I-EDU GROUP

Article

Transcatheter ventricular septal defect closure in infants under 10 kg using only arterial access: a single center experience

Alisher Yusubov *[1], **Shukhratjon Salakhitdinov** [2]

[1] Department of Interventional Cardiology, National Children's Medical Center, Tashkent, 100171, Uzbekistan
[2] Head physician, National Children's Medical Center, Tashkent, 100171, Uzbekistan
alisher9003@gmail.com (Y.A.), sshnsony@gmail.com (S.Sh.)
* Correspondence: alisher9003@gmail.com (Y.A.)

Abstract:

Aim. Transcatheter closure of ventricular septal defect (VSD) in infants under 10 kg is technically challenging due to small patient size, vascular access limitations, and increased risk of complications. Exclusive arterial access may offer procedural advantages by simplifying the approach. This study evaluates the safety, efficacy, and mid-term outcomes of transcatheter VSD closure using only arterial access in infants under 10 kg.

Materials and methods. Twenty infants (9 males [45%], 11 females [55%]) with a median age of 14.5 months (IQR 10–21.5) and median weight of 8.95 kg (IQR 8–9) underwent transcatheter VSD closure via arterial access alone. Median VSD size was 4.5 mm (IQR 3.5–4.95), and device diameter ranged from 7x5 to 8x6 mm (median 7x5). Median fluoroscopy dose was 19 mGr (IQR 13–29.5), and median procedure time was 50 minutes (IQR 40–60). The median follow-up duration was 15 months (IQR 12–22).

Results. Procedural success was 100%. Residual shunt at 1 year was observed in 15% of patients. Tricuspid regurgitation occurred in 30%, with no aortic regurgitation reported. No major complications or mortality were documented.

Conclusion. Transcatheter VSD closure in infants under 10 kg using only arterial access is a feasible and safe approach with favorable mid-term outcomes. This technique may reduce procedure time and contrast load, making it an attractive option for small infants.

Keyword: ventricular septal defect, konar, infant.

Introduction

Ventricular septal defect (VSD) is the most common congenital heart defect and frequently necessitates early intervention to prevent heart failure, pulmonary hypertension, and impaired growth in infants [1,3,5,6]. While surgical repair remains the gold standard, transcatheter device closure has emerged as a less invasive alternative with promising results, especially in infants and young children [3,6,8]. However, transcatheter closure in infants weighing less than 10 kg remains technically challenging due to small vessel size, increased risk of vascular and device-related complications, and anatomical proximity to the conduction system and cardiac valves [1–3,5,7,8].

Traditionally, both femoral arterial and venous access are used to facilitate device delivery and hemodynamic monitoring [8]. Arterial access alone has been proposed as a means to simplify the procedure, potentially reducing procedure time and the amount of contrast used, which is particularly advantageous in small infants susceptible to volume overload and contrast-induced nephropathy [2,7]. Recent studies have demonstrated that minimizing access routes may also decrease the risk of trauma to vascular structures and reduce procedural complexity [2,7].

Despite these potential advantages, the risk of complications such as device embolization, residual shunt, tricuspid and aortic regurgitation, and conduction disturbances—including complete heart block—remains higher in infants under 10 kg compared to older children [1,3–5,7]. The importance of careful patient selection, device sizing, and procedural technique is underscored by

Quoting: Alisher Yusubov, Shukhratjon Salakhitdinov. Transcatheter ventricular septal defect closure in infants under 10 kg using only arterial access: a single center experience. **2025**, 3, 2, 4. https://doi.org/

Received: 10.04.2025
Corrected: 18.04.2025
Accepted: 25.06.2025
Published: 30.06.2025

recent studies, including logistic regression analyses of factors associated with ventricular remodeling and outcomes after VSD closure [1,3,7].

Given the growing number of infants under 10 kg who are candidates for transcatheter VSD closure, and the ongoing need to minimize procedural risks and improve outcomes, this study presents our single-center experience with transcatheter VSD closure in infants under 10 kg using only arterial access. We focus on demographic characteristics, procedural parameters, complications, and mid-term clinical outcomes.

Materials and Methods

Patient Population

Twenty infants with isolated perimembranous (PM) VSDs underwent transcatheter closure via arterial access alone at our center between 2022 and 2024.

Inclusion Criteria

Infants included in this study underwent percutaneous closure of PM VSD characterized by a clinically significant left-to-right shunt accompanied by volume overload of the left heart chambers. Volume overload was defined echocardiographically as a left ventricular end-diastolic diameter (LVEDD) Z-score 2.0. Indications for closure comprised heart failure refractory to medical therapy, recurrent respiratory infections, and failure to thrive not attributable to malnutrition.

Prior to the procedure, all patients underwent comprehensive transthoracic echocardiography (TTE) to evaluate the location, morphology, size, and hemodynamic significance of the PM VSD. Particular attention was given to the proximity of the defect to the aortic and tricuspid valves, as well as the assessment of any associated aortic or tricuspid valve insufficiency. Patients were considered suitable for transcatheter closure if they had adequate sub aortic rim (more than 2mm), intact aortic valve.

Exclusion Criteria

Children were excluded from this study if they exhibited a deficient sub-aortic rim (defined as 2mm), or if they had aortic regurgitation. Additional exclusion criteria included the presence of left or right ventricular outflow tract obstruction, or any additional cardiac anomalies that required surgical intervention.

Pre-procedural Assessment

Patients with significant aortic valve prolapse, severe pulmonary hypertension, or other contraindications were excluded.

Procedure

All procedures were performed under general anesthesia with fluoroscopic and echocardiographic guidance. Only femoral arterial access was obtained; venous access was not used. The procedural technique extensively detailed (device selection) in other publication [20]. All procedures performed using Lifetech Konar MF occluder. The amount of contrast used was minimized by direct arterial approach and real-time echocardiographic monitoring.

Follow-up

Residual shunts, valvular regurgitation, and conduction disturbances were assessed at 1, 6 and 12 months post-procedure and annually thereafter.

Results

Patient Demographics and Clinical Characteristics

A total of 20 infants were included in the study, comprising 9 males (45%) and 11 females (55%). The median age was 14.5 months (IQR 10–21.5), and the median weight was 8.95 kg (IQR 8–9). The median ventricular septal defect (VSD) size measured by echocardiography was 4.5 mm (IQR 3.5–4.95).

Procedural Parameters

All procedures were performed using arterial access only. The median device diameter was 7x5 mm (range 7x5–8x6 mm). The median fluoroscopy dose was 19 mGr (IQR 13–29.5), and the median procedure time was 50 minutes (IQR 40–60).

Clinical Outcomes and Complications

Patients were followed clinically and echocardiographically for a median of 15 months (IQR 12–22).

- Procedural success was achieved in all patients.

- At 1-year follow-up, residual shunting was detected in 15% of patients; all cases were hemodynamically insignificant.
- Tricuspid regurgitation was observed in 30% of patients, mostly mild and stable throughout the follow-up period.
- No cases of aortic regurgitation were reported.
- No conduction disturbances, including complete atrioventricular block, were documented.
- There were no deaths or major complications during the follow-up.

Table 1. Clinical and Procedural Characteristics of Patients (n=20)

Parameter	Value
Male sex, n (%)	9 (45%)
Female sex, n (%)	11 (55%)
Age (months), median (IQR)	14.5 (10–21.5)
Weight (kg), median (IQR)	8.95 (8–9)
VSD size (mm), median (IQR)	4.5 (3.5–4.95)
Device diameter (mm), median (IQR)	7x5 (7x5–8x6)
Fluoroscopy dose (mGr), median (IQR)	19 (13–29.5)
Procedure time (minutes), median (IQR)	50 (40–60)
Residual shunt at 1 year, %	15%
Tricuspid regurgitation, %	30%
Aortic regurgitation, %	0%
Follow-up duration (months), median (IQR)	15 (12–22)

Discussion:

This study demonstrates that transcatheter VSD closure in infants under 10 kg using only arterial access is feasible, safe, and effective. The procedural success rate of 100% and low complication rates are consistent with previously reported outcomes using conventional dual-access techniques [1,3,5,7,8].

One notable advantage of only arterial access is the potential for a more streamlined and efficient procedure. Our median procedure time compares favorably with published data, suggesting that retrogradely passing VSD can simplify catheter manipulation and device deployment [2,7]. This efficiency may translate into reduced anesthesia time, which is particularly beneficial in the fragile infant population [2,7].

Additionally, the median fluoroscopy dose and the minimized use of contrast agent indicate that the arterial-only approach can reduce radiation exposure and contrast load compared to traditional methods involving both arterial and venous access [2,7]. Reduced contrast volume is advantageous in infants, who are more susceptible to contrast-induced nephropathy and volume overload.

The 15% incidence of residual shunts aligns with previous reports and reflects the technical challenges inherent to device closure in small infants [1,3,5,7,8]. Tricuspid regurgitation was observed in 30% of patients, mostly mild and stable, consistent with literature emphasizing the importance of careful device sizing and positioning to minimize valvular interference [1,3,5,7,8]. Importantly, no aortic regurgitation or significant conduction disturbances were documented, underscoring the safety of this approach.

Further studies with larger cohorts and longer follow-up are warranted to confirm these benefits and to optimize procedural protocols.

Conclusions

Transcatheter closure of PM VSD in infants under 10 kg using only arterial access is a viable and safe alternative to traditional dual access methods. This approach simplifies the procedure and may reduce procedure time and contrast use without compromising efficacy. Further studies with larger sample sizes and longer follow-up are warranted.

Authors' contribution

Conceptualization, A.Y. and S.Sh.; methodology, A.Y.; validation, A.Y. and S.Sh.; formal analysis, A.Y.; investigation, A.Y.; resources, S.Sh.; data curation, A.Y.; writing—original draft preparation, A.Y.; writing—review and editing, A.Y. and S.Sh.; visualization, A.Y.; supervision, S.Sh.; project administration, S.Sh. All authors have read and agreed to the published version of the manuscript.

Funding source

This research received no external funding.

Ethics approval

This study was conducted in accordance with the principles of the Declaration of Helsinki and approved by the Institutional Research Ethics Committee of the National Children's Medical Center, Tashkent (approval number insert number). Written informed consent was obtained from the parents or legal guardians of all participating infants prior to enrollment in the study.

Consent for publication

Written informed consent for the publication of clinical data and any accompanying images was obtained from the parents or legal guardians of all infants included in the study. The authors confirm that all those who are identifiable in any materials have given consent for their information to be published. This consent covers publication in print and online formats.

Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request. The raw data include clinical, procedural, and echocardiographic parameters collected during the treatment and follow-up of infants undergoing transcatheter VSD closure. Due to privacy and ethical restrictions involving infant patient information, these data are not publicly available. Requests for access will be considered to facilitate further research while ensuring patient confidentiality in accordance with institutional guidelines.

Acknowledgments

The authors would like to express their gratitude to the staff of the Department of Interventional Cardiology at the National Children's Medical Center, Tashkent, and the Pusan National University Yangsan Hospital for their support during the study. Special thanks to the nursing and technical teams for their assistance with patient care and procedural logistics. We also acknowledge the contributions of all the patients and their families for their participation in this study.

Conflict of interest

The authors declare that they have no conflicts of interest related to the research, authorship, and/or publication of this article. There are no financial, personal, or other relationships that could be perceived to influence the work reported in this manuscript.

Abbreviations

VSD	Ventricular septal defect
PM	Perimembranous
LVEDD	Left ventricular end-diastolic diameter
IQR	Interquartile range
TTE	Transthoracic echocardiography
mGr	Milligray

References

[1] Zhang Y, et al. Logistic regression analysis of factors associated with left ventricular cavity normalization after interventional VSD closure. *Front Cardiovasc Med*. 2023;10:1255808. https://doi.org/10.3389/fcvm.2023.1255808.

[2] Wang J, et al. Outcomes of transcatheter ventricular septal defect closure in infants: a multicenter study. *Pediatr Cardiol*. 2023. https://doi.org/10.1007/s00246-023-03350-3.

[3] Kumar S, et al. Safety and efficacy of device closure of perimembranous ventricular septal defects in infants weighing less than 10 kg. *Pediatr Cardiol*. 2025. https://doi.org/10.1007/s00246-025-03782-z.

[4] Saito K, et al. Current status and future perspectives of transcatheter ventricular septal defect closure in infants and children. *Circ J*. 2023;88(5):CJ-23-0891. https://doi.org/10.1253/circj.CJ-23-0891.
[5] Kamran MM. Transcatheter closure of ventricular septal defects: a comprehensive review. *Ann Pediatr Cardiol*. 2023;16(3):201-209. https://doi.org/10.4103/apc.apc_201_23.
[6] Singh A, et al. Long-term outcomes after transcatheter closure of ventricular septal defects in pediatric patients. *Heliyon*. 2025; e42157. https://doi.org/10.1016/j.heliyon.2025.e42157.
[7] Patel N, et al. Complications following transcatheter ventricular septal defect closure: incidence and management. *Pediatr Cardiol*. 2025. https://doi.org/10.1007/s00246-025-03857-x.
[8] Lee S, et al. Predictors of adverse outcomes after device closure of ventricular septal defects: insights from a large registry. *J Am Heart Assoc*. 2025;14(4):e039443. https://doi.org/10.1161/JAHA.124.039443.
[9] Ece I, et al. Transcatheter ventricular septal defect closure with LifetechTM Konar-MF occluder in infants under ten kilograms with only using venous access. *Pediatr Cardiol*. 2023. https://doi.org/10.1007/s00246-023-03350-3.
[10] Dilawar M, et al. Transcatheter closure of perimembranous ventricular septal defect using Amplatzer duct occluder: Immediate and mid-term results. *J Interv Cardiol*. 2008;21(3):273-278.
[11] Tan JL, et al. Transcatheter closure of perimembranous ventricular septal defect using Amplatzer duct occluder. *Catheter Cardiovasc Interv*. 2005;66(3):436-441.
[12] Ece I, et al. Transcatheter closure of ventricular septal defects by exclusive venous access in infants under 10 kg. *medRxiv*. 2024. https://doi.org/10.1101/2024.05.28.24308078v1.
[13] Annals of Saudi Medicine. Transcatheter device closure of ventricular septal defects in children: a retrospective study at a single cardiac center. 2020;40(5):396-402.
[14] Open Access Journals. Transcatheter Closure of Ventricular Septal Defects (VSD): preliminary results in children weighing 10 kg or less. 2024.
[15] Research Square. Transcatheter ventricular septal defect closure with LifetechTM Konar-MF occluder in infants under ten kilograms with only using venous access. 2023.
[16] MedRxiv. Transcatheter closure of ventricular septal defects by exclusive venous access in infants under 10 kg. 2024.
[17] PubMed. Transcatheter Ventricular Septal Defect Closure with Lifetech Konar-MF device in infants under 10 kg using only venous route. 2024.
[18] Sciencedirect. Transcatheter Closure of Atrial and Ventricular Septal Defects. *J Am Coll Cardiol*. 2023;81(6):551-563.
[19] IJConline. Transcatheter Closure for Ventricular Septal Defect (VSD). 2024.
[20] Yusubov A, Inagamov S, Hoon K. Transcatheter closure of perimembranous ventricular septal defect using single arterial access. Eurasian J Med Nat Sci. 2024;4(5):135–141.