

Early experience of fetal laser photocoagulation for twin-to-twin transfusion syndrome in the Philippines

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ABSTRACT

Objectives: This study aims to review the outcomes of monochorionic pregnancies with Twin-to-Twin Transfusion Syndrome (TTTS) treated with fetal laser photocoagulation (FLP) in the Philippines and to compare these with outcomes from the early experiences of other nearby centers in Southeast and East Asia.

Methods: This is a single center retrospective cohort study of 7 patients who underwent FLP for TTTS before 26 weeks of gestation from June 2021 to March 2024. Preoperative, perioperative, perinatal, and neonatal outcomes were analyzed and a comparison with other Asian centers was performed.

Results: Patients treated were in advanced stages III-IV of TTTS (86%). Gestational age at FLP was 22.1 ± 2.8 weeks. The perinatal overall survival rate was 64% with a double survivor rate of 57%, a single survivor rate of 14%, and at least one survivor in 71%. The interval between FLP and delivery was 36.6 ± 25.2 days with age at delivery of 27.1 ± 4.3 weeks. Compared to 5 other Asian centers, procedures performed per year ranged from 2.5 to 14.2 cases. Overall fetal survival rates were between 64 to 82%.

Conclusion: Our center's early experience of treating TTTS with FLP reflects the current conditions of prenatal screening and access to specialized care in the country. Early recognition of TTTS is key to providing patients and their families timely management and support. Devising local standardized assessments for education and performance of FLP, establishing the surgical learning curve, facilitating audits, and initiating research will improve fetal surgery benchmarks in the country.

INTRODUCTION

Twin-to-twin Transfusion Syndrome (TTTS) is a pathologic condition due to anomalous placental vascular anastomoses and occurs in 10% of monochorionic gestations (Lewi 2020). Intertwin discordance in terms of fetal size, amniotic fluid volume, fetoplacental hemodynamics or structural defects is the basis for its classification into progressive stages by Quintero et al in 1999 (see Table I). Without intervention, poor maternal and fetal outcomes are inevitable (Chalouhi et al. 2010).

Currently, fetal laser photocoagulation (FLP) is the gold standard of treatment for stages II to IV of TTTS between 16 to 26 weeks of gestation as it alone addresses the underlying pathology. The procedure was first performed by De Lia et al in 1988 via laparotomy and insertion of an endoscope into the amniotic cavity under general anesthesia (De Lia et al. 1990).

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Date received: March 6, 2024

Date revised: June 16, 2024

Date accepted: June 19, 2024

DOI: <https://doi.org/10.54645/202417SupCPZ-82>

KEYWORDS

monochorionic pregnancy, TTTS, Quintero staging, fetal laser photocoagulation, fetal therapy

The procedure was then modified by Ville et al into a minimally invasive technique by using a percutaneous approach to introduce a 2.0-mm fiber-optic endoscope under local anesthesia (Ville et al. 1995). As compared to secondary treatments, septostomy and amnioreduction, which only provide temporarily relief of pressure between the fetal compartments, FLP occludes these so called chorioangiopagus vessels in the chorionic plate effectively minimizing the shared circulation. The first FLP procedure done in the Philippines was performed on June 5, 2021 at the St. Luke's Medical Center – Global City. Since then, a total of 7 cases have been performed within a 3-year period.

This study aims to review the outcomes of monochorionic twin pregnancies with TTTS treated with FLP in the Philippines and to compare these with outcomes from the early experiences of other centers in Asia.

METHODS

Study population. This is a retrospective cohort study of 7 consecutive cases of fetal laser coagulation for TTTS performed in a single center between June 2021 to March 2024. Twin-to-twin transfusion syndrome was diagnosed after a standard ultrasound evaluation and staged according to the Quintero criteria (Table I). Fetal 2D echocardiography, congenital anomaly scans, and cervical scan assessments were also required. Patients were properly counseled concerning their diagnosis and the management options available locally. Complete procedural information, particularly for FLP, along with its possible outcomes (i.e., fetal loss, neurological damage in surviving twin(s), premature membrane rupture) were thoroughly explained to the couple and informed consent obtained.

FLP procedure. The patients were fasted for at least 6 hours and given prophylactic tocolytics (100 mg isoxsuprine in 500 mL normal saline drip) and antibiotics (cefazolin 2 gm) prior to the

Table I: The Quintero Staging for Twin-to-Twin Transfusion Syndrome (Quintero et al. 1999).

STAGE	DONOR	RECIPIENT
I	DVP \leq 2.0 cm	DVP \geq 8.0 cm
II	bladder absent	bladder present
III	Doppler abnormalities present in one or both twins (UmbA AEDF/REDF, DV Aa/Ra, UmbV P)	
IV	Hydrops in one or both twins	
V	Demise of one or both twins	

Legend: DVP – deepest vertical pocket, UmbA – umbilical artery, AEDF – absent end diastolic flow, REDF – reversed end diastolic flow, DV – ductus venosus, Aa – absent a wave, Ra – reversed a wave, UmbV P – umbilical vein pulsations

operation. Pre-operative ultrasound and Doppler studies were performed to confirm fetal status, amniotic fluid volumes, placental location and fetal cord insertions for determination of the site of entry of the fetoscope. All procedures were performed by a single team of operators electively and in an operating theater under regional epidural anesthesia. Instruments used included a 2.0 mm HOPKINS® Telescope 30° with both an 11.5 Fr operating sheath and a working insert with lever (Karl Storz, Tuttlingen, Germany), and a 1064 nm neodymium-doped yttrium aluminum garnet (Nd:YAG) laser with a 400 μ m fiber (Fotona, Ljubljana, Slovenia). Depending on the placental location, the mother was placed in supine or slightly lateral position for adequate visualization and ease of vascular ablation. A small abdominal incision was made, and the operating sheath inserted under ultrasonographic guidance into the amniotic cavity of the recipient fetus. The vascular equator located between the placental cord insertions of both twins was identified. Anastomosing vessels in the equator were coagulated sequentially, and when feasible, the equator itself in its entirety using the Solomon technique. In some cases, post-laser amniodrainage was performed to achieve a deepest vertical pocket (DVP) of 5 to 6 cm. Upon removal of the operating sheath, hemostasis was confirmed, and an absorbable suture was used to close the skin incision. Post-operatively, ultrasound and Doppler studies were repeated at 0-, 12-, and 24-hour intervals. Patients were discharged between 36-48 hours post-laser. They were monitored weekly after discharge for at least 3 weeks and then transferred to their referring institutions for continuous surveillance and subsequent delivery. In cases with irregular contractions, patients were given up to 60 mg of nifedipine daily. Only one patient needed a McDonald cerclage 36 hours post-laser for a short cervix.

Both perinatal and neonatal outcomes were assessed. The perinatal period was defined as the period from 28 weeks gestation to 7 days after birth while the neonatal period was defined as the period from birth to 28 days of life. Overall survival, double infant survival, single infant survival, and at least one survivor rates were calculated for both these periods.

The overall survival rate was calculated by dividing the number of surviving fetuses by the total number of fetuses, while all other rates were taken as proportions of the number of pregnancies specified.

Comparison of FLP in Southeast and East Asia. A literature search using three online databases (PubMed, Scopus, JSTOR) was performed to find single-center FLP early experiences in the region between 2008 to 2023. A simple tabulation for comparison of antenatal details and perinatal outcomes was performed.

RESULTS

A total of 7 cases of monochorionic-diamniotic pregnancies with Stage II-IV TTTS underwent FLP in a single center in the Philippines between June 2021 to February 2024. All cases were referred to our institution for TTTS management and subsequently returned to their referring institutions for delivery, except for one case of double fetal loss and one case with short cervix necessitating a cerclage. Both of these patients were transferred to our center for further management. Initial antenatal characteristics of patients prior to the FLP procedure are summarized in Table II. The mean maternal age at diagnosis was 30.3 ± 4.0 years, of which 57% of cases (4 of 7) were primigravids. The mean gestational age when first referred to our institution was 21.4 ± 2.8 weeks. The ultrasonographic estimated fetal weights were 359.7 ± 170.1 grams and 522.4 ± 259.7 grams for the donor and recipient fetuses respectively with an average intertwin weight discordance of $31.1 \pm 11.2\%$. The average deepest vertical pocket (DVP) of amniotic fluid in each fetal compartment was 1.3 ± 0.8 cm in the donor and 10.0 ± 3.2 cm in the recipient. Patients were referred to our center for FLP already at advanced stages of TTTS: 14% (1 of 7) in Stage II, 43% (3 of 7) in Stage III, and 43% (3 of 7) in Stage IV, therefore, all except one case (86%), exhibited abnormal Doppler flow patterns in the donor with two recipient fetuses (29%) found to have abnormal patterns as well.

Perioperative FLP details and delivery outcomes are summarized in Table III. The mean gestational age at FLP was 22.1 ± 2.8 weeks with an average of 4.9 ± 6.7 days interval between the time the patient was first seen at our institution to the elective FLP procedure. Placental location was anterior in 57% (4 of 7) and posterior in 43% (3 of 7). Marginal umbilical cord insertion was noted in 86% of donor (6 of 7) and 14% of recipient (1 of 7) fetuses.

Perinatal and neonatal outcomes were summarized in Table IV. There were 2 out of 7 cases (29%) with double intrauterine fetal demise, and 1 out of 7 cases (14%) with single intrauterine fetal demise. The perinatal overall survival rate was 64% (9 out of 14 fetuses) with a double survivor rate of 57% (4 out of 7 pregnancies), a single survivor rate of 14% (1 out of 7 pregnancies) and at least one survivor in 71% (5 out of 7 pregnancies). The average interval between FLP and delivery was 36.6 ± 25.2 days with a mean gestational age at delivery of 27.1 ± 4.3 weeks. Live birth weights of surviving donor twins were 803.8 ± 107.8 grams ($n=4$) while surviving recipient twins weighed 1443.0 ± 517.1 grams ($n=5$). The neonatal overall survival rate was 43% (6 out of 14 fetuses) with a double survivor rate of 14% (1 out of 7 pregnancies), a single survivor rate of 57% (4 out of 7 pregnancies) and at least one survivor in 71% (5 out of 7 pregnancies).

A comparison of single-center early experiences with FLP in six (6) Southeast and East Asian centers was summarized in Table V (Loh et al. 2020, Kweon et al. 2019, Yang et al. 2010, Tan et al. 2023, Chang et al. 2012). Reports from four (4) other centers in the region were not included due to insufficient data, articles not being in English, or data being reported from a consortium of centers rather than a single center. Cases treated were between Quintero stages I-IV. The average number of procedures performed per year ranged from 2.5 to 14.2 cases, with the gestational age at which FLP was performed ranging from 20.1 to 22.4 weeks. The average interval between FLP to delivery ranged from 5.2 to 11.1 weeks. Perinatal overall fetal survival rates reported were between 64% and 82%.

DISCUSSION

Fetal laser photocoagulation has been performed around the world for the past 33 years but was introduced in the Philippines only in 2021. It was merely in the past decade that training workshops for fetal invasive surgical procedures were organized in the Southeast and East Asian regions but proficiency in these highly technical operations will require inclusion into our local specialist training programs for acquisition of the necessary skills and to increase surgical hours of experience. Our current local specialists had to train in centers in Europe and North America, both of which see a considerable number of cases and employ an apprenticeship approach with hands-on surgical instruction. Incorporating continuous simulation training will improve clinical performance and maintain surgical competence. To maintain proficiency, fetal medicine centers will need to perform a suggested 25 procedures annually (Edwards et al. 2016). In order for this to be feasible in our setting, establishing a referral center for these cases is ideal.

Taking into consideration the current low case volume seen, this may be due to the low detection of early TTTS leading to late referral and suboptimal management of cases. Early recognition of TTTS is key to providing patients and their families timely management and support. Once a monochorionic gestation is identified, intensive ultrasound surveillance between 16-26 weeks by qualified sonographers to detect developing complications such as TTTS in this special population is warranted. The majority of cases referred to our center were in

advanced stages (III to IV) of TTTS. Their complete work-up should include fetal 2D echocardiography, as well as congenital anomaly and cervical scans, aside from growth and Doppler flow assessments. Post-laser monitoring is also important, as complications such as selective intrauterine growth restriction (sIUGR) or twin anemia polycythemia sequence (TAPS) can develop, and the optimal timing of delivery should be assessed (Chalouhi et al. 2011).

As procedures increase, devising local standardized assessments for education and performance of FLP, establishing the actual surgical learning curve, facilitating audits, and initiating research will improve fetal surgery benchmarks in the country (Natarajan et al. 2022, Peeters et al. 2014). Although already evidenced through the early experience of our center, such important data will also serve as basis for much needed grants for institutions to build technical centers and for financial support for patients due to the enormous expense of treating TTTS. Moreover, key points still under contention such as Solomon technique efficacy, underlying fetocardiovascular events in TTTS, as well as the development of innovative surveillance methods, can be looked into as part of the promotion of local research in the field.

Majority of the cases seen in this report were referrals with temporary transfer of management to our institution for the FLP procedure and eventual return to the referring institution for delivery. We provided these referring institutions with continuous support concerning optimal delivery time but variable expertise and expenses in treating TTTS and preterm birth in both private and government settings dictated and oftentimes limited the management patients received.

Birth outcomes were subsequently obtained from attending physicians and neonatal progress was followed in each of these outside institutions. As such, an immediate colored-dye evaluation of the placenta upon delivery was only possible in 4 of 7 cases (57%). Residual anastomoses localized near the margins of the placenta were present in two (2) anterior placentas and absent in the remaining two (2) posterior placentas.

As compared to other countries in the region, the reported experiences of other centers suggested greater advancements in prenatal screening techniques and wider adaptation locally resulting in the detection of cases at earlier stages of TTTS. Greater procedural competency due to bigger case volumes improved surgical team proficiency. This can be illustrated by the anesthetic of choice. A majority of centers in the region used local anesthesia while other reports still included general anesthesia, spinal or a combination of local with intravenous sedation. Our Philippine team anticipated long procedures and agreed to use regional epidural for these initial cases.

Finally, the outcomes of fetal surgery are only as good as the neonatal care provided afterwards. Thus, as the majority of FLP cases result in inevitable preterm deliveries, a multidisciplinary team approach and accessible high-quality neonatal services are essential to increase the chances of bringing pregnancies closer to term or, in cases of indicated preterm deliveries, improving the odds of survival. In the future, establishing collaborative networks with centers abroad for training and technical support, along with vast improvements in the local front, will surely benefit those we have chosen to serve.

CONCLUSION

Our center's early experience of treating TTTS with FLP reflects the current conditions of prenatal screening and access to

Table II: Initial antenatal characteristics of patients with monochorionic-diamnionic pregnancies prior to fetal laser photocoagulation for Twin-to-Twin Transfusion Syndrome

CASE	MATERNAL AGE (years)	OBSTETRIC SCORE	AGE OF GESTATION (weeks)	DONOR WEIGHT (grams)	RECIPIENT WEIGHT (grams)	INTERTWIN WEIGHT DISCORDANCE (%)	DONOR DVP (cm)	RECIPIENT DVP (cm)	DONOR BLADDER	RECIPIENT BLADDER	DONOR DOPPLER FINDINGS	RECIPIENT DOPPLER FINDINGS	OTHER FINDINGS	QUINTERO STAGE
1	28	G1P0	17	165	232	40	1.65	8.2	absent	present	UmbA AEDF			III
2	34	G2P1 (0101)	19.9	268	360	26	1.03	9.06	absent	present	DV Ra	DV Ra, UmbA iAEDF	Recipient with hydrops	IV
3	30	G3P1 (1011)	20.3	308	440	30	0	10.4	absent	present		UmbV P	Recipient with hydrops	IV
4	23	G1P2 (1001)	21.3	282	498	43	1.11	7.96	absent	present	UmbA AEDF		Recipient with hydrops	IV
5	32	G1P0	25.7	691	993	30	2.55	12.75	absent	present	UmbA iAEDF/ REDF			III
6	35	G3P1 (1011)	21.7	351	392	10	0.8	15.4	absent	present				II
7	30	G1P0	23.6	453	742	39	1.9	6.0	absent	present	UmbA iAEDF			III
Mean	30.3		21.4	359.7	522.4	31.1	1.3	10.0						
±	±		±	±	±	±	±	±						
SD	4.0		2.8	170.1	259.7	11.2	0.8	3.2						

Legend: DVP – deepest vertical pocket, UmbA – umbilical artery, AEDF – absent end diastolic flow, REDF – reversed end diastolic flow, iAEDF - intermittent absent end diastolic flow, iREDF – intermittent reversed end diastolic flow, DV – ductus venosus, Ra – reversed a wave, UmbV P – umbilical vein pulsations

Table III: Perioperative details and delivery outcomes of patients with monochorionic-diamnionic pregnancies treated with fetal laser photocoagulation for Twin-to-Twin Transfusion Syndrome

CASE	AGE OF GESTATION (weeks)	INTERVAL FROM FIRST SEEN TO FLP (days)	QUINTERO STAGE	PLACENTA LOCATION	PLACENTAL CORD INSERTION DONOR	PLACENTAL CORD INSERTION RECIPIENT	SEQUENTIAL TECHNIQUE	SOLOMON TECHNIQUE	INTERVAL FROM FLP TO DELIVERY (days)	AOG AT DELIVERY (weeks)	MODE OF DELIVERY	LIVEBIRTH WEIGHT DONOR (grams)	LIVEBIRTH WEIGHT DONOR (grams)
1	17.9	2	III	Anterior	Marginal	Central	Yes	No	18	19.4	Vaginal	^	^
2*	20.1	2	IV	Posterior	Marginal	Central	Yes	Yes	67	29.7	Abdominal	950	990
3	20.7	3	IV	Anterior	Marginal	Marginal	Yes	Inc	19	23.4	Vaginal	^	^
4	23.7	20	IV	Posterior	Marginal	Central	Yes	Yes	46	30.3	Abdominal	820	2170
5	26	2	III	Anterior	Marginal	Central	Yes	Inc	8	27.1	Abdominal	720	1060
6	21.9	1	II	Anterior	Central	Central	Yes	No	71	31.9	Abdominal	^	1800
7	24.1	4	III	Posterior	Marginal	Central	Yes	Inc	28	28.1	Abdominal	720	1195
Mean	22.1	4.9							36.6	27.1		803.8	1443
±	±	±							±	±		±	±
SD	2.8	6.7							25.2	4.3		107.8	517.1

* Note of right lower extremity ischemic necrosis in the recipient
 ^ intrauterine demise

Table IV: Perinatal and neonatal outcomes from seven monochorionic-diamnionic pregnancies treated with fetal laser photocoagulation for Twin-to-Twin Transfusion Syndrome

PERINATAL OUTCOMES	No. (%)
Overall Survival <i>per fetus</i> (n=14)	9 (64%)
Double survivor <i>per pregnancy</i> (n=7)	4 (57%)
Single survivor <i>per pregnancy</i> (n=7)	1 (14%)
At least one survivor <i>per pregnancy</i> (n=7)	5 (71%)
NEONATAL OUTCOMES	
Overall Survival <i>per fetus</i> (n=14)	6 (43%)
Double survivor <i>per pregnancy</i> (n=7)	1 (14%)
Single survivor <i>per pregnancy</i> (n=7)	4 (57%)
At least one survivor <i>per pregnancy</i> (n=7)	5 (71%)

(The perinatal period was defined as the period from 28 weeks gestation to 7 days after birth while the neonatal period was defined as the period from birth to 28 days of life.)

Table V: Comparison of early experiences with fetal laser photocoagulation in Southeast and East Asian centers.6-9

CENTER	COUNTRY	YEARS REPORTED (No. of years)	NO. OF FLP PROCEDURES (average/year)	AOG AT PROCEDURE*	PROCEDURE TO DELIVERY INTERVAL*	AOG AT DELIVERY*	QUINTERO STAGES	DUAL DEMISE-IN-UTERO	SINGLE DEMISE-IN-UTERO	NO DEMISE	OVERALL FETAL SURVIVAL
St. Luke's Medical Center - Global City	Philippines	2021-2024 (2.8)	7 (2.5)	22.4 (17.9-26.0)	5.2 (1.1 - 9.6)	27.1 (19.4-31.9)	II-IV	2	1	4	9 of 14 (64%)
KK Women's and Children's Hospital	Singapore	2011-2017 (6)	15 (2.5)	20.3 (16.3-25.0)	11.1 (5.7-18.6)	31.2 (27.6-37.0)	II-III	1	5	8	21 of 28 (75%)
Seoul National University	South Korea	2011-2018 (7)	57 (8.1)	20.5 (18.1-22.9)	6.6 (0.34 – 13.6)	29.29 (22.8 - 35.8)	I-IV	7	19	31	81 of 114 (71%)
Raja Permaisuri Bainun Hospital	Malaysia	2019-2020 (1.2)	17 (14.2)	22 (no range reported)	7 (no range reported)	29 (21-37)	II-IV	4	0	13	26 of 34 (76%)
Chinese University of Hong Kong	Hong Kong	2002-2008 (6.2)	30 (4.8)	22 (16-27)	10 (0-18)	32 (21-37)	I-IV	4	3	23	49 of 60 (82%)
Chang Gung Memorial Hospital	Taiwan	2005-2010 (5)	44 (8.8)	20.1 (17-25)	10.8 (no range reported)	30.6 (no range reported)	I-IV	9	13	22	57 of 88 (65%)

*Reported as mean in weeks (range)

specialized care in the country. It is a glimpse of the status of fetal therapy in dire need of more technically trained specialists and development of facilities with complete equipment and machinery.

ACKNOWLEDGEMENTS

The authors would like to thank Dr. Maria Lora P. Garcia-Tansengco, Dr. Bernabe R. Marinduque, Dr. Catherine Grace L. Lim and the St. Luke's Medical Center – Global City for all of their support. Moreover, the authors would like to acknowledge Ms. Cheryl Glazer of Spectrumed, Inc for her generosity.

CONFLICT OF INTEREST

The authors declare no conflicts of interest.

CONTRIBUTIONS OF INDIVIDUAL AUTHORS

CLV is the sole first author and corresponding author. All authors were involved in the Conceptualization, Methodology, Conduction and Manuscript Revision of the research. Additionally, CLV contributed the Analysis, Original Draft Writing and Editing of the Research.

REFERENCES

Chalouhi GE, Essaoui M, Stirnemann J, Quibel T, Deloison B, Salomon L, Ville Y. Laser therapy for twin-to-twin transfusion syndrome (TTTS). *Prenat Diagn.* 2011; 31(7): 637-646.

Chalouhi GE, Stirnemann JJ, Salomon LJ, Essaoui M, Quibel T, Ville Y. Specific complications of monochorionic twin pregnancies: twin-twin transfusion syndrome and twin reversed arterial perfusion sequence. *Semin Fetal Neonatal Med.* 2010; 15(6): 349-356.

Chang YL, Chao AS, Chang SD, Hsieh PC, Wang CN. 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. *Taiwan J Obstet Gynecol.* 2012; 51(3): 350-353.

De Lia JE, Cruikshank DP, Keye WR Jr. Fetoscopic neodymium:YAG laser occlusion of placental vessels in severe twin-twin transfusion syndrome. *Obstet Gynecol.* 1990; 75(6): 1046-1053.

Edwards AG, Teoh M, Hodges RJ, Palma-Dias R, Cole SA, Fung AM, Walker SP. Balancing patient access to fetoscopic laser photocoagulation for twin-to-twin transfusion syndrome with maintaining procedural competence: are collaborative services part of the solution? *Twin Res Hum Genet.* 2016; 19(3): 276-284.

Kweon SY, Lee SM, Cho K, Park CW, Park JS, Jun JK. Fetal survival immediate after fetoscopic laser ablation in twin to twin transfusion syndrome. *J Korean Med Sci.* 2019; 34(3): e20.

Lewi L. Monochorionic diamniotic twins: What do I tell the prospective parents? *Prenat Diagn.* 2020; 40(7): 766-775.

Loh M, Bhatia A, Tan KL, Thia E, Yeo GSH. Outcomes following selective fetoscopic laser ablation for twin-to-twin

transfusion syndrome: a single-centre experience. *Singapore Med J.* 2020; 61(10): 523-531.

Natarajan L, Gosavi AT, Wataganara T, Su LL, Amin Z, Leung TY, Choolani M, Biswas A, Mattar CN. Mentoring a surgical team towards procedural competence in the early learning curve for selective fetoscopic laser photocoagulation. *Singapore Med J.* 2022; 63(5): 274-282.

Peeters SH, Van Zwet EW, Oepkes D, Lopriore E, Klumper FJ, Middeldorp JM. Learning curve for fetoscopic laser surgery using cumulative sum analysis. *Acta Obstet Gynecol Scand.* 2014; 93(7): 705-711.

Quintero RA, Morales WJ, Allen MH, Bornick PW, Johnson PK, Kruger M. Staging of twin-twin transfusion syndrome. *J Perinatol.* 1999; 19(8 Pt 1): 550-555.

Tan LN, Gardener GJ, R Jeganathan JR, Naidu A, Hassan G, Ahmad Zainuddin R, Kilby MD. Fetoscopic laser ablation for twin-to-twin transfusion syndrome in Malaysia: A 15-month retrospective cohort review from an emerging centre in South East Asia. *Med J Malaysia.* 2023; 78(1): 68-73.

Ville Y, Hyett J, Hecher K, Nicolaides K. Preliminary experience with endoscopic laser surgery for severe twin-twin transfusion syndrome. *N Engl J Med.* 1995; 332(4): 224-227.

Yang X, Leung TY, Ngan Kee WD, Chen M, Chan LW, Lau TK. Fetoscopic laser photocoagulation in the management of twin-twin transfusion syndrome: local experience from Hong Kong. *Hong Kong Med J.* 2010; 16(4): 275-281.