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BRIEF REPORT

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Long-term outcome of kidney function after twin–twin transfusion syndrome treated by intrauterine laser coagulation

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Abstract Twin–twin transfusion syndrome (TTTS) is caused by unbalanced shunting of blood between monochorionic twins. It is well known that chronic hypotension and hypovolemia may cause renal insufficiency in the donor twin. The long-term outcome of kidney function after TTTS has not previously been delineated in the literature, however. The aim of this study was to evaluate the long-term outcome of kidney function in children after intrauterine laser treatment for severe TTTS. Eighteen surviving twin pairs after intrauterine laser treatment for TTTS were involved in the study. Their gestational age at birth was 29–39 weeks, their median birth weight was 2050 g, and their median age at evaluation was 3 years 1 month, range 1 year 9 months to 4 years 5 months. Serum creatinine, cystatin C, and beta 2-microglobulin, sodium, potassium, and phosphate excretion, and urine albumin and alpha-1-microglobulin were measured. Creatinine clearance was calculated by use of the Schwartz formula. The laboratory findings for all 36 children were within normal limits. There were no significant differences between donors and recipients. Despite severe alteration of renal function before the laser treatment (anuria–polyuria) no long-term impairment of renal function could be detected in any of the 18 twin pairs.

Keywords Kidney function · Laser coagulation · Twin–twin transfusion syndrome · Preterm infant · Intrauterine treatment

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Introduction

Twin–twin transfusion syndrome (TTTS) is a serious complication in monochorionic twin pregnancies characterized by shunting of blood through placental vascular communications from the donor to the recipient twin [1]. As a result, the donor twin becomes hypotensive, hypovolemic, anemic, and oliguric, or even anuric, and the recipient twin becomes hypervolemic, polyglobulemic, and polyuric. Thus the donor twin is at high risk of developing renal insufficiency after delivery [2].

As a causal therapeutic strategy, endoscopic laser coagulation of the placental vascular anastomoses has recently been introduced [3]. Compared with other therapies such as serial amniodrainage, long-term neurodevelopmental outcome seems better after intrauterine laser coagulation [4].

Despite the risk of chronic renal failure, no studies have previously been published about the long-term outcome of the kidney function of surviving children after TTTS, especially not after intrauterine laser coagulation.

The aim of this study was to investigate the renal function of TTTS survivors, in their later life, after prenatal laser therapy.

Methods

Eighteen surviving twin pairs after intrauterine laser treatment for TTTS were included in this study. The prenatal endoscopic laser coagulation of the placental vascular anastomoses (median gestational age 20.7 weeks) had been performed at the Department of Prenatal Diagnosis and Therapy, Barmbek Hospital, Hamburg, Germany, between September 1997 and October 1999.

Using a fetoscope and a 0.4 mm Nd:YAG laser fiber, superficial blood vessel anastomoses crossing the intertwin membrane on the chorionic plate were coagulated by administration of repeated laser shots with an output of 50 to 60 W at a distance of 1 cm.

To reduce the risk of preterm rupture of the membranes and to minimize maternal discomfort and complications related to excessive polyhydramnios, amniotic fluid was drained after removal of the fetoscope until normalization of the amniotic fluid volume was achieved. [3]

Table 1 Laboratory findings of kidney function in children after TTTS

Gestational age (weeks)	Median		Range	
Age at examination (years)	35+1		29+2 to 37+5	
	3 1/12		1 9/12 to 4 5/12	
	Donors	Recipients	Donors	Recipients
Birth weight (g)	1740	2205	1200 to 3070	1340 to 3140
Serum				
Creatinine (mg dL^{-1})	0.43	0.41	0.33 to 0.62	0.29 to 0.58
Cystatin c (mg L^{-1})	0.73	0.72	0.57 to 1.05	0.58 to 1.06
β2-Microglobulin (mg L^{-1})	1.41	1.31	1.08 to 2.52	1.05 to 2.79
Sodium (mmol L^{-1})	139	139	136 to 144	136 to 143
Potassium (mmol L^{-1})	4.3	4.2	4.1 to 4.9	3.6 to 5.0
Phosphate (mmol L^{-1})	1.62	1.65	1.4 to 1.9	1.2 to 2.1
Creatinine clearance (Schwartz, mL min^{-1}/1.73 m^2)	125	132	82.9 to 167	88.7 to 172
Urine				
FE sodium (%)	0.84	0.70	0.20 to 2.40	0.19 to 5.52
FE potassium (%)	15.3	13.9	7.26 to 63.7	8.25 to 74.9
FE phosphate (%)	9.70	9.77	1.7 to 104	5.16 to 108
Albumin (mg dL^{-1})	0.39	0.54	0.35 to 1.20	0.32 to 230
Albumin/creatinine	0.01	0.01	0.005 to 0.08	0.005 to 2.94

FE=fractional excretion
For all characteristics differences between donors and recipients were not statistically significant ($P>0.05$, U-test)

Diagnosis of severe TTTS was made before 25 weeks of gestation because of the combination of single monochoriotic placenta, polyhydramnios and oligohydramnios, and stuck-twin. The donor twins also had small bladders, a sign of oliguria, and the recipients had dilated bladders, a sign of polyuria.

This study group was part of a larger group which was investigated for neurodevelopmental outcome [4]. The survival rate and obstetric outcome had already been reported.

Ranges and medians of gestational age, birth weight, and age at the time of examination are shown in Table 1. Blood and urine were sampled during a general follow-up examination. Parental consent was obtained and the protocol was approved by the Ethical Committee of the University of Bonn.

Serum creatinine, cystatin C, and beta 2-microglobulin, sodium, potassium, and phosphate excretion, and urine albumin were measured at the same time and age for both twins.

Cystatin C and beta 2-microglobulin were determined by particle-enhanced immunonephelometry (PENIA) using an assay available commercially (DADE–Behring, Marburg, Germany). Serum creatinine was measured using a modified Jaffé method (DADE–Behring). Creatinine clearance was calculated by use of the Schwartz formula [5].

The serum concentration of beta 2-microglobulin is greatly influenced by renal function, because it is almost exclusively eliminated by glomerular filtration with subsequent tubular re-absorption and catabolism [6].

Cystatin C is the appropriate diagnostic tool to detect patients with subclinical renal dysfunction [7]. Reference values were determined previously [8].

Mann–Whitney's two-sided rank-test (U-test) was used for the comparison of the two groups. Differences were regarded as statistically significant at $P<0.05$.

Results

All laboratory findings were within normal limits. There were no significant differences between donors and recipients. Ranges and medians of the values are shown in Table 1.

Discussion

Several studies describe postnatal renal failure after TTTS. It is thought that poor renal perfusion in utero of the donor fetus is the cause of damaged or delayed development of the kidneys [9]. In fetal autopsies, donors tended to have a paucity of proximal tubules, characteristic of renal tubular dysgenesis [10]. De Paepe et al. observed loss of differentiated proximal tubules, with atrophy of medullary tubules, in 12 of 25 donors [11].

Few data are available about the kidney function of survivors or TTTS beyond the perinatal period. Christensen et al. report transient renal insufficiency in one single donor twin whose renal function and growth had normalized by 6 months of age [12]. A study by Cincotta et al. [13] compared the perinatal mortality and morbidity of infants with TTTS with matched twin controls without TTTS. The incidence of perinatal renal failure was higher in survivors of TTTS—48% compared with 15%. Importantly, renal function had returned to normal in all survivors before discharge.

This study describes for the first time long-term outcome of kidney function after TTTS and laser coagulation of placental vascular anastomoses. It confirms that in surviving twins donors and recipients had normal renal function at a median age of three years.

These study results show that early laser treatment for TTTS (median 20.7 weeks of gestation) prevents long-term renal impairment in surviving twins.

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