Available online at www.sciencedirect.com

SciVerse ScienceDirect

Taiwanese Journal of Obstetrics & Gynecology 51 (2012) 350–353

www.tjog-online.com

Original Article

Short-term outcomes of fetoscopic laser surgery for severe twin–twin transfusion syndrome from Taiwan single center experience: Demonstration of learning curve effect on the fetal outcomes

Yao-Lung Chang*, An-Shine Chao, Shuenn-Dyh Chang, Peter C.C. Hsieh, Chao-Nin Wang

Department of Obstetrics and Gynecology, Chang Gung Memorial Hospital, Chang Gung University College of Medicine, Tao-Yuan, Taiwan

Accepted 29 June 2012

Abstract

Objective: To evaluate the learning curve effect on fetal outcomes while using fetoscopic laser photocoagulation (FLP) for twin–twin transfusion syndrome (TTTS) as managed by a newly established single center in Taiwan.
Materials and Methods: Between October 2005 and October 2010, women diagnosed to have TTTS before 26 weeks of gestation were offered FLP surgery. Cases were divided into first-half and second-half groups to evaluate the learning effect on fetal outcomes including at least one survival rate, two survival rate, and gestational age of delivery.
Results: A total of 44 cases with a median gestational age of 20.1 weeks (range 16–25) at operation were included in the study. Overall, both twins survived in 22 (50.0%) cases, whereas only one twin was born alive in 13 (29.5%), and neither was born alive in the remaining nine cases (20.5%). The total survival rate was 64.8%. When comparing the first-half 22 cases and the second-half 22 cases, there were significant improvements in total survival rate (54.7% vs. 75.0%, $p = 0.045$), a prolonged interval between operation and delivery (62.1 vs. 89.1 days, $p = 0.042$), and more advanced gestational age of delivery (28.3 vs. 33.0 weeks, $p = 0.008$) in the second-half 22 cases.
Conclusions: With increasing experience in using fetoscopic guide laser therapy for TTTS, the fetal survival rate could be improved with advanced gestational age at delivery.

Keywords: fetoscope; laser therapy; learning curve; twin–twin transfusion syndrome

Introduction

Twin–twin transfusion syndrome (TTTS) occurs in approximately one in five of all monochorionic, diamniotic twin pregnancies [1]. Traditionally, serial amnioreduction and laser therapy are the most effective treatment methods for TTTS [2]. Serial amnioreduction is effective in prolonging pregnancy by reducing the amount of amniotic fluid to prevent premature rupture of the membranes and preterm labor, but laser therapy directly coagulates the intertwined anastomotic placental vessels in order to divide the placenta into functional dichorionic [3]. Since the first randomized trial on interventions for TTTS was published [4], it has been recognized that the first-line treatment for all stages of TTTS diagnosed before 26 weeks is laser treatment. After training with Professor Quintero in Tampa, Florida, we have established a practical team for the laser therapy for severe TTTS in Chang Gung Memorial Hospital, Taiwan since 2005 October. After 5 years' experience, we found significant improvements in fetal survival and more advanced gestational age of delivery in the second-half case series in comparison with the first one. The purpose of this study is to report our experience and the learning curve effect to the outcomes of TTTS treated by fetoscopic laser photocoagulation (FLP) therapy in a single center in Taiwan.

* Corresponding author. Department of Obstetrics and Gynecology, Chang Gung Memorial Hospital, Linkou Medical Center, 5, Fu-Shin Street, Kweishan, Tao-yuan 333, Taiwan, ROC.
E-mail address: j12054@cgmh.org.tw (Y.-L. Chang).

1028-4559/$ - see front matter
http://dx.doi.org/10.1016/j.tjog.2012.07.005

Patients and methods

The study and procedure were approved by the local institutional review board. The diagnosis of TTTS was based on the following sonographic findings: (1) polyhydramnios, ≥8 cm of maximum vertical pocket (MVP) in the recipient twin; (2) oligohydramnios, MVP ≤ 2 cm in the donor twin, in a monochorionic twin pregnancy [5]. A detailed examination of the fetal anatomy was performed to rule out associated anomalies. Severity was assessed according to the Quintero staging system [5]. After completing the photocoagulation, amniotic fluid was drained to decrease the MVP of the recipient twin below 8 cm. If a cervical length of less than 2.0 cm was detected before surgery, cervical cerclage was performed after the laser therapy. The procedure was performed with a 2-mm 0° fetoscope (Storz 26008 AA; Karl Storz GmbH, Tuttlingen, Germany) or a 30° fetoscope (Storz 26008 BUA; Karl Storz GmbH) for mainly anterior placenta. The anastomoses were selectively coagulated with 15–30 W Nd-YAG or continuous diode laser beams, according to the diameter of the targeted vessel.

Statistical analysis was conducted with SPSS software (version 11.0 for Window; SPSS Inc., Chicago, IL). Qualitative data were compared using χ^2 test or Fisher exact test as appropriate. Continuous variables were tested for normality. We used two-sample Student's *t*-test or Mann–Whitney *U*-test to compare between groups for the continuous variable. A probability value of less than 0.05 was considered statistically significant.

Results

From October 2005 to October 2010, FLP operations were performed in 44 twin pregnancies complicated by severe second-trimester TTTS in Chang Gung Memorial Hospital, Taiwan. All surgeries were performed by one of the authors (Y.L. Chang). The median maternal age was 27 years (range 15–40), and the median parity was 1 delivery (range 0–3). The median gestational age at the time of surgery was 21 weeks (range 17–25). Preoperatively, 2 cases (4.5%) were classified as stage I, 14 cases (31.8%) as stage II, 24 cases (54.5%) as stage III, and 4 cases (9.%) as stage IV. The placenta was anterior or predominantly anterior in 15 (34.1%) cases. Two of them were due to severe polyhydramnios (MVP as 16.5 and 18 cm); the procedures were performed using the 0° fetoscope; in the other 13 cases, the procedures were performed using the 30° fetoscope. Table 1 displays the surgical outcomes of these cases. Overall, both twins were born alive in 22 (50.0%) cases, only one twin was born alive in 13 (29.5%), and neither was born alive in the remaining 9 (20.5%). Total survival rate was 64.8%. Two cases were found as reverse TTTS diagnosed by polyhydramnios in the previous donor and oligohydramnios in the previous recipient. Two cases were found as persistent TTTS post operation.

In five cases, the patients refused to undergo laser treatment after consultation: one stage I case received amnireduction at gestational age of 25 weeks, one termination of pregnancy at our hospital at gestational age of 17 weeks, and three patients returned to the referred hospital for pregnancy termination. Six cases received amnioreduction before laser therapy at other hospitals; among them, two cases received amnioreduction twice. Three cases received cervical cerclage after laser therapy due to short cervical length.

Table 1
outcomes of twin–twin transfusion syndrome treated by fetoscopic laser therapy.

Overall survival	64.8% (57/88)
Double survival	50% (22/44)
At least one survival	79.5% (35/44)
Gestational age of operation (wk)	20.1 ± 3.0
Gestational age of delivery (wk)	30.6 ± 5.9
Operation delivery interval (d)	75.6 ± 44.3
PROM with 3 wk after operation	11.36% (5/44)
Donor survival	68.2% (30/44)
Recipient survival	65.9% (29/44)
Reverse TTTS	4.5% (2/44)
Persistent TTTS	4.5% (2/44)
Twin anemia polycythemia sequence	2,28% (1/44)
Maternal pulmonary edema	6.8% (3/44)
Intraoperation intrauterine bleeding	4.5% (2/44)

PROM = premature rupture of the membranes; TAPS = twin anemia polycythemia sequence; TTTS = twin–twin transfusion syndrome.

Five cases experienced rupture of membrane within 3 weeks after operation; 2 (40%) of them had membrane resealed at 14 and 8 days after leakage of amniotic fluid: one with donor demise in the uterus 4 days after surgery and delivery of the recipient at 29 weeks, and one with two survivals delivered at 35 weeks. The other three cases without membrane resealed eventually lost two fetuses due to extreme prematurity.

In order to evaluate the learning effect on the fetal outcomes, we divided the cases into first-half 22 and second-half 22 cases (Table 2). The total survival rate, gestational age of delivery, and interval between surgery and delivery between the two time intervals were significantly different. The second-half cases had better total survival rate, prolonged interval between operation and delivery, and advanced gestational age of delivery than the first-half cases. Because gestational age at operation was not significantly different between the first-half 22 and second-half 22 cases, the advanced gestational age of delivery in the second-half 22 cases was mainly due to the prolonged interval between operation and delivery.

Selective techniques were achieved in 40 cases; in 4 cases, we had to ablate more than 1 vessel due to the uncertainty of communication. Intraoperative complications were noted in 2 cases (9.1%): one case of bleeding occurred during laser coagulation due to laceration of a placental vessel, but after laser coagulation at the upstream of the lacerated vessels the bleeding ceased, and the surgery was completed and two live babies were delivered at gestational age of 29 weeks. In another case, the bleeding was caused by a transplacental insertion of the fetoscope due to the difficult anterior wall placenta position; however, the bleeding ceased after the operation by external uterine compression from the abdomen.

There were three mothers who suffered from pulmonary edema after surgery; two of them were easily managed by diuretics, and the respiratory symptoms resolved within 24

Table 2
Outcomes of fetoscopic guide laser therapy for twin–twin transfusion syndrome between first and second-half 22 cases.

	First-half 22 cases	Second-half 22 cases	*P* value
Overall survival	54.7% (24/44)	75% (33/44)	0.045
Double survival	36.3% (8/22)	63.6% (14/22)	0.13
At least one survival	72.7% (16/22)	86.3% (19/22)	0.46
Gestational age of operation (wk)	19.44 ± 3.0	20.69 ± 2.9	0.166
Interval between operation and delivery (d)	62.1 ± 35.8	89.1 ± 48.6	0.042
Gestational age of delivery (wk)	28.3 ± 6.2	33.0 ± 4.6	0.008

hours after operation. Another patient had a protracted course of pulmonary edema lasting for 12 days due to mirror syndrome, which was caused by transient donor hydrops after the operation; this patient eventually had a good perinatal outcome with delivery at gestational age of 36 weeks with dual survival.

Discussion

In this series of 44 TTTS who received FLP for TTTS in Taiwan, the total survival rate was 64.8%, and at least one survival rate was 79.5%. Overall survival of TTTS treated by fetoscope had been reported to range from 45% to 70%, and survival of at least one twin ranges from 60% to 85% and higher [6]. So, our first 5-year results are similar to the average result. Comparison of the first- and second-half cases (44 cases in total) showed improvement in the total survival rate, from 54.7% to 75.0%, and gestational age of delivery, from 28.3 to 33.0 weeks. Because there is no significant difference in at least one survival rate—76.7% in the first-half 22 cases and 86.3% in the second-half 22 cases—the difference in survival rate between first half and second half groups could be due to increasing the double survival rate in the second-half 22 cases: from 36.4% to 63.6%, although the p value is not significant ($p = 0.13$). Hence, the learning curve effect that increased the total survival rate in fetoscopic-guided laser therapy for TTTS in our center mainly is due to the increase in the dual survival rate in the second-half 22 cases.

In their review report, by Ahmed et al [7] failed to show a significant impact of high case loads (experience) to the fetal outcomes, but they believed that a learning curve most certainly exists. However, Morris et al [8] found the need for experience in 61 and 111 procedures to reach 85% and 90% of at least one survival rate. After we divided our cases into first- and second-half groups, we found that the total survival rate and gestational age of delivery are significantly improved in the second-half cases. If we do not analyze the immediate outcomes at this time point, after 44 operations we can obtain a 64.8% total survival rate; the learning curve effect would be diluted by the favorable outcomes in the upcoming cases.

Since Dr Quintero developed the technique of selective laser photocoagulation of communicating vessels (SLPCV) [3], it has been accepted as the mainstay of surgical technique for treatment of TTTS [7]. Dr Quintero further described the sequential method of selective laser photocoagulation and found that it is associated with a decreased likelihood of intrauterine fetal demise of the donor twin and an increased rate of dual survivors compared to SLPCV [9]. Our operation method for all 44 cases is SLPCV without sequence; among them, there were 40 cases where the selective technique could be achieved. So the improved outcomes of the second-half cases is not due to the modified surgical technique but should be attributed to our increasing experience; the result requires concentration of cases in a single center.

Since fetoscopic-guided laser therapy can achieve better fetal outcomes than serial amnioreduction [2], considerations regarding maternal safety should become an important issue [10]. In our series, three patients manifested maternal pulmonary edema and two patients suffered from intrauterine bleeding. Two of the three patients who suffered from pulmonary edema could be classified as cases of fluid overload because of the presence of significantly more intravenous crystalloids due to regional anesthesia. In a review of maternal complications after FLP TTTS, there were 5 cases of pulmonary edema found in 40 reports including 1758 cases [10]. Although not every report would comment on maternal complications, the incidence of pulmonary edema in our cases is still high at 4.5% (excluding one case of mirror syndrome) under regional anesthesia. So, after maturation of the whole team, local anesthesia may be chosen in future surgeries.

The weak points of this study are the small number of cases and the lack of long-term neurological outcomes follow-up, but as we have previously noted, having a large number of cases would dilute the effect of the learning curve of using laser therapy for TTTS and make the differences harder to discern. So the value of this report is to present the learning curve effect on the outcomes of fetuses treated by FLP for TTTS in a newly established center. We continue to follow up the outcomes of these babies, especially their neurological outcomes, and are currently accumulating these data.

In conclusion, we found that with increased experience with FLP for TTTS, fetal survival rate could be improved, interval between operation and delivery could be prolonged, and gestational age of delivery could be increased in a newly established center.

References

[1] Benirschke K. The placenta in twin gestation. Clin Obstet Gynecol 1990; 33:18–31.
[2] Roberts D, Gates S, Kilby M, Neilson JP. Interventions for twin–twin transfusion syndrome: a Cochrane review. Ultrasound Obstet Gynecol 2008;31:701–11.
[3] Quintero RA, Morales WJ, Mendoza G, Allen M, Kalter CS, Giannina G, et al. Selective photocoagulation of placental vessels in twin–twin transfusion syndrome: evolution of a surgical technique. Obstet Gynecol Surv 1998;53:S97–103.
[4] Senat MV, Deprest J, Boulvain M, Paupe A, Winer N, Ville Y. Endoscopic laser surgery versus serial amnioreduction for severe twin-to-twin transfusion syndrome. N Engl J Med 2004;351:136–44.
[5] Quintero RA, Morales WJ, Allen MH, Bornick PW, Johnson PK, Kruger M. Staging of twin–twin transfusion syndrome. J Perinatol 1999; 19:550–5.

[6] Rossi AC, D'Addario V. Laser therapy and serial amnioreduction as treatment for twin-twin transfusion syndrome: a metaanalysis and review of literature. Am J Obstet Gynecol 2008 Feb;198(2):147–52.

[7] Ahmed S, Luks FI, O'Brien BM, Muratore CS, Carr SR. Influence of experience, case load, and stage distribution on outcome of endoscopic laser surgery for TTTS—a review. Prenat Diagn 2010;30: 314–9.

[8] Morris R, Selman TJ, Harbidge A, Martin WL, Kilby MD. Fetoscopic laser coagulation for severe twin-to-twin transfusion syndrome: factors influencing perinatal outcome, learning curve of the procedure and lessons for new centres. BJOG 2010;117:1350–7.

[9] Quintero RA, Ishii K, Chmait RH, Bornick PW, Allen MH, Kontopoulos EV. Sequential selective laser photocoagulation of communicating vessels in twin–twin transfusion syndrome. J Matern Fetal Neonatal Med 2007;20:763–8.

[10] Merz W, Tchatcheva K, Gembruch U, Kohl T. Maternal complications of fetoscopic laser photocoagulation (FLP) for treatment of twin–twin transfusion syndrome (TTTS). J Perinat Med 2010;38:439–43.