Failing Fontan circulation is a multifactorial problem without clear predictors and with uncertain onset. We sought to investigate the correlations between systemic venous flow return and the clinical condition of Fontan patients. Flow measurements using phase contrast magnetic resonance imaging (MRI) were performed in the superior and inferior vena cava (SVC, IVC) in 61 Fontan patients. Median postoperative follow-up time was 6.7 (0.6-14.1) years; median age at MRI was 11.6 (4.0-44.6) years. Eight patients were identified clinically as a subgroup with suboptimal hemodynamics. The effective forward flow of combined SVC and IVC flow volume was defined as the venous cardiac index (vCI, l/min/m²). SVC flow ratio was defined as SVC flow in relation to vCI. The vCI and flow distribution between the SVC and IVC were investigated in relation to the hemodynamics and patients’ age at MRI. Venous flow return through the SVC was 1.1 (0.6-3.4) l/min/m² and through the IVC 1.8 (0.6-3.2) l/min/m²; total vCI was 3 l/min/m² (1.2-5.1). Patients with suboptimal Fontan hemodynamics showed significantly lower IVC flow return (median of 1.5 vs. 1.9 l/min/m², p = 0.027) and increased SVC flow ratio (0.56 vs. 0.35, p = 0.005) in comparison to those with good clinical condition. The total vCI decrease was correlated with older patient age (r = 0.575,
p< 0.001). Altered systemic venous flow return is associated with suboptimal Fontan hemodynamics and seems to progress with patients’ age and long-term follow-up after Fontan operation. Thus, MRI flow volume measurements might help in monitoring Fontan patients before the onset of clinical signs of suboptimal hemodynamics.