OBSTETRICS

Stage-based outcomes of 682 consecutive cases of twin–twin transfusion syndrome treated with laser surgery: the USFetus experience

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OBJECTIVE: We sought to describe stage-specific perinatal outcomes after selective laser photocoagulation of communicating vessels (SLPCV) for twin-twin transfusion syndrome.

STUDY DESIGN: Patients with twin-twin transfusion syndrome underwent SLPCV preferentially using sequential vs standard laser technique. Patient characteristics and outcome data were examined by Quintero stage.

RESULTS: Of 682 consecutive women studied, the Quintero stage distribution was: 114 stage I (17%), 177 stage II (26%), 328 stage III (48%), and 63 stage IV (9%). Perinatal survival of at least 1 twin did not differ according to stage (I-92%, II-93%, III-88%, IV-92%; $P = .30$). However, dual twin survival differed by stage (I-79%, II-76%, III-59%, IV-68%; $P < .01$), primarily because stage III pregnancies were associated with decreased donor twin survival ($P < .01$). Sequential SLPCV was associated with improved donor survival, independent of stage (odds ratio, 1.67; 95% confidence interval, 1.16–2.40; $P < .01$).

CONCLUSION: Stage-specific perinatal outcomes after laser therapy may assist physicians in patient counseling and in planning future studies.

Key words: Quintero stage, sequential laser surgery, twin-twin transfusion syndrome

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Twin-twin transfusion syndrome (TTTS) develops from unbalanced exchange of blood through vascular communications in the monochorionic placenta. Preferential shunting of blood from 1 twin (donor) to the other twin (recipient) causes hypovolemia and oliguria in the donor fetus, and volume overload and polyuria in the recipient fetus. These hemodynamic alterations lead to variable degrees of donor twin oligohydramnios, recipient twin polyhydramnios, and characteristic anatomical and arterial/venous flow abnormalities that can be identified by ultrasound. Because TTTS is not a homogeneous disorder, the Quintero staging system was developed to categorically describe these ultrasound findings and to facilitate standardization among investigators.[1] Although there is debate in the literature, the Quintero staging system is the current method of choice for the preoperative classification of TTTS patients.[2]

Most studies have shown that selective laser photocoagulation of communicating vessels (SLPCV) is the optimal treatment for TTTS.[3] Laser surgery has resulted in survival rates for at least 1 twin ranging from 65-93% and dual survival rates ranging from 18-62%.[4] Although several factors may influence perinatal outcomes in laser-treated TTTS patients, including surgical technique and experience, one important consideration is disease severity.[5] Knowledge of perinatal outcomes of laser-treated patients according to Quintero stage may facilitate patient selection and counseling.

The aim of this study was to describe perinatal outcomes after laser surgery according to Quintero stage in a large, consecutively enrolled, prospectively staged cohort of TTTS patients.

Materials and Methods

We analyzed data collected prospectively from all patients undergoing laser therapy for the treatment of TTTS at participating USFetus centers. At present, the USFetus Consortium comprises 2 institutions, the University of Miami and University of Southern California Fetal Therapy Programs, both of which are tertiary referral centers for fetal therapy and share a common computer database into which data from all treated pregnancies are prospectively entered. Both institutions utilize similar surgical instruments and techniques. All consecutive cases of TTTS treated via laser sur-

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gery in Florida from 2002 through 2010 and in California from 2006 through 2010 were included.

At their initial assessment, all patients with monochorionic-diamniotic multiple gestations underwent a complete ultrasonographic examination, and the diagnosis of TTTS was made if the maximum vertical pocket of amniotic fluid measured ≤2 cm in the donor's sac and ≥8 cm in the recipient's sac. Once the diagnosis of TTTS was established, the severity of the syndrome was prospectively classified according to the Quintero staging system,[1] as follows: stage I: meets criteria for TTTS without the ultrasound findings of the more advanced stages; stage II: bladder of the donor twin not visible during the entirety of the ultrasound examination, normal fetal Doppler evaluation; stage III: critically abnormal Doppler findings in the umbilical artery (persistent absent or reversed end-diastolic flow), umbilical vein (pulsatile flow), or ductus venosus (reversed atrial systolic flow) in either twin; stage IV: hydrops fetalis defined as presence of abnormal fluid collection in at least 2 fetal compartments including subcutaneous tissues, pericardial space, pleural space, and abdominal cavity; stage V: demise of 1 or both twins. Stage III patients were further subdivided into the following categories: stage III donor if only the donor twin had critically abnormal Doppler findings, stage III recipient if only the recipient twin had critically abnormal Doppler findings, and stage III donor/recipient if both were affected. Stage III (donor involved) connotes both stage III donor and stage III donor/recipient patients. No patients were upstaged based on echocardiographic findings.

Patients categorized as Quintero stage I-IV were offered laser surgery if they were diagnosed with TTTS between 16-26 weeks' gestation. In addition to being offered laser therapy, patients were also counseled regarding alternative management options including expectant management, pregnancy termination, amnioreduction, and umbilical cord occlusion of the more gravely ill twin. Women who desired laser surgery gave written consent. Three patients >26 weeks' gestation received special institutional review board approval to undergo laser surgery, and were included in the analysis. Monoamniotic twins were excluded from the analysis. Triplet pregnancies and patients with a short cervix were not excluded.

Women received either local anesthesia with intravenous conscious sedation or, rarely, regional anesthesia. All cases were performed percutaneously. The trocar was inserted into the sac of the polyhydramniotic recipient under direct ultrasound guidance. A 3.3-mm diagnostic endoscope (Richard Wolf Inc, Vernon Hills, IL) was used to map the entire placental vascular equator. After placental vascular mapping was completed, the vascular communications were photocoagulated using neodymium:yttrium-aluminium-garnet laser energy at 20-40 W delivered into the amniotic cavity by 600 μ quartz noncontact fibers through the operating channel of the endoscope. Sequential SLPCV (SQLPCV), a procedure in which the donor-to-recipient vascular communications are laser photocoagulated first, was attempted in all patients after April 2003, as described previously.[6] Standard SLPCV in any order was performed if SQLPCV could not be completed for technical reasons. Each case was categorized as having had SQLPCV vs standard SLPCV immediately after surgery. At the end of the surgery, amniotic fluid was removed until the maximum vertical pocket in the recipient's sac measured approximately ≤8 cm. Patients with a cervical length <2.0 cm were offered cervical cerclage, as previously described.[7] After treatment, patients returned to their referring physicians to be subsequently managed and delivered.

Patient characteristics and outcome data were collected prospectively and examined by Quintero stage. Survival outcomes studied were: intrauterine fetal demise (IUFD) of the donor, IUFD of the recipient, 30-day survival of the donor, 30-day survival of the recipient, 30-day survival of at least 1 fetus, and 30-day survival of both fetuses. The χ^2 analysis or Kruskal-Wallis testing was used to determine differences in study populations or outcomes by stage. Furthermore, we compared stage-specific survival outcomes according to procedure type (SQLPCV vs SLPCV) and the presence of intrauterine growth restriction (IUGR) of the donor, defined as an estimated fetal weight <10th percentile. We also conducted a subanalysis of the survival outcomes of stage III patients, dividing them into those with donor affected (stage III donor), recipient affected (stage III recipient), or both affected (stage III donor/recipient).

Multivariable logistic regression models were created for each of the survival outcomes, using the variables of stage (with stage I as a reference and dummy variables for stage II, stage III [recipient], stage III [donor involved–includes both stage III donor and stage III donor/recipient patients], and stage IV), study center (using Florida site as the reference), donor twin IUGR, and use of SQLPCV to estimate the independent effects of these variables.

Means are reported ± SD. Odds ratios and their 95% confidence intervals are expressed for logistic regression results. A P value < .05 was considered statistically significant. Perinatal outcomes of 413 patients have been published previously.[6,8,9] This study was approved by the institutional review boards at the University of Miami, FL, and at the Health Sciences Campus of the University of Southern California, Los Angeles, CA.

RESULTS

A total of 682 consecutive TTTS patients were treated with laser surgery from March 2002 through March 2010, 472 (69.2%) at the Florida site and 210 (30.8%) at the California site. Of the total number of patients, 16.7% (n = 114) were categorized as stage I, 26.0% (n = 177) as stage II, 48.1% (n = 328) as stage III, and 9.2% (n = 63) as stage IV.

Patient characteristics are described in Table 1. Compared with stage I patients, stage II and stage III patients had a mean gestational age at time of laser surgery that was approximately 1 week earlier ($P < .01$), which was consistent with the lower mean estimated fetal weights of both the donor and recipient fetuses found in these cases ($P < .01$). At delivery, the mean gestational age was similar regardless of stage ($P = .43$). The rate of