

# The Role of Special Intrauterine Balloon and Intrauterine Contraceptive Device after TCRA in the Treatment of Intrauterine Adhesions

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## Research Article

**Keywords:** Intrauterine adhesion, Asherman syndrome, IUB, IUD, TCRA, Hysteroscopy

**Posted Date:** March 31st, 2022

**DOI:** <https://doi.org/10.21203/rs.3.rs-1462234/v1>

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## **Abstract**

## **Background**

It is of vital importance to focus on the prevention of intrauterine adhesion(IUA) relapse. Up to now, which method has a higher efficacy is still a matter of controversy. We tried to find a better method.

## **Methods**

In this retrospective cohort study, all of the 69 included IUA patients experienced transcervical resection of adhesion(TCRA), and after surgery, 31 patients were placed special intrauterine balloon(IUB) and 38 patients were placed intrauterine contraception device(IUD). All IUA patients had undergone post-operative hormone sequential therapy with estrogen-progesterone and adequate course of antibiotics therapy. Fisher's exact test, logistic regression method, Kaplan-Meier method and Cox proportional hazards regression model were used for statistical analysis.

## **Results**

The readhesion rate significantly varied from patients in IUB group and IUD group, in 15.39% and 54.06% respectively( $P = 0.002$ ). For recurrent moderate IUA patients, the severity of patients in IUB group had been significantly reduced than IUD group( $P = 0.035$ ). For severe IUA patients, cold knife management had a greater advantage than electric instrument( $P = 0.011$ ). There was a significant difference in the intrauterine pregnancy rate of IUA patients in IUB group and IUD group after treatment, in 55.56% and 14.29%, respectively( $P = 0.015$ ).

## **Conclusions**

Patients in this special IUB group had better outcomes than IUD. For preventing readhesion and improving conception rate, the use of cold knife during procedure, placing IUB, estrogen therapy and adequate course of antibiotics therapy after TCRA all have positive influence.

## **Background**

Intrauterine adhesions (IUA), also known as Asherman syndrome, which refers to partial or total adhesion of the uterine cavity or cervical canal due to the endometrial trauma. There are a variety of clinical manifestations, including menstrual abnormalities, such as hypomenorrhea, amenorrhea, dysmenorrhea, and infertility, recurrent spontaneous abortion(RSA), placenta previa or placenta implantation. Studies showed that there is a rising trend in the prevalence of IUA in China, dilation and curettage(D&C) is the most common cause of IUA, especially uterine curettage after the termination in different periods of pregnancy, according to the statistics, the incidence of IUA after multiple D&C procedures is as high as 14.0%-32.0%[1, 2].

The treatment of Asherman syndrome aims to restore the anatomy and volume of uterine cavity, in the meantime, improves symptoms of different clinical presentations, and most importantly, to prevent the reformation of IUA and repair endometrium. Transcervical resection of adhesion(TCRA) by hysteroscopy is the routine operation for IUA, however, studies showed that the recurrent rate after TCRA reaches up to 48.0%-62.5%, and the pregnancy rate is only 22.5%-33.3%[3, 4]. Therefore, taking measures to prevent readhesion and promote endometrial regeneration and repair endometrium is absolutely crucial. At present, the methods applied to reducing IUA recurrence rate after TCRA mainly

include the placement of intrauterine contraceptive device(IUD), intrauterine balloon(IUB), and biological glue materials. Estrogen, growth factor and granulocyte colony-stimulating factor(G-CSF) can be used for promoting endometrium growth. Occasionally, a number of adjuvant drugs are used to improve uterine artery blood perfusion, like aspirin, sildenafil citrate, pentoxifylline[5]. A cohort study suggested that IUB and IUD are superior to biological glue in preventing readhesion after surgery, in addition, IUB has better efficacy than IUD[1].

It is of vital importance to focus on the prevention of IUA relapse. Up to now, which method has a higher efficacy is still a matter of controversy. The purpose of this retrospective cohort study is to analyze the difference of curative effect in IUA patients who were respectively treated with a special kind of IUB and IUD after TCRA, which has certain guiding significance for clinical work.

## Materials And Methods

### Patients and data collection

In this study, 69 patients with Asherman syndrome were treated at Xiamen Maternal and Child Health Hospital between May 2020 and August 2021. All of the patients experienced TCRA by hysteroscopic surgery. After TCRA, 31 patients were placed IUB in family planning department and 38 patients were placed IUD in gynecology department. The follow-up cutoff time was October 2021. Clinical data were gathered from institutional database. All of the clinical records were anonymized. The approval for this study was provided by the ethical committee of Xiamen Maternal and Child Health Hospital, Xiamen, China. Owing to the retrospective study analyzed clinical historic data of patients, written informed consent was formally waived.

### Evaluation before TCRA

Prior to TCRA, all patients underwent pre-operative evaluations consisted of a detailed medical history, especially history of menstrual pattern, reproductive history, previous intrauterine operation history, as well as clinical examinations, routine blood and vaginal secretion determination, electrocardiogram and transvaginal ultrasonography.

### Operation

In all cases, transcervical resection of adhesion by hysteroscopy was performed under general anesthesia with the use of similar operating systems, [instrument and equipment](#). After adhesion separation, patients involved in this study took either of the two adjunctive treatments(a special IUB or a heart-shaped copper IUD, Figure 1) as readhesion preventive measure, which depended on the experience of operators. The intrauterine balloon used in this study is unique in a much more soft elastic saccule(4.0millimeters/mm, F12, Manufacturer: Nantong Sanli Medical Devices Co., Ltd.) that is inflated with 2.5-3.0 milliliters(ml) normal saline, besides, it is used without dilating cervix, which is still attractive in price and quality. Usually, the tube with this kind of balloon is applied to hydrotubation or hysterosalpingography(HSG) in department of Family Planning , Xiamen Maternal and Child Health Hospital. At the end of procedure, extra tube outside cervix was curled up into the vagina, keeping orifice opening to drain fluid.

According to the 1988 American Fertility Society (AFS) scoring system[6], patients with IUA are divided into three stages, designed as mild(a score of 1-4), moderate(a score of 5-8) and severe(a score of 9-12). This classification standard evaluates the extent of cavity involved, type of adhesion and menstrual pattern of patients during hysteroscopic surgery.

### Treatment after TCRA

All of 69 patients with Asherman syndrome had undergone post-operative hormone sequential therapy with estrogen-progesterone based on last menstrual period. From the day of surgery, complex packing estradiol tablets/estradiol and dydrogesterone tablets(Femostone. 2 milligram/mg, 2mg, 10mg. Manufacturer: Abbott Healthcare Products B.V.) was administered orally. Some gynecologists were prefer to administering Progynova(estradiol valerate tablets, 2-6mg daily, Manufacturer: DELPHARM Lille S.A.S.) for 21 days, during the last 10 days, combined with Duphaston(dydrogesterone tablets, 20mg daily, Manufacturer: Abbott Healthcare Products B.V.). Short-term oral prophylactic antibiotic therapy was used routinely. IUB was taken out 7 days after TCRA. The second-look hysteroscopic procedure was recommended one month after the operation, 2-3 days after menstruation. Nevertheless, some patients delayed, even five patients in IUB group did not recheck, and in IUD group, one patients did not perform the second-look hysteroscopy.

### **Statistical analysis**

The statistical analysis was processed by SPSS 20.0 statistical software tool for Windows(IBM Corporation, Armonk, NY, USA). Statistical description varied from **categorical data** and quantitative data. The normal test of continuous variables was performed by Kolmogorov-Smirnov Z test. Continuous data fit the normal distribution were described as mean $\pm$ SD(standard deviation), on the contrary, as median(interquartile range/IQR). The categorical data were described as frequency and percentage. For difference comparison among two groups, Fisher's exact test was used in the univariate analysis, in the meantime, logistic regression method was applied for further verification. The cumulative conception rate of patients pursuing pregnancy was calculated by Kaplan-Meier method and compared by the log-rank test. And then, Cox proportional hazards regression model was used to calculate hazard ratio(HR), with 95% confidence interval(CI). A two-side value of P<0.05 was considered statistically significant.

## **Results**

### **Baseline clinical features**

Table 1 and Table 2 showed the clinical characteristic features of 69 patients with Asherman syndrome involved in this study in detail. There were 31 patients in IUB group, and 38 patients in IUD group. According to the difference comparison among two groups, there was no significant differences between the basic characteristics, like age, BMI, number of intrauterine pregnancy, number of D&C procedures, number of intrauterine surgeries, a symptom of dysmenorrhea, menstruation assessment before surgery, complicated with thin endometrium or not[thin endometrium was discussed as endometrial thickness less than 7 millimeter in late proliferative and secretory phase in this study[5, 7]], complicated with chronic endometritis or not and the interval between two times of TCRA(Table 1, P > 0.05). As shown in Table 1, the mean age of patients included was  $32.65 \pm 5.48$  years old, which was  $32.26 \pm 5.38$  years old in IUB group and  $32.97 \pm 5.62$  years old in IUD group. Because of the orientation of treatment, IUA patients with missed abortion, recurrent spontaneous abortion or infertility chose family planning department to seek treatment in this hospital. Hence, the result showed statistically significant differences(Table 1, P < 0.05). The results indicated that there were 75.36%(52/69) patients experienced menstruation decreasing, 15.94%(11/69) patients with amenorrhea, and 8.70%(6/69) IUA patients with dysmenorrhea.

Table 1  
Baseline clinical features of IUA patients

Categories	IUB(n = 31)			IUD(n = 38)			Mean ± SD/median(IQR)	P-value
	n	%	Mean ± SD/median(IQR)	n	%	Mean ± SD/median(IQR)		
Age(years)			32.26 ± 5.38		32.97 ± 5.62		32.65 ± 5.48	0.330
< 35	21	67.74		21	55.26			
≥ 35	10	32.26		17	44.74			
BMI(kg/m <sup>2</sup> )			20.96(3.89)		21.78 ± 3.05		21.08(4.26)	0.661
< 18.5	2	6.45		5	13.16			
18.5–24.9	25	80.65		27	71.05			
≥ 25	4	12.90		6	15.79			
Gravidity(IUP)								0.860
0	0	0.00		1	2.63			
1	4	12.90		6	15.79			
≥ 2	27	87.10		31	81.58			
Number of D&C procedures								0.253
0	1	3.23		3	7.89			
1	5	16.13		12	31.58			
≥ 2	25	80.65		23	60.53			
Number of intrauterine surgeries								0.379
0	1	3.23		3	7.89			
1	4	12.90		9	23.68			
≥ 2	26	83.87		26	68.42			
Number of MA								0.029
0	8	25.81		20	52.63			
≥ 1	23	74.19		18	47.37			
Dysmenorrhea								0.684
Yes	2	6.45		4	10.53			
No	29	93.55		34	89.47			
Menstruation assessment before surgery								0.333

Categories	IUB(n = 31)			IUD(n = 38)			Mean ± SD/median(IQR)	P-value
	n	%	Mean ± SD/median(IQR)	n	%	Mean ± SD/median(IQR)		
Amenorrhea	7	22.59		4	10.53			
Less	21	67.74		31	81.58			
Equal	3	9.68		2	5.26			
Increased	0	0.00		1	2.63			
Complicated with thin endometrium <sup>a</sup>								1.000
Yes	17	80.95		25	80.65			
No	4	19.05		6	19.35			
Complicated with CE								0.153
Yes	3	23.08		2	6.67			
No	10	76.92		28	93.33			
Complicated with RSA								< 0.001
Yes	21	67.74		7	18.42			
No	10	32.26		31	81.58			
Complicated with infertility								0.029
Yes	0	0.00		6	15.79			
No	31	100.00		32	84.21			
Interval between two times of TCRA(days)			31.50(11.00)			35.00(36.00)	33.00(28.00)	0.439
21–28	10	34.46		9	24.32			
29–56	11	42.31		17	45.95			
> 56	5	16.13		11	29.73			
IUA score of primary TCRA			6.35 ± 1.60			8.00(2.00)	8.00(2.00)	< 0.001
2–4	4	12.90		1	2.63			
5–8	26	83.87		22	57.89			
9–12	1	3.23		15	39.47			

Categories	IUB(n = 31)			IUD(n = 38)			Mean ± SD/median(IQR)	P-value
	n	%	Mean ± SD/median(IQR)	n	%	Mean ± SD/median(IQR)		
Menstruation assessment after primary TCRA								0.554
Increased	28	90.32		31	81.58			
Less	1	3.23		1	2.63			
Equal	2	6.45		6	15.79			
IUA score of secondary TCRA								0.002
0	22	84.62		17	45.95			
2–4	3	11.54		4	10.81			
5–8	1	3.85		14	37.84			
9–12	0	0.00		2	5.41			
Score decrease in moderate IUA patients after primary TCRA <sup>b</sup>								0.035
≤ 4	2	8.70		8	36.36			
> 4	21	91.30		14	63.64			
Mechanical or electric management in primary TCRA								< 0.001
Mechanical	31	100.00		14	36.84			
Electric	0	0.00		24	63.16			
Fertility intention								
Contraception	13	41.94		15	41.67			1.000
Pursuing pregnancy	18	58.06		21	58.33			
Pregnancy after the last TCRA								0.015
Yes	10	55.56		3	14.29			
No	8	44.44		18	85.71			

Categories	IUB(n = 31)			IUD(n = 38)			Mean ± SD/median(IQR)	P-value		
	n	%	Mean ± SD/median(IQR)	n	%	Mean ± SD/median(IQR)				
IUA: intrauterine adhesion; IUB: intrauterine balloon; IUD: intrauterine device; SD: standard deviation; IQR: interquartile range; BMI: body mass index, defined as weight in kilograms divided by the square of height in meters(kg/m <sup>2</sup> ); IUP: intrauterine pregnancy; D&C: dilation and curettage; MA: missed abortion; CE: chronic endometritis; RSA: recurrent spontaneous abortion; TCRA: transcervical resection of adhesions.										
<sup>a</sup> : Thin endometrium was discussed as endometrial thickness less than 7 millimeter in late proliferative and secretory phase in this study.										
<sup>b</sup> : According to the data difference in distribution, we only analyzed score decrease in moderate IUA patients after primary TCRA.										

Table 2  
Univariate correlation analysis of IUA severity.

Variables	Mild(n = 5)		Moderate(n = 48)		Severe(n = 16)		P-value
	n	%	n	%	n	%	
Age(years)							0.294
< 35	3	60.00	32	66.67	7	43.75	
≥ 35	2	40.00	16	33.33	9	56.25	
BMI(kg/m <sup>2</sup> )							0.724
< 18.5	1	20.00	4	8.33	2	12.50	
18.5–24.9	4	80.00	37	77.08	11	68.75	
≥ 25	0	0.00	7	14.58	3	18.75	
Gravidity(IUP)							0.196
0	0	0.00	1	2.08	0	0.00	
1	0	0.00	10	20.83	0	0.00	
≥ 2	5	100.00	37	77.08	16	100.00	
Number of D&C procedures							0.192
0	0	0.00	4	8.33	0	0.00	
1	0	0.00	15	31.25	2	12.50	
≥ 2	5	100.00	29	60.42	14	87.50	
Number of intrauterine surgeries							0.565
0	0	0.00	4	8.33	0	0.00	
1	0	0.00	11	22.92	2	12.50	
≥ 2	5	100.00	33	68.75	14	87.50	
Number of MA							0.512
0	1	20.00	19	39.58	8	50.00	
≥ 1	4	80.00	29	60.42	8	50.00	
Complicated with thin endometrium							0.700
Yes	2	66.67	29	80.56	11	84.62	
No	1	33.33	7	19.44	2	15.38	
Complicated with CE							0.395
Yes	0	0.00	5	17.24	0	0.00	
No	3	100.00	24	82.76	11	100.00	
Complicated with RSA							0.088

Variables	Mild(n = 5)		Moderate(n = 48)		Severe(n = 16)		P-value
	n	%	n	%	n	%	
Yes	4	80.00	20	41.67	4	25.00	
No	1	20.00	28	58.33	12	75.00	

On account of patients was performed ambulatory surgery in family department of Xiamen Maternal and Child Health Hospital, considering the time of operation and safety, most severe IUA patients were treated in gynecology department in the inpatient department. Therefore, as Table 1 suggested, there was a significant difference in the severity of two groups( $P < 0.05$ ).

According to Table 2, IUA patients were classified as three degree, mild, moderate and severe, in 5 patients(7.25%), 48 patients(69.56%) and 16 patients(23.19%), respectively. The result indicated that age, BMI, number of intrauterine pregnancy, number of D&C procedures, number of intrauterine surgeries, complicated with thin endometrium, CE, MA and RSA or not all did not affect the severity of patients with Asherman syndrome(Table 2,  $P > 0.05$ ).

As Table 1 and Table 2 showed, 84.06%(58/69) IUA patients had at least 2 times intrauterine pregnancy, 69.57% (48/69) patients had at least 2 times of D&C procedures, 75.36%(52/69) patients had at least 2 times of intrauterine surgeries, and 60.87%(42/69) patients accompanied with thin endometrium before TCRA.

## Clinical efficacy

In this research, the clinical efficacy was presented through menstruation assessment after primary TCRA, IUA score of secondary TCRA and score decrease in moderate IUA patients after primary TCRA. No significant difference was found in menstruation changing in patients of two groups, placed with a special IUB or IUD, menstrual volume was increased in 90.32% and 81.58% patients respectively (Table 1,  $P > 0.05$ ). There was a striking difference in IUA score of secondary TCRA, which revealed that the readhesion rate varied from two groups in statistics, in 15.39% and 54.06% respectively(Table 1,  $P = 0.002$ ). As mentioned above, this study only statistically tested the difference of score decrease in moderate IUA patients after primary TCRA, as showed in Table 1, the severity of patients in IUB group had been significantly reduced( $P = 0.035$ ). According to Table 3, multivariate logistic analysis further verified the differences between two subgroups in IUA score of secondary TCRA and score decrease after primary TCRA, the odds ratio(OR) and 95%CI were (OR 2.342, 95%CI 1.473–3.724,  $P < 0.001$ ) and (OR 1.632, 95%CI 1.122–2.375,  $P = 0.010$ ), respectively.

Table 3  
Multivariate logistic analysis of the difference between two subgroups.

Variable	OR	95% CI	P-value
IUA score of secondary TCRA	2.342	1.473–3.724	< 0.001
Score decrease after primary TCRA	1.632	1.122–2.375	0.010

In consideration of the condition that family planning department in this hospital only performed TCRA with mechanical instruments, like cold knife, blunt dissection. This study made a difference analysis of mechanical procedure or electric management during TCRA surgery in moderate and severe IUA patients of IUD group. As Table 4 showed, for severe IUA patients, about the decline of IUA score after primary TCRA, cold knife management had a greater advantage( $P = 0.011$ ).

Table 4

Difference analysis of two types hysteroscopic management in moderate and severe IUA patients(Only IUD group).

Decline of IUA score after primary TCRA	Cold knife	Electric knife	P-value
Moderate IUA patients			0.380
$\leq 4$	2	6	
$> 4$	7	7	
Severe IUA patients			0.011
$\leq 8$	0	10	
$> 8$	3	1	

## Intrauterine pregnancy rate posttreatment

Statistic data of this study showed that intrauterine pregnancy rate of IUA patients in IUB group and IUD group after treatment was 55.56%(10/18) and 14.29%(3/21) with a significant difference(Table 1,  $P = 0.015$ ). Table 5 indicated that the average time to conception of two groups was  $28.67 \pm 10.69$  days and  $94.67 \pm 29.40$  days. As showed in Fig. 2, the cumulative conception rate of IUA patients after treatment in IUB group was significantly higher than IUD group(HR 0.201, 95%CI 0.055–0.734,  $P = 0.007$ ).

Table 5  
Time to conception of women in two groups.

IUB		IUD	
days	Mean ± SD/median(IQR)	days	Mean ± SD/median(IQR)
22	28.67 ± 10.69	62	94.67 ± 29.40
23		103	
41		119	
72			
72			
109			
111			
120			
155			
195			

## Discussion

According to the results above, overall, IUA patients treated with the special IUB after TCRA had a better outcome than IUD, whose readhesion rate was much lower and severity was reduced much more significantly. However, both methods could notably improve the menstrual volume, which might benefit from the utilization of hormone sequential therapy with estrogen and progesterone. Most important of all, though, patients with Asherman syndrome placed with the special intrauterine balloon after surgery had much higher intrauterine pregnancy rate than patients placed with intrauterine contraception device after TCRA procedure, particularly within two months after last surgery. But we need to point out that as the limitations of this study, the sample size was small and lack of adequate blinding, these conclusions are yet require further validation.

To a certain extent, IUD can partially separate from the intrauterine wall and reduce the formation of readhesion. Randomized controlled trials(RCT) found that for patients who placed IUD after TCRA, the overall conception rate and live birth rate were 27.5%-47.2% and 20.0%-28.0%, respectively[4, 8, 9], the reformation rate was 35.0%-43.1%[9, 10]. It was reported that 62.7% of IUA patients returned to normal menstruation by this way[1]. Given that intrauterine contraception device has limited barrier surface, there is higher readhesion rate. As the result of this study showed, the rate of menstrual volume increasing was 81.58%, the conception rate of IUA patients in IUD group was 14.29% and the recurrence rate was 54.06%.

After TCRA, placing an IUB can not only block the adhesion of different uterus wall, it is also convenient for drainage of hematometra and inflammatory exudation in uterine cavity, which contribute to minimize the risk of infection and

reduce the recurrence rate of intrauterine adhesion. Other study found that menstruation of up to 81.4% IUA patients had improved, who were placed IUB after surgery[1], and the overall conception rate was 33.9%-48.1%, the recurrence rate of IUA after surgery was 13.6%-38.7%[9–13]. Compared with placing IUD after TCRA, IUB could lead to a lower adhesion AFS score and in the meantime result in a lower recurrence rate[1], which was entirely consistent with the results in this study. According to the results above, the rate of menstrual volume increasing was 90.32%, the conception rate of IUA patients in IUB group was 55.56% and the recurrence rate was only 15.39%.

Although the clinical effect of placing IUB after TCRA has been confirmed, it is still not completely suitable for uterine cavity because of the shape, elasticity and compression of the balloon. Therefore, sometimes IUB can not separate wound surface adequately, especially for the wound surface of bilateral cornua uteri, and may affect blood supplies on endometrium, which usually result in repair deficiency eventually necrosis. It is well known that trauma and infection are the main pathogenesis of IUA, leading to endometrial ischemic change and hypoxia, which promote associated endometrial repair deficiency and fibrosis signal pathways or molecular mechanisms[14, 15]. Study found that the level of vascular endothelial growth factor(VEGF) was elevated due to the vascular endothelial injury resulted from insufficient blood supply[16]. And meanwhile, as research showed, estrogen receptors were detected increasing because of estrogen deficiency in local ischemic endometrium[17]. As the advantage of this study, about the special intrauterine balloon used in this research, there is no need to dilate cervix when in use, in addition, a soft elastic saccule improving blood supply significantly may be the reason of such a good therapeutic effect, which may up-regulate many repair factors and down-regulate some proinflammatory factors and fibrosis promotion factors.

In addition, to prevent the recurrence of IUA after surgery, it largely benefits from the use of estrogen in maintenance therapy, that can promote endometrial growth and regeneration to repair wound. A randomized controlled study found that estrogen inhibited reformation of adhesion and the routine daily estrogen dose(2mg) was effective quite sufficiently, there was no significant difference between a routine dose and a higher dose[18]. According to the result showed in this study, 80.77%(42/52) IUA patients complicated with thin endometrium before TCRA, therefore estrogen therapy is extremely important postoperation and preconception.

There are two kinds of operating instruments for hysteroscopic adhesiolysis, electric and non-electric, the latter includes blunt dissection and cold scissors. As this study showed, for severe IUA patient, non-electric method was more effective than electric method for preventing readhesion after TCRA. A meta-analysis also found that cold scissors is more efficient in preventing recurrence of intrauterine adhesion[19].

Chronic endometritis is a continuous inflammation of endometrium, there are lots of plasma cells in the endometrial stroma, as the marker, CD138 and CD38 are detected to find plasma cells by immunohistochemistry(IHC)[20, 21]. Studies revealed that the incidence of CE was 35.4%-46.28% in moderate and severe IUA patients, who had a higher recurrence rate and poorer reproductive outcome[22, 23]. In this hospital, sometimes operators diagnosed CE by visual signs during hysteroscopy, so that IHC was optional in pathological examination, hence only 11.63%(5/43) IUA patients were diagnosed by postoperative pathology. It should be pointed that adequate course of antibiotic therapy is vitally important.

In conclusion, the key for treatment of IUA patients lies in prevention of recurrence after TCRA. The results of this research suggested that patients in this special IUB group had better outcomes than patients in IUD group, especially for reducing severity of moderate patients. For preventing readhesion and improving conception rate, the use of cold knife, placing IUB, estrogen therapy and adequate course of antibiotics therapy all have positive influence. Owing to the small sample size in this study, the results still require further validation, it is necessary to carry out a larger retrospective study or a rigorous prospective RCT to further define the efficacy and outcome of the special intrauterine balloon. Besides, we will conduct another molecular biology and subendometrium hemodynamic research to further

explore the effect and mechanism of this kind of special IUB when used in prevention of readhesion and improving uterine endometrial receptivity.

All authors confirmed that all methods were carried out in accordance with relevant guidelines and regulations.

## Declarations

### Acknowledgements

The authors acknowledge the case management system in the medical record room of Xiamen Maternal and Child Health Hospital for providing substantially all clinical data of included patients; and thank Yan-Wei Sha, Department of Reproductive Medicine, Xiamen Maternal and Child Health Hospital, for his valuable discussion during this study.

### Author's contributions

Zhen-Yu Luo, Wen-Rong Wang: Conceived and designed the study.

Lin-Lin Zhuang, Kai Wang: Included patients and provided data; Analyzed data and wrote the paper.

Hai-Lan Shen, Jia-Hui Lin, Ye Lu: Included patients and provided data.

All authors read and approved the final manuscript.

### Funding

No funding was available for this study.

### Availability of data and materials

The datasets used and/or analysed during the current study available from the corresponding author on reasonable request.

### Code availability

Not applicable.

### Ethics approval and consent to participate

The approval for this study was provided by the human research ethics committee of Xiamen Maternal and Child Health Hospital, Xiamen, China. Owing to the retrospective study design and analysis of clinical data, written informed consent was formally waived.(The ethics committee: the human research ethics committee of Xiamen Maternal and Child Health Hospital, Xiamen, China. Approval No. KY-2021-051-K01)

### Consent for publication

Not applicable.

### Competing interests

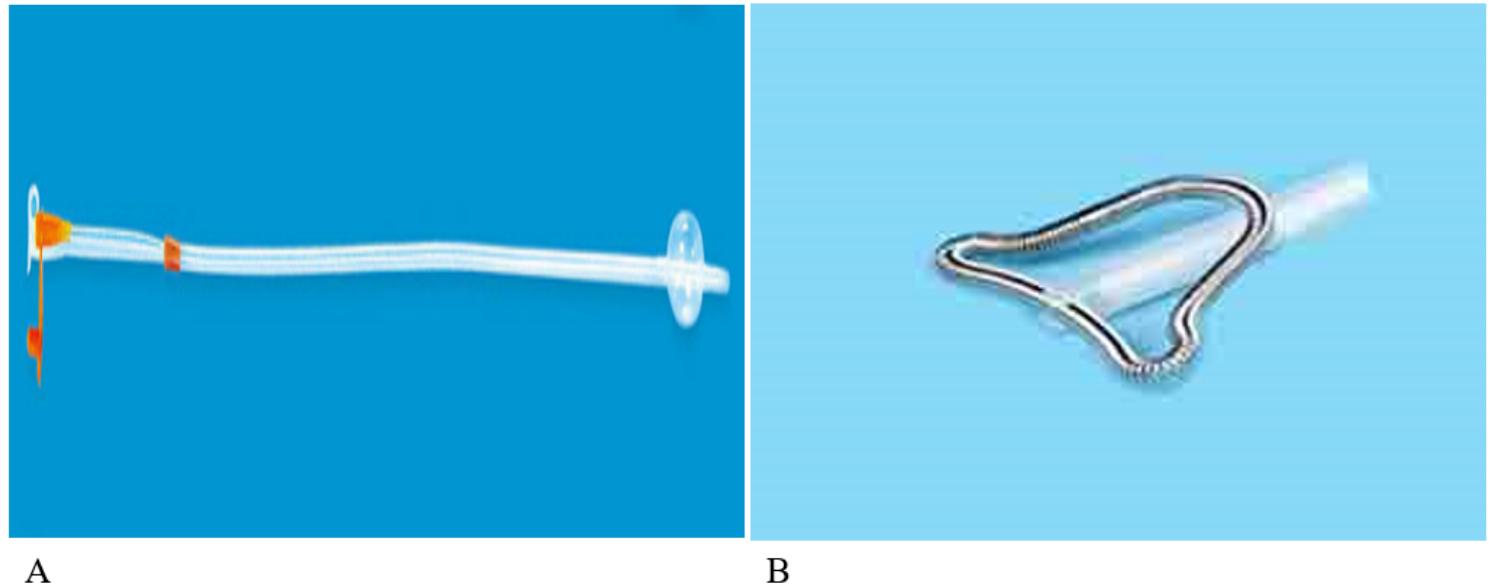
The authors declare no conflict of interest.

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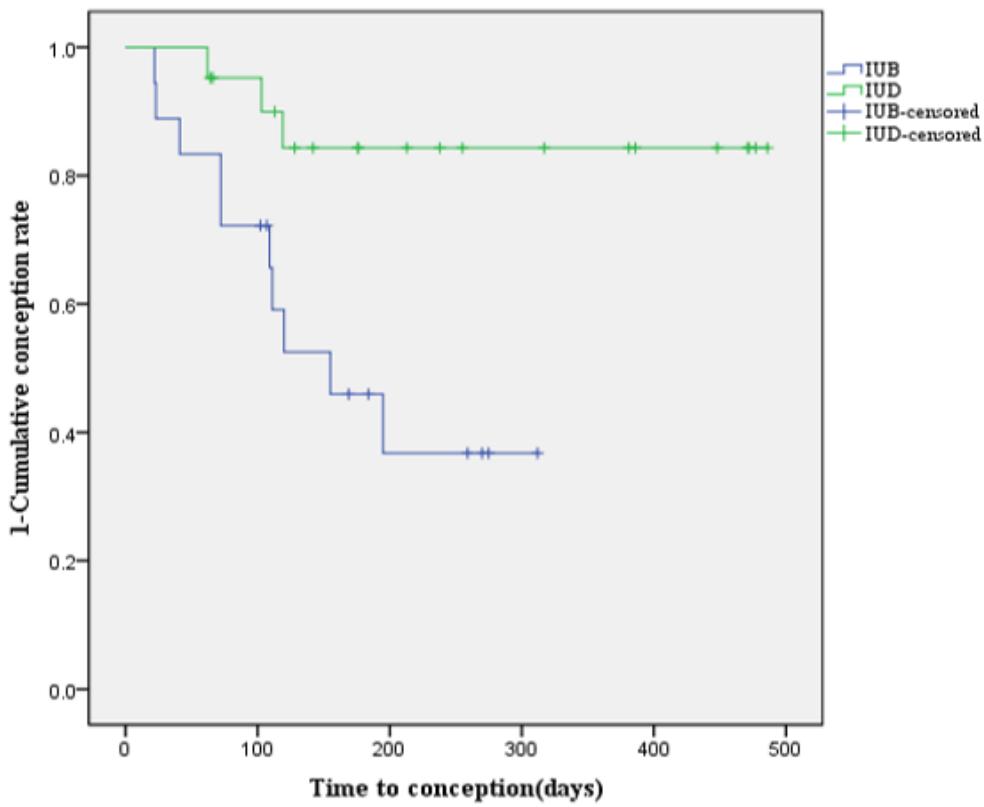
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## Figures



**Figure 1**

Special used intrauterine balloon(A), heart-shaped copper IUD(B).



**Figure 2**

Cumulative conception rate after TCRA in IUA patients treated with IUB or IUD.