

Selective Fetal Reduction in Complicated Monochorionic Twin by a Singletine Cool Tip Radiofrequency Ablator As Compared To Already Published Data Using Multitine Radiofrequency Ablator - A Single Center Experience

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Abstract

Aim: To evaluate perinatal outcomes in women with complicated monochorionic pregnancies who underwent selective fetal reduction (SFR) using radiofrequency ablation (RFA) by a cool-tip, single tine ablator and compare our results with already published studies on RFA done using multi-tine needle.

Materials and methods: This is a retrospective study, including patients with complicated monochorionic pregnancies who underwent SFR using the single tine RFA (17gauge cool tip RFA needle from Covidien) during the study period from January 2024 to December 2025 from Maternal Fetal Medicine unit in Hospital Tunku Azizah, Kuala Lumpur.

Results: 16 women with complicated monochorionic pregnancies underwent RFA including 10 for twin reversed arterial perfusion (TRAP) sequence, 4 for discordant major fetal anomalies, 1 with selective fetal growth restriction (sFGR) and 1 with twin-to-twin transfusion syndrome (TTTS).

The average maternal age was 31.3 years (27 to 40 years). The mean gestational age at the time of the procedure was 21.4 weeks (ranged from 17.4 to 26.3 weeks). RFA was technically successful in achieving SFR in all. At an average 1.8 ablation cycles and an average of 3.2 minutes duration of ablation per cycle were needed for complete cessation of blood flow. The mean gestational age at delivery among the live born was 35.1 weeks.

The overall survival was 87.5 % (14/16) with co-twin loss of 0.06 % (1/16), miscarriage of 0.06 % (1/16) and 0.06 % (1/16) had PPROM within 4 weeks of the procedure. The pregnancy success rates among TRAP sequence, TTTS and discordant anomaly groups were 90 % (9/10), 100 % (1/1), and 80 % (4/5) respectively. There were no maternal complications documented in all the cases.

Conclusion: This study shows that the pregnancy outcome using a single-tine cool tip RFA needle in carefully selected cases shows a better outcome as compared to other studies which used multi-tine RFA needle. Single-tine cool tip RFA needle has advantages of having technical simplicity, higher precision, lower risk of collateral thermal injury and lower cost, thus, making it a preferable option for selective fetal reduction in complicated monochorionic twin.

Introduction

Monochorionic pregnancies are associated with specific complications owing to placental sharing with the presence of multiple vascular anastomoses in them.^{1,2} Complications in monochorionic pregnancies include TTTS, selective fetal growth restriction, discordant anomalies, TAPS and TRAP. As a result, these conditions may lead to death of the affected twin and perinatal morbidity and mortality of the co twin. Co twin demise or major insult to the brain or other vital organs of the co twin takes place following single fetal demise due to sudden exsanguinations through vascular anastomosis towards the dead twin.³⁸

Monochorionic twin (MC) specific complications include twin-to-twin transfusion syndrome (TTTS), selective intrauterine growth restriction (sFGR), twin reverse arterial perfusion sequence (TRAPS), twin anemia-polycythemia sequence (TAPS), and conjoined twins.⁴ Discordant structural anomalies are more common in MC twins (6–8%) than in DC twins (1–2%).⁵

Selective fetocide is one of the treatment option to minimize the potential neurological injuries and to improve the chances of survival of the normal co-twin in complicated monochorionic pregnancies. In some of these situations, selective termination of one of the fetuses may have to be considered to minimize the risk to the other fetus or to maximize the chance of the surviving fetus.

Different invasive procedures, including Bipolar cord coagulation (BCC), Radiofrequency ablation (RFA), Fetoscopic laser coagulation, and Microwave ablation (MWA), have been described.^{6,7,8} However Radiofrequency ablation is the most commonly employed technique for selective fetal reduction.

Radiofrequency (RF) is a part of the electromagnetic spectrum bounded by frequencies of 3Hz to 300 GHz. The RFA probe acts as the cathode of a closed electrical circuit completed by the application of dispersing pads on the patient's thighs. The RF ablation causes coagulative necrosis of tissue at high temperatures. The Radiofrequency prob itself is not the source of heat and is not hot to touch. It generates an alternating electromagnetic field that sets adjacent molecules into motion. The molecules immediately adjacent to the prob are the source of heat, which is then transmitted farther by tissue conductivity.

In the current study, we describe the perinatal outcomes of 16 cases of complicated monochorionic twin pregnancies that underwent selective reduction using radiofrequency ablation with a single tine RFA needle at our institution according to the indications for the intervention

Material and methods

Study criteria

This is a retrospective study, including patients with complicated monochorionic pregnancies who underwent SFR using the single tine RFA (17gauge cool tip RFA needle from Covidien) during the study period from January 2024 to December 2025 from Maternal Fetal Medicine unit in Hospital Tungu Azizah, Kuala Lumpur.

Indications

16 women with complicated monochorionic pregnancies underwent RFA including 10 for twin reversed arterial perfusion (TRAP) sequence, 4 for discordant major fetal anomalies, 1 with selective fetal growth restriction (sFGR) and 1 with twin-to-twin transfusion syndrome (TTTS).

A detailed ultrasound (US) examination of all fetuses was performed before RFA, using GE Voluson E10, with a transabdominal curvilinear transducer of 1-5 MHz frequency by a trained fetal medicine consultant. Diagnosis of chorionicity was made according to the standard sonographic criteria.^{10,11} TTTS was staged according to Quintero and sFGR was defined based on Delphi consensus and classified according to Gratacos.^{12,13,14} Anomalies incompatible with life or causing severe debility at birth and which could lead

to intrauterine demise were included. A written informed consent was obtained from each patient before the procedure. All MC twins managed with RFA at our center were operated on by the same fetal therapy team.

Technique:

RFA was performed in operation theatre under local anaesthesia with aseptic precautions. The cool tip RF system (Covidien) consists of a 15cm long, 17 gauge cool tip RF electrodes with a 2-3cm exposed metallic tip and a dispersive pad applied to the patient skin (grounding). An external pump was used to infuse chilled distilled water into the cooling lumen of the RF electrode which prevents charring of the tissue. The RF was set on standard ablation mode, with varying amounts of energy generated a target temperature of 80-85 °C. Once the average goal temperature is reached, the device maintains the output for a defined time interval and then shuts off to enable tissue cooling.

Under ultrasound guidance, the RF needle was inserted percutaneously and through the uterus into the abdominal umbilical cord insertion site of the targeted fetus. The radiofrequency energy is then applied. The area representing the zone of thermal injury can be easily seen on ultrasound as an hyperechoic area. An average of 1.8 ablative cycles were required, with an average of 3.2 minutes time taken to achieve complete cessation of blood flow in the umbilical vein.

Successful procedure was defined as cessation of blood flow in the umbilical cord of the targeted twin on color doppler and power doppler along with idiosyncratic cardiac rhythm after completion of RFA cycles in the same setting.

Follow up

The middle cerebral artery peak systolic velocity (MCA-PSV) was assessed 24 hours after the procedure to detect fetal anemia in the surviving twin. All women were discharged 24 hours after surgery followed by an ultrasound after 1 week and then once every 2 weeks.

Cases were followed up for maternal and neonatal outcomes which included overall survival rate, PPRM less than 4 weeks of the procedure, co-twin loss, miscarriage and the average delivery age in those cases that ends up with a live birth

Statistical analysis

Results

16 women with complicated monochorionic pregnancies underwent RFA including 10 for twin reversed arterial perfusion (TRAP) sequence, 4 for discordant major fetal anomalies, 1 with selective fetal growth restriction (sFGR) and 1 with twin-to-twin transfusion syndrome (TTTS).

The average maternal age was 31.3 years (27 to 40 years). The mean gestational age at the time of the procedure was 21.4 weeks (ranged from 17.4 to 26.3 weeks). RFA was technically successful in achieving SFR in all. At an average 1.8 ablation cycles and an average of 3.2 minutes duration of ablation per cycle were needed for complete cessation of blood flow. The mean gestational age at delivery among the live born was 35.1 weeks.

The overall survival rate was 87.5 % (14/16) with co-twin loss of 0.06 % (1/16), miscarriage of 0.06 % (1/16) and 0.06 % (1/16) had PPRM within 4 weeks of the procedure. The pregnancy success rates among TRAP sequence, TTTS and discordant anomaly groups were 90 % (9/10), 100 % (1/1), and 80 % (4/5) respectively. There were no maternal complications documented in all the cases.

Discussion

To our knowledge, this is the first study reporting on outcomes of selective feticide with a single time RFA

device and also its advantages over multi tine radiofrequency ablator in Malaysia.

This current study compares outcome with the pooled data of 23 previous studies that have evaluated outcomes of RFA using multi-tine RFA needles. Variables evaluated and compared were the mean gestational age at the time of procedure, average number of ablation cycles and average time needed to achieve cessation of blood flow, incidence of co-twin demise, percentage of miscarriage and PPRM, the mean gestational age at delivery and the overall survival rates. Table 1 summarises the results of this current study and compares them with the pooled data of 23 previous studies that have evaluated outcomes of RFA using multi-tine RFA needles.

	Pooled data from 23 studies using multi-tine RFA needle	Our study using single-tine RFA needle
Mean gestational age at the time of procedure	19 weeks	21.4 weeks
Average number of ablations required to achieve cessation of blood flow	2.5 cycles	1.8 cycles
Average time needed to achieve cessation of blood flow	12.6 minutes	3.2 minutes
Mean gestational age at delivery	34.9 weeks	35.1 weeks
Overall survival rate	76.8%	87.5%

Table 1: Shows the comparison of variable outcome between pooled data from 23 studies using multi-tine RFA needle as compared to our study which used single-tine RFA needle.

The pooled data showed that the overall mean fetal survival rate was 76.8% whereas our study showed an overall survival rate of 87.5%. The mean gestational age at delivery was comparable, 35.1 weeks in our study as opposed to 34.9 weeks from the pool data which used multi-tine RFA.

In our experience, the advantage of selective fetal reduction using a single-tine RFA needle was that the procedure was simpler and faster with better perinatal outcomes as compared to multi-tine RFA. The average ablation cycle required was 1.8 cycles with an average time required to achieve complete cessation of blood supply was 3.2 minutes. This is significantly faster as compared to the pool data of cases using multi-tine RFA needle, which required average of 2.7 ablative cycles and an average of 10 minutes to achieve a successful ablation.

We believe that the type of RFA needle, careful preoperative assessment, strict patient selection and proficient operative skills are the main key determining factors for successful fetal reduction. We also hypothesized that the single tine needle being smaller (17 G vs 14-16G for multi-tine) and without the hassle of opening and closing the tines or ensuring proper placement of the multiple tines, would be technically simpler, reduce the operating times and cause less trauma to the membranes, thus effectively translating into lesser procedure related complications like PPRM within 24 hours to 4 weeks post procedure.

The cool tip RF generator continuously monitors tissue impedance throughout the procedure and adjusts the output accordingly would be of an added benefit. The cool tip electrodes internally circulate chilled

water, cooling the tissue adjacent to the electrode which in turn maximises energy deposition and also prevents charring of the adjacent tissue which acts as an insulating sleeve around the probe and limits further ablation of the desired tissue.

The cause of post-op co-twin fetal demise after RFA is likely multifactorial and has not been clearly elucidated in current literature. The potential risk factors for co-twin loss after RFA could be the indications themselves influencing the perinatal outcome after RFA, polyhydramnios increasing the risk of preterm delivery, cardiac dysfunction in the surviving twin, co-twin FGR, chorioamnionitis or procedure-related complications.

The highest risk period is 24–48h after the procedure. In our study, the percentage of co-twin intrauterine deaths was 0.06% (1/16), with the most likely cause of acute transfer of intravascular volume from the co-twin to the hypotensive, dying fetus of unsuccessful or incomplete coagulation of the target vessel. Sometimes intrauterine death of the co-twin may occur late, several weeks after surgery, and the underlying reason remains unknown.⁵ Thermal injuries to the mother or fetus have also been reported following RFA.²⁴ However, in our study, there were no maternal or fetal thermal damage observed.

Our strength in this study is that it reviews all multi-tine RFA studies in recent years and compares them with ours. Also, almost every kind of complication was included and data were compared with that of multi-tine RFA. The limitation of this study is the retrospective nature of our research and the small number of cases, making it difficult to generalize the data for prognostication. Further multi-center prospective studies are needed to more effectively compare the perinatal outcomes in single-tine RFA versus multi-tine RFA.

Conclusion

This study shows that the pregnancy outcome using a single-tine cool tip RFA needle in carefully selected cases shows a better outcome as compared to other studies which used multi-tine RFA needle. Single-tine cool tip RFA needle has advantages of having technical simplicity, higher precision, lower risk of collateral thermal injury and lower cost, thus, making it a preferable option for selective fetal reduction in complicated monochorionic twin.

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