.001	0.472	0.001

Figure 1. Profile of hemodynamic parameters.



[a], $P<0.05$ compared with T0; [aa], $P<0.01$ compared with T0 ; [b], $P<0.05$ compared with T1; [bb], $P<0.01$ compared with T1 ; [c], $P<0.05$ compared with T2; [cc], $P<0.01$ compared with T2 ; △, $P<0.05$ compared with VSD group.

Conclusions

RPAM could track ventricular efficiency changes in children with TOF. Left ventricular efficiency was deteriorated after surgical repair in TOF children because of the marked increase of the afterload and the slight increase of contraction, and it needs to be optimized.