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Paper Accepted*

ISSN Online 2406-0895

Original Article / Оригинални рад

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Selective fetal termination in monochorionic twin pregnancies – pregnancy outcome after bipolar cord coagulation and interstitial laser coagulation

Селективна фетална терминација код монохорионских близанаца – исход трудноће након биполарне коагулације пупчаника и интерстицијалне ласер коагулације

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Received: August 6, 2018

Revised: September 21, 2018

Accepted: November 25, 2019

Online First: November 27, 2019

DOI: <https://doi.org/10.2298/SARH180806125M>

***Accepted papers** are articles in press that have gone through due peer review process and have been accepted for publication by the Editorial Board of the *Serbian Archives of Medicine*. They have not yet been copy-edited and/or formatted in the publication house style, and the text may be changed before the final publication.

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SUMMARY

Introduction/Objective Presenting the perinatal outcome after selective fetal termination (SFT) in mono chorionic (MC) twins done by bipolar cord coagulation (BCC) and interstitial laser coagulation (ILC).

Methods During a five-year period SFT was done in 22 MC twins. BCC was done in 15 and ILC in seven cases. We registered: indication for SFT, gestational age at SFT, immediate postoperative death and late death of the co-twin, PPRM (preterm pre-labor rupture of membranes), gestational age at delivery/abortion, procedure-to-delivery interval, mode of delivery, neonatal body weight and 5-minute Apgar score.

Results Livebirth was significantly higher after BCC than ILC (86.7:57.1%). Gestational age at intervention was higher in BCC (20.2 ± 1.8 : 16.5 ± 1.7 weeks). Gestational age at delivery/abortion was lower for ILC (32.5 ± 4.8 : 27.5 ± 9.5 weeks); but there was no difference when compared only livebirths (33.8 ± 3.7 : 34.7 ± 4.5 weeks). There was no difference between procedure-to-delivery/abortion interval (86.7 ± 33.7 : 77.1 ± 73.0 days); but interval was significantly higher after ILC when compared only livebirths (93.3 ± 33 : 133 ± 30.9 days). There was no difference in PPRM (26.7:14.3%); preterm delivery (69.2:50%); Cesarean section rate (84.6:75%); neonatal body weight (2174 ± 82.4 : 2475 ± 823 g); or Apgar score (7.7 ± 1.9 : 9.2 ± 1.0).

Conclusion There is no ideal method of SFT in MH twins. Success of each SFT method depends upon correctly set indication, gestational age at procedure, and SFT technique. Risk of co-twin death is less after BCC than after ILC. As in University Clinic for Gynecology and Obstetrics Narodni Front better results were achieved after BCC, this method became a standard for SFT in MH twins, except in cases of TRAP sequence before 16 weeks.

Keywords: selective fetal termination; mono chorionic twins; bipolar cord coagulation; interstitial laser coagulation

САЖЕТАК

Увод/Циљ Приказати перинатални исход након селективне феталне терминације (СФТ) код монохорионских (МХ) трудноћа урађених биполарном коагулацијом пупчаника (БКП) и интерстицијалном ласер коагулацијом (ИЛК).

Метод Током петогодишњег периода СФТ је урађена код 22 МХ трудноћа – БКП код 15, а ИЛК код седам случајева. Регистровани смо: индикацију за СФТ, гестациску доб приликом СФТ, рану и касну смрт другог близанца, PPRM (претерминско прснуће плодних овојака), гестациску доб на порођају/побачају, интервал од интервенције до порођаја/побачаја, начин порођаја, телесну масу неонатуса и петоминутни Апгар скор.

Резултати Живорођеност је била значајно виша након БКП него након ИЛК (86,7:57,1%). Гестациска доб приликом СФТ је била виша код БКП ($20,2 \pm 1,8$; $16,5 \pm 1,7$ недеља). Гестациска доб на порођају/побачају је била нижа код ИЛК ($32,5 \pm 4,8$; $27,5 \pm 9,5$ недеља), али разлика није била значајна кад су поређени само живорођени ($33,8 \pm 3,7$; $34,7 \pm 4,5$ недеља). Није постојала разлика у интервалу између интервенције и порођаја/побачаја ($86,7 \pm 33,7$; $77,1 \pm 73,0$ дана), али је интервал био значајно већи након ИЛК кад су поређени само живорођени ($93,3 \pm 33$; $133 \pm 30,9$ дана). Није постојала разлика у учесталости PPRM (26,7:14,3%); претерминског порођаја (69,2:50%); учесталости царског реза (84,6:75%); телесне масе неонатуса ($2174 \pm 82,4$; 2475 ± 823 г); ни Апгар скор ($7,7 \pm 1,9$; $9,2 \pm 1$).

Закључак Не постоји идеални метод СФТ код МХ трудноћа, а успех сваке методе зависи од правилно постављене индикације, гестациске доби приликом интервенције и технике СФТ. Степен живорођености је већи након БКП него након ИЛК: Пошто су у ГАК “Народни фронт” бољи резултати постигнути након БКП, ова метода је постала стандард за СФТ код МХ трудноћа, осим у случајевима ТРАП секвенце пре 16нг.

Кључне речи: селективна фетална терминација; монохорионске трудноће; биполарна коагулација пупчаника; интерстицијална ласер коагулација

INTRODUCTION

Mono chorionic (MC) twin pregnancies present challenge to the obstetricians due to the placental anastomoses between the twins. About half of those pregnancies are uneventful, but the other half may be complicated by twin to- twin transfusion syndrome (TTTS), selective

fetal growth restriction (sFGR), twin reversed arterial perfusion sequence (TRAP sequence) or discordance for fetal abnormality (DFA). In most severe forms of those complications, when one fetus is severely anomalous, or is suffering severe distress, particularly if the condition is compromising the non-affected fetus, selective fetal termination (SFT) may be the best option, as in the case of single intrauterine death of one fetus, profound consequences for the surviving twin are reported, including a 15-25% risk of death or neurological damage [1–4].

SFT in MC pregnancies is difficult because conventional feticide techniques with intracardiac injection of potassium chloride are not an option, as the substance could embolize to the non-affected twin through the placental vascular anastomoses [1, 2, 5]. Complete separation of twin's blood flow is the only option for successful selective fetal termination. In the cases of uncomplete separation the other twin may die as the consequence of acute agonal interfetal hemorrhage through placental anastomoses [2, 5]. Therefore, complete and permanent occlusion of the affected twin's umbilical cord flow is recommended to protect the surviving twin. Umbilical cord occlusion may be done by several methods, such as fetoscopic cord ligation, interstitial laser coagulation, monopolar coagulation, radiofrequency ablation or ultrasound-guided bipolar cord coagulation [5–9].

The aim of this study is to presents pregnancy outcome after selective fetal termination in monochorionic pregnancies done by ultrasound-guided bipolar cord coagulation and interstitial laser coagulation in a single tertiary center.

METHODS

A retrospective observational study included all MC pregnancies in which SFT was performed by bipolar cord coagulation (BCC) or interstitial laser coagulation (ILC) in University Clinic for Gynecology and Obstetrics “Narodni front” during 5-year period. Indication for SFT were severe forms of TTTS, Quintero stage III and IV [10]; sFGR with worsening fetal Doppler velocity suggesting high risk of intrauterine death in non-viable fetus[11]; TRAP sequence in the cases when abdominal circumference ratio between the acardiac fetus and the donor is over 50% or with the signs of congestive heart failure in the donor; or DFA. In each case, after extended counseling about the risk of selective feticide vs.

expectant management, the patients opted for the SFT. After the Ethics committee approved SFT, written consent for the procedure was obtained.

BCC was done in the operating room under general anesthesia, complete aseptic procedures and prophylactic measures - intravenous antibiotics (ceftriaxone) and acute tocolysis for 48 hours. After skin disinfection, under the ultrasound guidance, a 3.3-mm trocar was introduced into the targeted fetus amniotic cavity avoiding transplacental approach, if possible 5-10cm from chosen coagulation site. Then a 3mm bipolar forceps was passed down the trocar, directed towards the cord of the terminating twin, which was grasped with the forceps. Coagulation started at the power of 26W for 15 seconds. The effect of the coagulation was monitored by the appearance of turbulence and steam bubbles caused by the local heating of tissue between the blades of the forceps. If necessary, bipolar energy was increased by 5W for 15 seconds, to a maximum 45W. The procedure was considered successful when echogenic bubbles were seen coming from the cord and the cord itself appeared hyperechogenic. The procedure was repeated in two other sites for safety. Confirmation of occlusion was also provided by the absence of detectable color Doppler flow in the distal part of the cord, with at least 2 min of persistent asystole. If necessary, interventions that enable easier BCC performance (amnioinfusion, amnioderivation, septostomy) had been done previously.

ILC was done under ultrasound guidance by introducing 18G needle next to abdominal cord insertion of the targeted twin near the confluence of viteline arteries and intrahepatic veins. Then, a laser fiber 400 μ m was introduced through the needle 4mm outside the top of the needle, and coagulation started with the power of 20W for 10-15 seconds. If necessary coagulation was repeated with power higher for 5-10W until maximum of 50W. Procedure was considered successful if hyperechogenic area was visualized peripherally and cessation of circulation was visualized by Doppler. Prophylactic measures included intravenous antibiotics (ceftriaxone) and acute tocolysis for 48 hours.

Cardiac activity of the co-twin was monitored during the entire procedure and immediately afterwards, and, peak systolic velocity in the middle cerebral artery were measured after 2h and 24h to detect acute fetal anemia. Fetal heart rate monitoring or tocogram were done after 1h, 24h and 48h. Patients were discharged at least after 48 h. CNS ultrasound was done after 7-14 days, and CNS MRI after 3-8 weeks. Monitoring continued in a two-week interval by measuring biometry, BP and Doppler. Delivery was

conducted near term. Mode of delivery was according to obstetrical indications. After birth chorionicity was confirmed by the pathologist.

We registered: maternal age and parity, indication for SFT, gestational age at SFT, operating time for BCC (defined as skin-to-skin time), early complications (postoperative uterine activity, amniotic fluid leakage), immediate postoperative death within 24 h of the co-twin, late death of the co-twin, preterm pre-labor rupture of membranes (PPROM), gestational age at delivery, procedure-to-delivery interval, mode of delivery, neonatal body weight and 5-minute Apgar score.

Statistical analysis included calculating means and standard deviations, frequencies, Student t test and Hi square test (*SPSS ver. 24*). $p < 0.05$ was considered significant.

RESULTS

In a five-year period 22 SFT were done in monochorionic pregnancies – 15 (68.18%) by BCC and 7 (31.82%) by ILC.

Indications for BCC were sFGR in 7 (46.67%); TTTS (stage III/IV) in 4 (26.67%) (Stage III in 3 and Stage IV in 1); DFA in 3 (30%) and TRAP in 1 case (4.56%). In the cases of DFA, the first anomalous fetus had multiple anomalies - agenesis of the distal part of the leg, polyhydramnios and bowel obstruction; the second had CNS anomaly (Dandy Walker anomaly); while third had discordant chromosomal anomaly (45,XO) with cystic hygroma. Two cases were dichorionic triplets with sFGR and DFA. The average gestational age at intervention was 20.2 ± 1.8 weeks. In 9 cases (60%) we performed intervention that enables easier BCC performance (amnioinfusion in 5; amnioderivation in 3; while one case had unsuccessful attempt of fetoscopic laser coagulation). Karyotype was done in 8 cases (53.33%); in 3 for maternal age; in 3 for DFA; 1 for sFGR and in one case of TRAP. BCC was successful in all cases. Trocar was directly introduced into the amniotic cavity of the “target” twin in 14 cases (93.3%). Accidental septostomy occurred in one case after introduction of a trocar through co-twin amniotic sac making monoamniotic (MA) pregnancy. There was no early fetal death and 2 cases (13.33%) of late fetal death; one case of TTTS after 36 days as a consequence of cord entanglement due to iatrogenic MA pregnancy; and the other case of DFA done at 16+4 week after 46 days for no obvious cause.

(Table 1.) Livebirth after BCC was 86.7% (13/15). Preterm delivery occurred in 69.2%; PPRM in 26.7%. The average gestational age at delivery was 33.8 ± 7 weeks. Cesarean section was performed in 84.6%. (Table 2.)

ILC was done for TRAP in 4 (57.13%); and by DFA, sFGR and TTTS in one case each (14.29%). The average gestational age at ILC was 16.5 ± 1.7 weeks. Karyotype was done in 5 cases (71.43%) – 4 CVS and one amniocentesis. ILC was successful in all cases. In one case uterine activity was registered. There were 3 early fetal deaths (42.86%) and no late fetal death. (Table 3.) Live birth after ILC was 57.1% (4/7). Preterm delivery occurred in 50%; PPRM in 14.3%. The average gestational age at delivery was 34.7 ± 4.5 weeks. Cesarean section was performed in 75%. (Table 4.)

Livebirth was significantly higher after BCC than ILC (86.7:57.1%). Gestational age at intervention was higher in BCC. Gestational age at delivery/abortion was lower for ILC; but there were no difference when compared only livebirths. There were no difference between procedure-to-delivery/abortion interval; but interval was significantly higher after ILC when compared only livebirths. There was no difference in PPRM; preterm delivery; Cesarean section rate; neonatal body weight; or Apgar score (Table 5)

DISCUSSION

SFT is a treatment option in well-selected cases of complicated MC twin pregnancy [1, 2]. Imperative in those cases is immediate, permanent and complete obliteration of the umbilical cord. Different techniques are used, each of them has its own challenges, as well as operative and preoperative risks [1, 5–9]. In selected cases we used equipment available in our institution – BCC in 68.18% and ILC in 31.82%.

The indications for the SFT are well defined. In most studies TTTS presents the major indication for the procedure (25 – 72%) and is performed in stages III – IV when previous therapeutic procedures were ineffective and/or if fetal demise is expected. It may be done either in donor or recipient twin. In the severe cases of early presentation of sFGR, when fetal death of sFGR fetus is expected, SFT may be the only option for the survival of eutrophic twin. sFRG is reported to be 2–56% of indications for SFT. TRAP sequence is reported to be done in 12–40% with cardiac overload of the pump twin. Discordant fetal anomaly is done in

about 35% of all SFT [3, 6–9]. In our series indications differ between different techniques. BCC is done mostly for sFGR and TTTS, while ILC is done predominantly in TRAP.

Gestational age plays important role in SFT survival rate. The general attitude is that optimal results in SFT after 18-20weeks are done by umbilical occlusion, while intrafetal methods are the choice in earlier gestation [3, 6, 8]. BCC is best option after 18weeks, to avoid introduction of a relatively large instrument into still small uterus. Pregnancy loss is reported to be 41% if done at 16–17 weeks; and 3% if done after 18 weeks. After 24 gw umbilical diameter may exceed the forceps diameter, making complete and immediate occlusion impossible by BCC [6, 8,]. ILC is best done in earlier gestation, as it is needle method with diameter of 17G. Failure of ILC if done after 18gw is a consequence of enlarged vessels diameter [3]. In our series gestational age at BCC was optimal, done after 18gw and before 24weeks in 14 cases. Gestational age ant ILC was lower, and complications occurred in higher gestational age.

Previous studies report that desirable instrument approach in BCC is directly into the amniotic sac of the “target” twin, which can be achieved in about 63%. In the cases with olygohydramnios in severe forms of sFGR or TTTS amnioinfusion may be done previously. Occasionally instrument may be introduced through healthy twin amniotic sac in order to avoid transplacental approach or iftwins are in unfavorable position, sometimes causing septostomy and iatrogenic MA pregnancy [3, 12]. We performed amnioinfusion in five cases and amnioderivation in three cases; while in one case instrument was introduced through co-twin amniotic sac with accidental septostomy and late death of the co-twin. Operating time wasn't influenced by placental position or accessibility of target twin amniotic sac as we previously performed amnioinfusion. No previous intervention was done before ILC as intrafetal methods don't require previous interventions. SFT was successful in all cases regardless of technique.

Early fetal death was registered three times (42.86%) after ILC; while late fetal death twice (13.33%) after BCC [6, 8]. As different techniques carry different perioperative risks, previous studies concluded that late fetal death is more often after BCC; while early fetal loss is more often after ILC [6, 8,10]. Early fetal death in ILC may be the consequence of difficult needle maintenance in abdomen for repeat coagulation and divergent energy dissemination, and/or prolonged time for complete cessation of blood flow with the risk of co-twin damage, which may explain three early co-twin deaths in ILC [12, 13, 14]. The cause of late fetal

death, that may not always be explained, may be cord entanglement, compression of the co-twin with fibrous occluded cord or amniotic band syndrome [5, 6, 9]. In our small series there were two deaths of the co-twin after BCC. In one case late death of the co-twin occurred as a consequence of the cord entanglement in iatrogenic MA pregnancy, while the other couldn't be explained, but it was done at 16 + 4 weeks.

PPROM is reported to happen in 10–30% and is responsible for most preterm births [5, 6, 7, 10]. In our series PPRM was registered in 22.73% (26.7% in BCC and 14.3% in ILC); while preterm birth occurred in 64.7% (69.2% in BCC and 50% in ILC).

Overall survival rate in MC pregnancies was 77.27%, but difference was found according to applied technique - 86.67% in BCC and 57.14% in ILC. Previous studies report both smaller and larger series of cases of SFT with the similar survival rate as ours [5–9, 12, 15, 16, 17]. Less survival after ILC may be the consequence if recruitment – fetal loss occurred only if SFT had been done after 16 gw; while BCC was always done in optimal gestational age. Concerning the limitations of gestational age and technique, as well as survival rate, BCC is a method of choice for SFT, except in cases where urgent SFT is required before 16gw. Results from other authors about survival according to different indications for SFT report best survival in TTTS after BCC and in TRAP sequence after intrafetal methods, due to difficult BCC in short edematous cord in TRAP sequence [3, 15, 16, 17]. In our study comparison by indication couldn't be done due to relatively small number of cases.

Few studies report neonatal morbidity and mortality after SFT, and even fewer evaluate neurological or psychomotor development, reporting normal development in the age of two years in 70–92%, explaining impaired development by prematurity [15–20]. In our series no specific neonatal morbidity was reported both after BCC and ILC, except for those that are consequence of prematurity.

CONCLUSION

We may conclude that there is no ideal method of SFT in MH twins. Risk of co-twin death is less after BCC than after ILC. There is no difference in the frequency of PPRM and PTD between two methods. Success of each SFT method in MH twins depends upon

correctly set indication, gestational age at procedure, and SFT technique. BCC is a method of SFT optimally done between 18 and 22 weeks in the cases when normal amniotic fluid is present in “targeted” fetus amniotic sac and there is enough space for instrument manipulation. If that isn't a case, previous amnioinfusion may be done. Interstitial methods may be the choice in the cases of severe oligohydramnios or anhydramnios, early gestation with small fetal volume and/or short umbilical cord of the targeted twin. ILC represents US guided SFT method optimally done in 16 weeks, without the need for previous interventions. Concerning the fact that ILC is followed by great risk of early co-twin death, this method should be applied in selective cases with low dynamic circulation or less risky method should be applied. As in OB/Gyn Clinic Narodni Front better results were achieved after BCC, this method became a standard for SFT in MH twins, except in cases of TRAP sequence before 16 weeks.

Conflict of interest: None declared.

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Table 1. Bipolar cord coagulation – description of the cases related to the procedure

	Indications	GA at SFT (week)	Previous interventions	Duration (min.)	Early fetal death (< 24h)	Late fetal death
1	sFGR	21 + 5	AC – 17 + 1 gw	22	No	No
2	sFGR	23 + 5	AI	14	No	No
3	sFGR	21 + 6	/	16	No	No
4	sFGR	18 + 6	AI	23	No	No
5	sFGR	20 + 3	AC – 17 + 2 gw / AI	13	No	No
6	sFGR	19 + 5	AI	17	No	No
7	sFGR (DH triplets)	21 + 3	/	21	No	No
8	TTTS – R (St IV)	22 + 4	FLK – 19 + 5 / AD – 21 + 6 gw	19	No	No
9	TTTS - D (St III)	20 + 0	/	18	No	After 36 days – MA
10	TTTS – D (St III)	19 + 3	AC – 16 + 5 gw / AD – 18+3 gw / AI	15	No	No
11	TTTS – D (St III)	19 + 4	AC/AD – 18 + 5gw	16	No	No
12	TRAP	19 + 6	AC – 16gw	15	No	No
13	DFA	16 + 4	AC – 15 + 5gw	11	No	After 46 days
14	DFA	21 + 1	CC during BKP	19	No	No
15	DFA (DH triplets)	18 + 3	AC (in both MC)	15	No	No
		20.2 ± 1.8	AI-5, AD-3, FLC-1, AC/CC-8/1	16.9 ± 3.4		2/15 (13.3%)

sFGR – selective fetal growth restriction; TTTS – twin to twin transfusion syndrome; D –

donor; R - recipient; TRAP – twin reversed arterial perfusion; DFA – discordant fetal

anomaly; DH – dichorionic; GA – gestational age; GW – gestational week; SFT – selective

fetal termination; AI – amnioinfusion; AD – amnioderivation; FLC – fetoscopic laser

coagulation; AC – amniocentesis; CC – cordocentesis

Table 2. Bipolar cord coagulation – description of the cases related to the pregnancy outcome

	GA (week) Del/Ab	Beginning of delivery	Interval BCC – delivery (days)	Delivery mode	Body weight (g)	5' Apgar
1. sFGR	37 + 1	Spontaneous	108	Vaginal	3,200	10
2. sFGR	28 + 3	Spontaneous + breech	33	CS	1,200	4
3. sFGR	39 + 1	Spontaneous	121	CS	3,100	9
4. sFGR	32 + 5	PPROM	90	CS	1,650	7
5. sFGR	29 + 5	Spontaneous	74	CS	1,350	6
6. sFGR	33 + 2	Fetal distress	95	CS	2,350	8
7. sFGR (DH triplets)	29 + 3	PPROM	54	Vaginal	1,220 1,300	7 6
8. TTTS R	32 + 1	Spontaneous	68	CS	1,800	6
9. TTTS D	(25 + 1)	Co-twin death	36	Ab induction	(600)	/
10. TTTS D	36 + 1	Spontaneous – repeat CS	124	CS	2,400	9
11. TTTS D	32 + 2	PPROM – placental abruption	88	CS	2,200	8
12. TRAP	38 + 2	Repeat SC	129	CS	3,700	10
13. DFA	(23 + 1)	Co-twin death	46	Ab induction	(400)	/
14. DFA	38 + 5	St post IVF	133	CS	2,700	10
15. DFA (DH triplets)	31 + 6	Fetal distress (PPROM of SFT at 20 + 5)	101	CS	1,400 1,450	6 6
Total (n = 15)	32.5 ± 4.8	PPROM 26.7%	86.7 ± 33.7		1,951 ± 965	
Live births (n = 13)	33.8 ± 3.7	PPROM 30.8%	89.6 ± 33	SC – 11 (84.6%)	2,174 ± 824	7.7 ± 1.9

sFGR – selective fetal growth restriction; TTTS – twin to twin transfusion syndrome; D –

donor; R – recipient; TRAP – twin reversed arterial perfusion; DFA – discordant fetal

anomaly; DH – dichorionic; GA – gestational age; GW – gestational week; BCC – bipolar

cord coagulation; Del – delivery; Ab – abortion; CS – cesarean section; PPROM – preterm

pre-labor rupture of membranes;

Table 3. Interstitial laser coagulation – description of the cases related to the procedure

	Indications	GA at SFT (week)	Previous intervention	Uterine activity	PPROM	Early co-twin death	Late co-twin death
1	TRAP	14 + 2	CVS	No	No	/	/
2	TRAP	15 + 3	CVS	No	No	/	/
3	TRAP	14 + 6	CVS	No	No	/	/
4	TRAP	16 + 4	CVS	Yes	No	Yes	/
5	DFA	17 + 5	AC	No	No	Yes	/
6	TTTS (Gr IV)	18 + 3	/	No	No	Yes	/
7	sFGR	18 + 1	/	No	No	/	/
Total	TRAP – 4 DFA – 1 sIUGR – 1 TTTS – 1	16.5 ± 1.7	CVS – 4 AC – 1				

TRAP – twin reversed arterial perfusion; DFA – discordant fetal anomaly; TTTS – twin to twin transfusion syndrome; sFGR – selective fetal growth restriction; GA – gestational age; PPRM – preterm pre-labor rupture of membranes

Table 4. Interstitial laser coagulation – description of the cases related to the pregnancy

outcome

	GA (week) Delivery/Ab	Beginning of delivery	Interval ILC-Delivery (days)	Delivery mode	Body Weight (g)	5' Apgar
1. TRAP	39+2	Spontaneous	175	Vaginal	3300	10
2. TRAP	32+1	Spontaneous	117	CS	2200	9
3. TRAP	29+5	PPROM	104	CS	1450	8
4. TRAP	(17+0)	Co-twin death	(3)	Ab induction	(180)	/
5. DFA	(18+1)	Co-twin death	(3)	Ab induction	(250)	/
6. TTTS	(18+5)	Co-twin death	(2)	Ab induction	(220)	/
7. sIUGR	37+4	Spontaneous	136	CS	2950	10
Total	27.5±9.5	PPROM 14.3%	77.1±73.0		1,507 ± 1,340	
Live births	34.7±4.5	PPROM 25%	133.0±30.9	CS – 75%	2475 ± 823	9.2 ± 1

TRAP – twin reversed arterial perfusion; DFA – discordant fetal anomaly, TTTS – twin to twin transfusion syndrome; sFGR – selective fetal growth restriction; GA – gestational age; ILC – interstitial laser coagulation; PPROM – preterm pre-labor rupture of membranes; CS – cesarean section; Ab – abortion

Table 5. Pregnancy outcome after bipolar cord coagulation and interstitial laser coagulation

	BCC (n = 15)	ILC (n = 7)
Livebirth n (%)	13/15 (86.7)	4/7 (57.1) *
GA at intervention (week)	20.2 ± 1.8	16.5 ± 1.7 *
GA at delivery/abortion	32.5 ± 4.8	27.5 ± 9.5 *
GA at delivery	(33.8 ± 3.7)	(34.7 ± 4.5)
Interval: intervention-delivery/abortion (days)	86.7 ± 33.7(36–133)	77.1 ± 73.0 (2–175)
Intervention-delivery (days)	89.6 ± 33	133.0 ± 30.9 *
PPROM / total n (%)	4/15 (26.7)	1/7 (14.3)
/ Delivery	4/13(30.8)	1/4 (25)
Preterm delivery n (%)	9/13 (69.2)	2/4 (50)
Cesarean section n (%)	11/13 (84.6)	3 /4 (75)
Body weight (g) – total	1,951 ± 965	1,507 ± 1,340
Live birth	2,174 ± 824	2,475 ± 823
5' Apgar score	7.7 ± 1.9	9.2 ± 1.0

*p<0.05

BCC – bipolar cord coagulation; ILC – interstitial laser coagulation; GA – gestational age;

PPROM – preterm pre-labor rupture of membranes