

Radiofrequency Ablation of Umbilical Cord for Reduction of Twin Reversed Arterial Perfusion Sequence: A Case Series and a Literature Review

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ABSTRACT

Background: Twin reversed arterial perfusion (TRAP) sequence is a rare disorder of monochorionic twins in which the placental anastomoses results in transitioning the blood from the normal fetus to the acardiac twin by a reversed arterial flow. This study aimed to investigate the radiofrequency ablation (RFA) outcome of the umbilical cord occlusion of acardiac twin to reduce TRAP sequence in monochorionic diamniotic pregnancies.

Methods: This prospective study investigated 25 cases of monochorionic diamniotic twin pregnancy with one acardiac fetus and selective reduction by RFA in the second trimester of gestational age in a referral hospital affiliated to Tehran University of Medical Sciences, Tehran, Iran, from 2018 to 2019.

Results: The mean±SD of gestational age in RFA and delivery were 20.0±3.8 and 35w±6.0 days, respectively, with a survival rate of 84%. A total of nine neonates were admitted to the neonatal intensive care unit, and four miscarriages were recorded in less than 24 weeks. The RFA procedure was successful in all pregnancies for selective termination of the acardiac twin.

Conclusion: RFA was a safe and reasonable method in a selective-fetal reduction in acardiac twins for monochorionic pregnancies.

Keywords: Fetal reduction, Radiofrequency ablation, Twin pregnancy

Introduction

Acardiac twinning identified as twin reversed arterial perfusion (TRAP) is a rare disorder of monochorionic twins (i.e., one twin with cardiac anomaly receives all of its perfusion from another co-twin) (1). The blood supplies of the acardiac twin are provided through the placental superficial anastomoses as an arterial-arterial connection, resulting in transitioning the blood from the normal fetus to the acardiac twin by a reversed arterial flow (2). On the other hand, an imbalance in the blood supply between the two fetuses leads to TRAP syndrome for 1 in 35,000 pregnancies (3) and 1 in 100 monozygotic twin pregnancies (2).

This type of pregnancy is more complicated

due to polyhydramnios, preterm delivery, and cardiac failure (4, 5). The proposed symptomatic therapies include amniocentesis, indomethacin, or inotropic agents (5). Moreover, some methods aim to block the cord and stop blood perfusion to the acardiac twins, such as radiofrequency ablation (RFA), bipolar cord coagulation, or photocoagulation of umbilical cord, and the coagulation of the placental anastomoses by laser power (6).

TRAP sequence could be managed by minimally invasive interventions, such as the bipolar cord coagulation (BCC) or RFA. Radiofrequency is a reliable technique in the treatment of the TRAP sequence (1, 7) such that

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if untreated, TRAP results in decreased survival rate to the quarter of the cases. In addition, heart failure is considered the main cause of mortality, and the risk to the pump twin increases by the growth of the acardiac twin.

For fetal reduction in complicated monochorionic twin pregnancies, RFA leads to thermal injury to tissues using high-frequency radio waves, applied to the umbilical cord of an abnormal twin. The success rate of the live neonates after RFA is reported the highest among those with selective fetal growth restriction following TRAP groups and the lowest in the fetus with anomaly (8).

To the best of our knowledge, the proposed technique is novel in Iran as few centers have utilized it by now. This study aimed at evaluating the effect of RFA on the treatment of the TRAP sequence twins.

Methods

In this prospective study, 25 women with monochorionic diamniotic twin pregnancy with one acardiac fetus and selected-reduction RFA were assessed in the second trimester of gestational age from June 2018 to September 2019 in Yas hospital, a tertiary center, affiliated to Tehran University of Medical Sciences, Tehran, Iran. Furthermore, all participants read and signed the copy of the informed consent before recruiting in the study, and the declaration of Helsinki on human rights was considered for all cases with an approval code (IR.TUMS.VCR.REC.1396.4772) obtained from the Ethics Committee of Tehran University of Medical Sciences, Tehran, Iran.

The present study included women with monochorionic multiple pregnancies over 18 years old with one acardiac twin in the second trimester. On the other hand, the women with vaginal bleeding, premature rupture of membranes, uterine contractions, dilatation of cervix (>1 centimeters) or effacement of the cervix, and any abnormal karyotype test results were excluded from the study.

The acardiac twin mass (weight ratio percentage of the affected twin) was estimated by ultrasound (9). The larger volume of the acardiac fetus leads to a greater load on the heart of the healthy twin.

In addition to positive events, all possible negative events, such as failure, premature rupture of membranes, intrauterine co-twin death, preterm labor, and thermal injury to the co-twins were completely explained to participants.

Detailed anomaly scan and fetal echocardiography were requested to exclude anomaly in co-twins, confirm intervention, and assess placenta and cervical length. The patients were admitted a day before the procedure and asked, 30 min before the procedure, to take two amoxicillin capsules 500 mg to prevent infection, indomethacin rectal suppository (50 mg), and undesirable contraction (repeated doses if needed every 6h). All procedures were followed by a single perinatologist expert in the field of fetal intervention.

Technique

In the operating room, grounding pads were placed under the maternal thighs and after washing the abdomen with povidone-iodine, light maternal sedation was performed with intramuscular 50 mg meperidine and 25 mg promethazine. The acardiac twin was reinvestigated by ultrasound (Philips, affinity 50, made of UK) to evaluate its position and placenta site. Local anesthesia (lidocaine 10%) was performed by continuous ultrasound monitoring, and a 17-gauge needle of radiofrequency (20-centimeter length and 2-centimeter tip expose) with a cool water center (RF medical MYGEN made of South Korea) was then inserted through the uterus to reach the umbilical vein for ablation.

The radiofrequency power was applied by a generator until 100°C from 1 to 2 min. The flow cessation in the umbilical cord was obtained and confirmed by the color Doppler. The needle was relocated a little to reach a better position without the cessation of vascular flow on the first try, and in an emergency, the radiofrequency energy additionally continued from 1 to 2 min.

After a 45-min procedure, cardiac asystole was obtained and confirmed by ultrasound in the next 24 h. Changing one fetus to asystole and surviving the other fetus after ending the procedure show a successful procedure. The peak systolic velocity of the middle cerebral artery with a color Doppler ultrasound was evaluated to find any evidence of fetal anemia in the pumped twin (before, immediately after, and 24 h following RFA).

However, the participants were discharged from the hospital one day after the procedure and visited one week later in the mentioned or local hospital by a perinatologist; moreover, follow-up visits were sustained to the time of delivery with calling patients or their physician by phone.

Statistical Analysis

All data were analyzed using SPSS software

(version 20; SPSS Inc., Chicago, IL, USA) and presented as mean±SD and frequencies (%) for continuous records and the categorical variables, respectively. The continuous data and categorical variables were compared by independent sample t-test and the Chi-square test, respectively. A p-value less than 0.05 was considered statistically significant.

Results

A total of 25 consecutive cases of monochorionic diamniotic twin pregnancy with one acardiac fetus suffering from TRAP sequence in 15 to 27 weeks of gestational age were recruited in the study. The demographic characteristics and obstetrical data of the participants are listed in Table 1.

The mean±SD of the gestational age at delivery was 35w+6 days, and the most common route of delivery was vaginal delivery (57.1%). A day after the procedure, nine neonates were admitted to

the neonatal intensive care unit, and four miscarriages were recorded in less than 24 weeks, while three of them had intrauterine fetal death (IUFD), one of the miscarriages was due to the premature preterm rupture of membrane (PPROM) as seen in Table 2. The overall survival rate after the procedure was 84%. Therefore, no adverse events were recorded for the mother who underwent RFA in the current study.

Table 1. Basic characteristics of the enrolled participants

Maternal characteristics	Findings
Maternal age (years)	32.3±5.8***
Maternal BMI* (kg/m ²)	27.3±3.1
Gravidity	2.1±1.3
Type of conception*	
Spontaneous	91.1%
Induction ovulation	8.9%
Gestational age at RFA** (week)	20.0±3.8

*Body mass index

**Radiofrequency ablation

*** Data are shown by mean±SD

Table 2. Obstetrics and neonatal outcome after selective reduction of TRAP (n=21)

Maternal characteristics	n (%)
Gestational age at delivery	
24-27 weeks	4 (19.0)
28-31 weeks	4 (19.0)
32-33 weeks	4 (19.0)
>33 weeks	9 (42.8)
Maternal complications	9 (42.8)
Rupture of membrane	1 (12.5)
Preeclampsia	3 (37.5)
Hemorrhage	5 (62.5)
Route of delivery	
Cesarean section	9 (42.9)
Normal vaginal delivery	12 (57.1)
Neonatal characteristics	n (%)
NICU** admission	9 (42.8)
Duration of NICU admission(days)	16.3±23.2*
Birth weight (gram)	2010±780*
≤1000	0 (0)
1000-1500	4 (19.0)
1500<	17 (80.9)

* mean±SD

** Neonatal Intensive Care Unit

Discussion

Based on the results, RFA can be considered a safe option for the fetal reduction in the TRAP sequence with an overall survival rate of 84%. No adverse events were detected, such as a co-twin burn or mother injury, and none of the cases experienced eminent vaginal bleeding after the procedure. RFA was known as an acceptable technique for a fetal reduction in complicated monochorionic multiple pregnancies (10) so that the nature of the disease results in avoiding the destruction of the TRAP sequence, leading to the death of both twins.

In complicated monochorionic pregnancies with an affected twin, the selective termination is reached due to stopping the blood flow of one fetus with ligation of the umbilical cord (11), fetoscopic laser coagulation (12), BCC (13), and mostly RFA (14).

Based on comparing the outcomes between bipolar cord occlusion and RFA, the live-birth rates were obtained at 86.7% and 81.3%, respectively; however, neonatal death was lower in the RF group (15). In the present study, the pregnancy success rate was approximately reported 85% that is more acceptable than the

results of the study by Bebbington et al. and Kumar et al. (16) with live birth rates of 70.7% and 78%, respectively (14). In just TRAP cases managed by RFA, the survival rate of pump twin was 70% (17).

Preterm birth and PPRM are considered common complications with potential adverse effects in neonates (12). Similarly, more than 50% of our live births were born preterm due to the mentioned reasons. Finally, no direct relationship was concluded between PPRM and RFA in this study.

The gestational age of the fetus during the procedure did not affect the outcome, which is consistent with the findings of a study by Kumar et al. (14). Furthermore, more than 30% of the cases were below 20 weeks of gestational age. However, it was expected that the success rate would be lower at the higher gestational age since the umbilical cord is thicker, and the process is more difficult. It is worth mentioning that no difference was observed in this regard.

Short-term follow-up of the neonates was considered a limitation that resulted in following their evolutionary and neurodevelopmental behaviors in childhood. More research is needed in a longer period for future studies.

Conclusion

RFA for the fetal reduction in acardiac twins seems safe and reasonable with minimal adverse events for the mothers and the fetus.

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Conflicts of interest

The authors have no conflict of interest.

Authors' contributions

F.R.S designed the study, M.G. was responsible for drafting the manuscript, M. Sh. contributed to manuscript editing and interpretation of data, B.S. was responsible for manuscript editing and interpretation of data, M.H. contributed to manuscript editing, and F.G designed the study.

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