

Totally Endoscopic Atrial Septal Defect Repair on Beating Heart: Clinical Outcome and Single-Surgeon Learning Curve Experience

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Objective: To evaluate the safety and efficacy of the **Hanoi ASD procedure**, which is totally endoscopic surgery for atrial septal defect (ASD) repair on beating heart. In addition, the present study also aimed to analyze the learning curve for this procedure.

Methods: From May 2016 to February 2023, 198 consecutive ASD patients weighing ≥ 20 kg were enrolled in the retrospective study. The Hanoi ASD procedure includes (1) unilateral or bilateral femoral arterial cannulation; (2) two or three 5 mm trocars and a 15 mm port; (3) ASD repair on beating heart, preventing air embolism with CO₂ insufflation and keeping the left atrium full of blood; and (4) not snaring the inferior vena cava. Cumulative sum (CUSUM) analysis was used to evaluate the cardiopulmonary bypass (CPB) and operation time learning curves. Variables among the learning curve phases were compared.

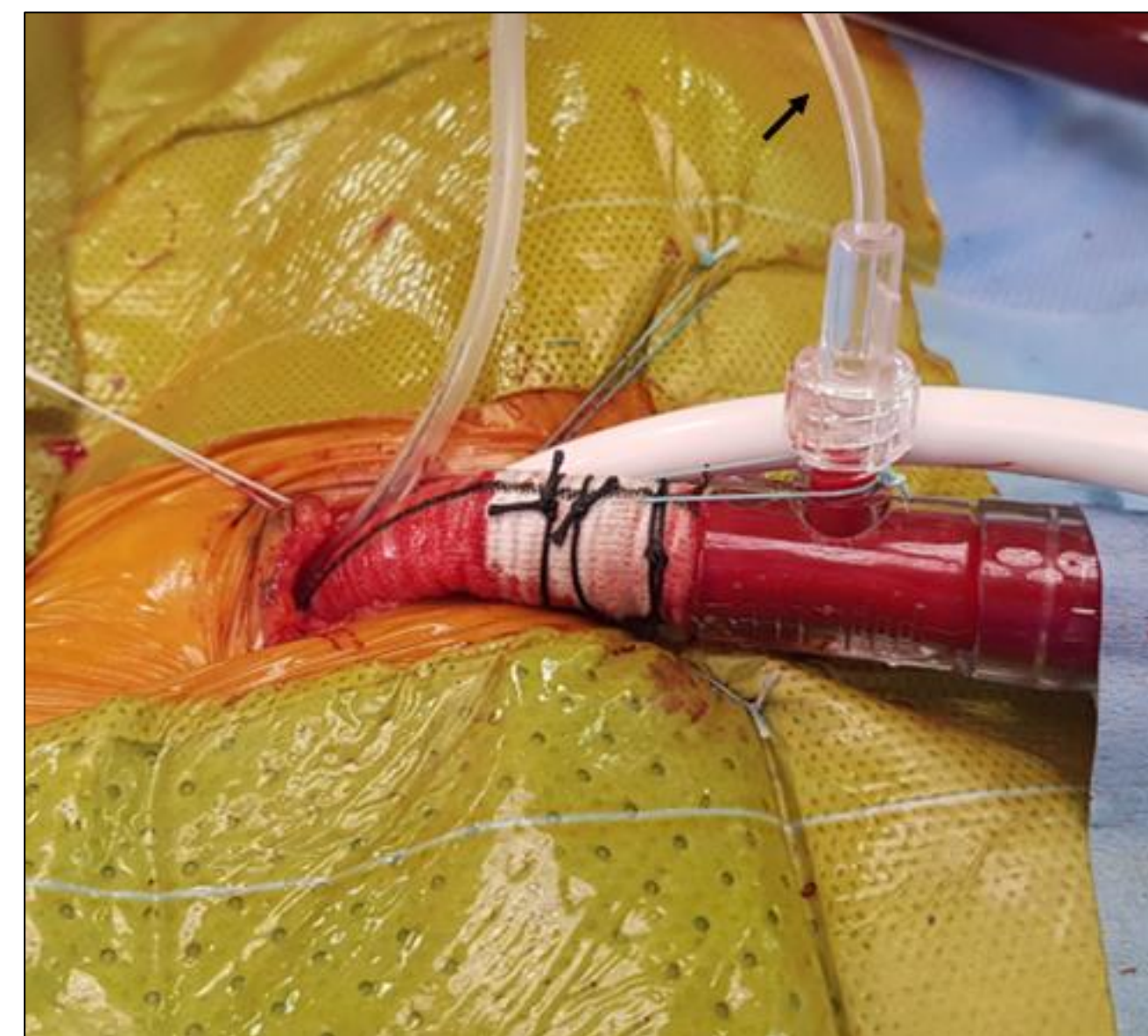


Table 1. Preoperative Patient Characteristics.

Variable	N = 198
Age, years	34 (24–48)
Female	150 (75.8)
BSA, m ²	1.46 (1.36–1.54)
Type of disease	
Isolated secundum ASD	192 (97)
Secundum ASD with p-APVC	6 (3)
ASD diameter, mm	30 (25–35)
RVED diameter, mm	37 (32–42)
Systolic PAP, mm Hg	45 (39–59)
TV regurgitation $\geq$ II	100 (50.5)

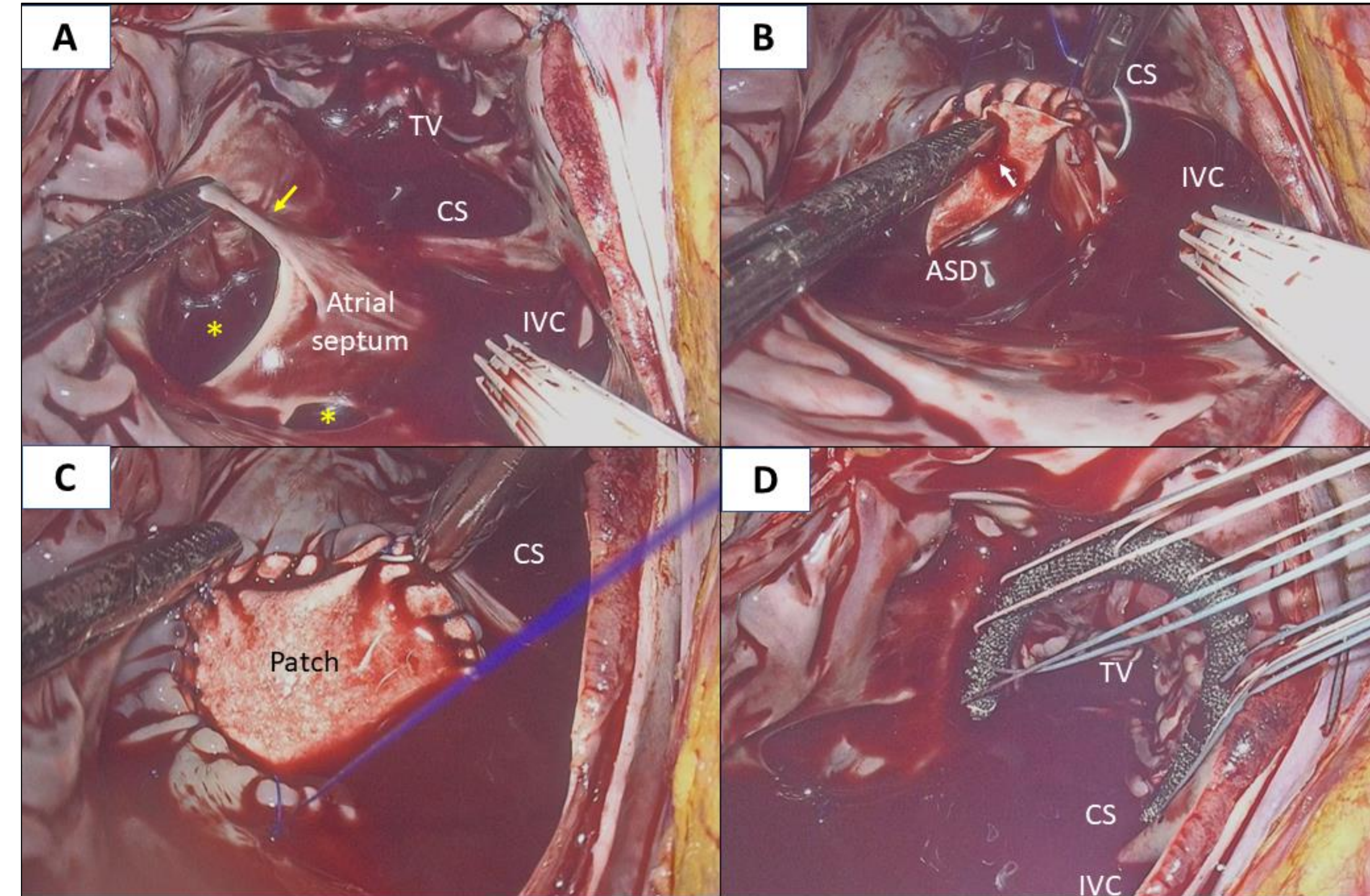
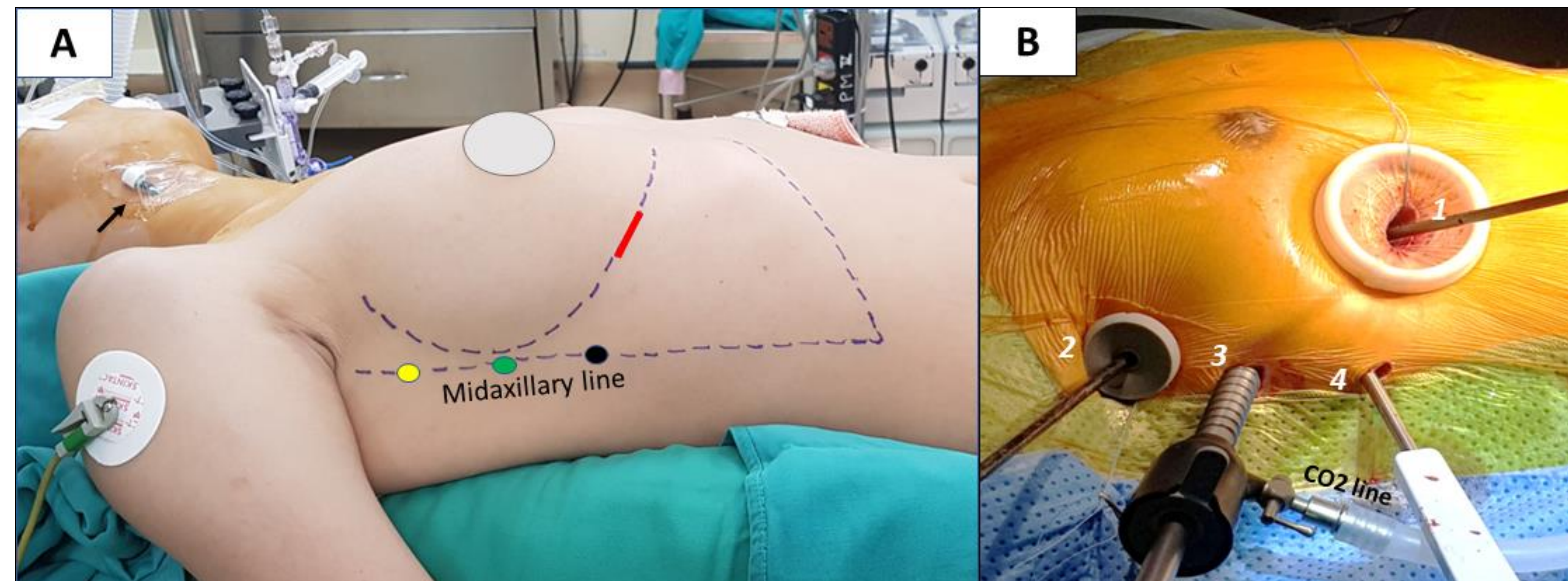


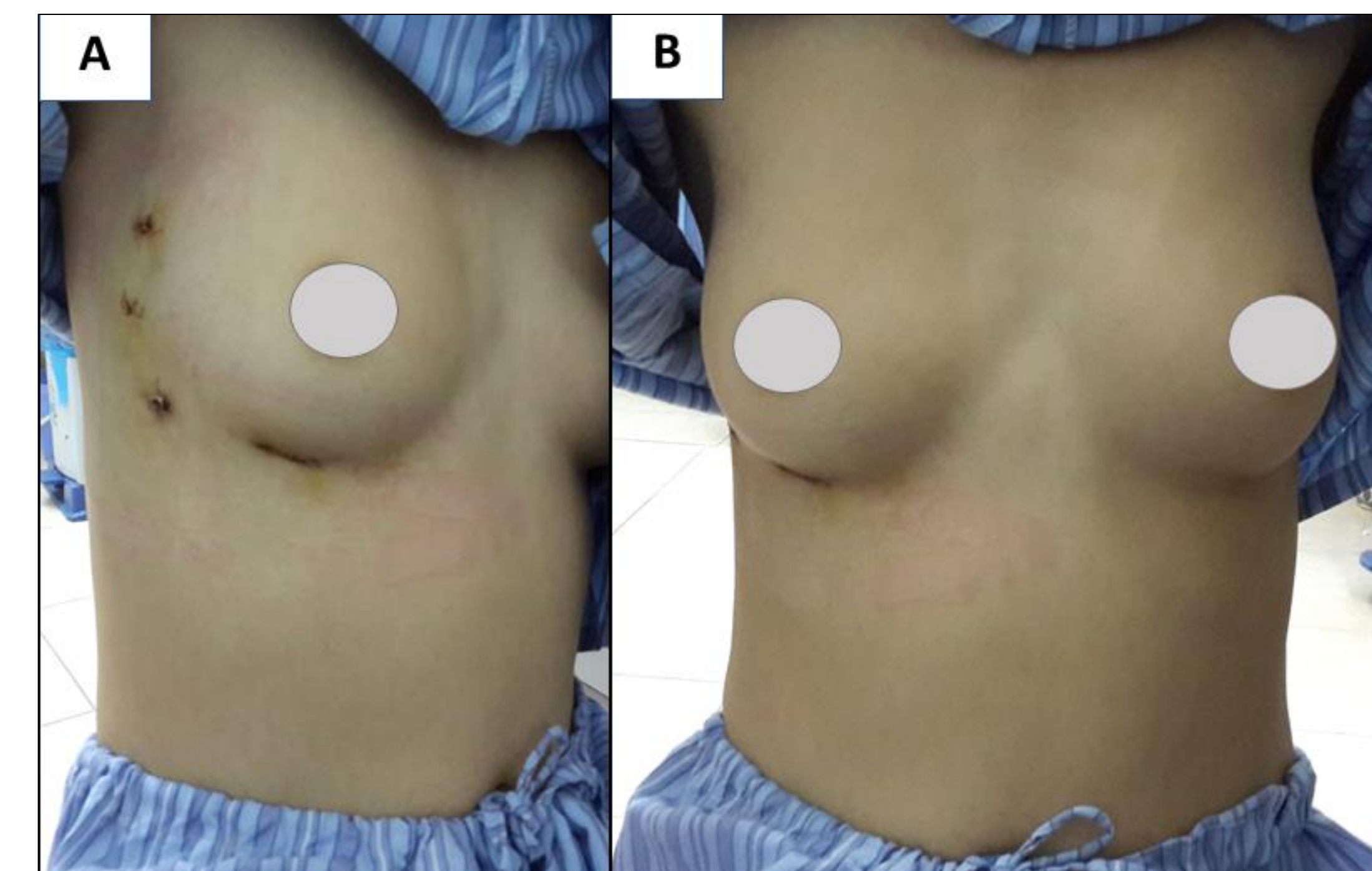
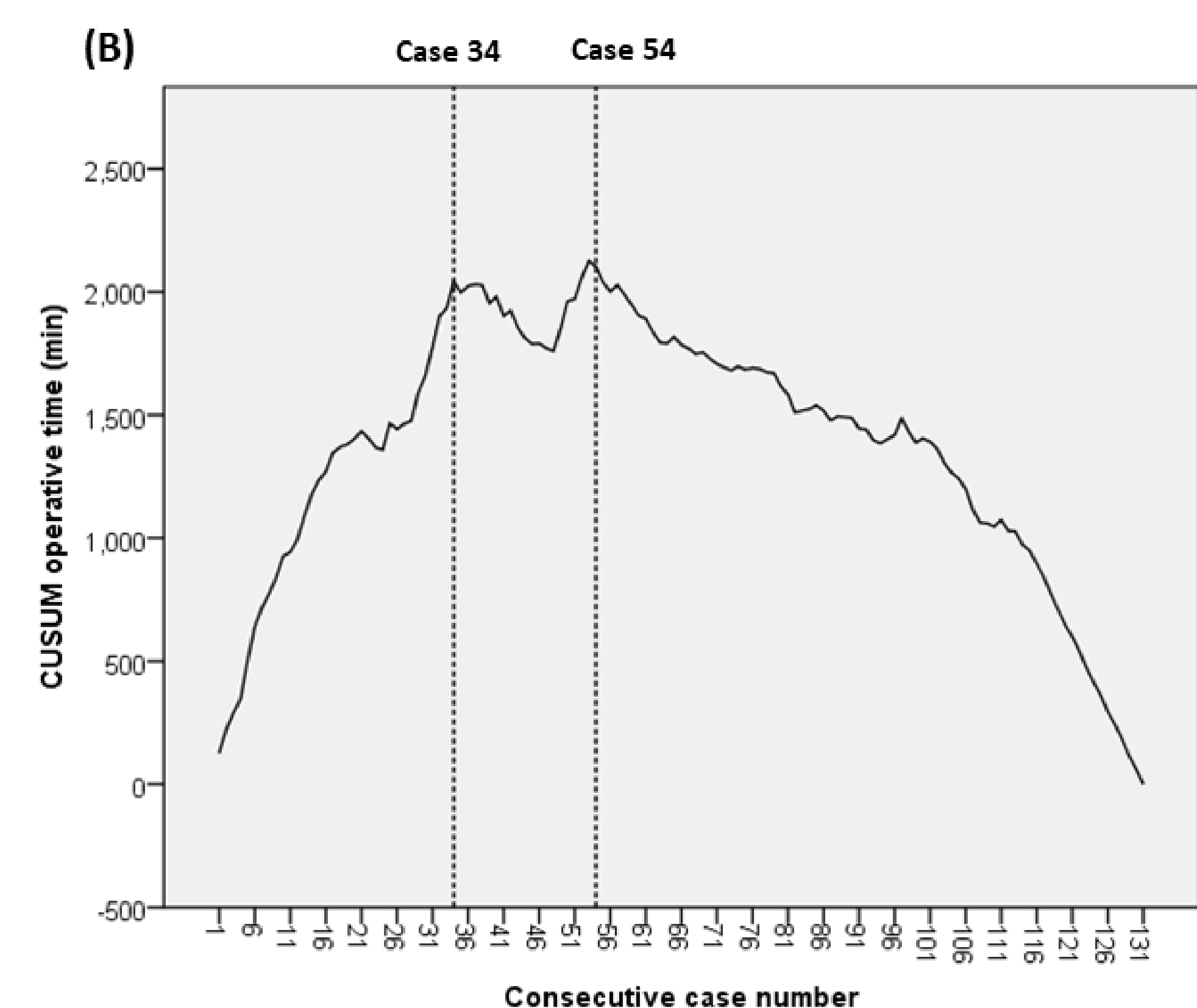
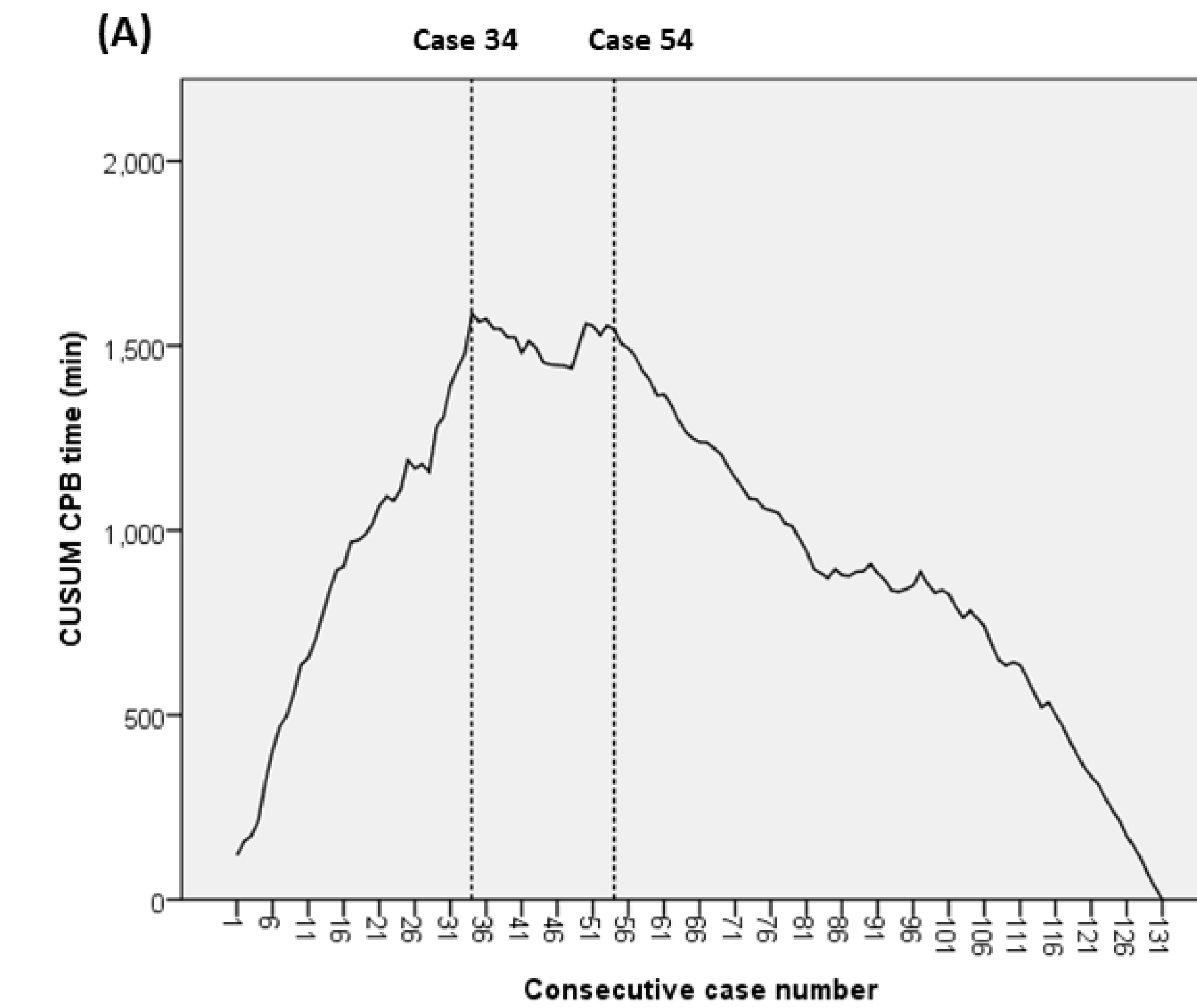
Table 6. Interphase Comparisons of Perioperative Characteristics (N = 131).

	Phase 1 (n = 34)	Phase 2 (n = 20)	Phase 3 (n = 77)	P value	p1	p2	p3
Age, years	28 (23–48)	34.8 $\pm$ 15.2	32 (23–42)	0.922			
BSA, m ²	1.41 (1.32–1.59)	1.44 $\pm$ 0.25	1.49 (1.39–1.56)	0.415			
CPB installation time, min	55.2 $\pm$ 14.2	41 (35–55)	45 (35–50)	0.001	0.051	<0.001	0.665
CPB time, min	147.3 $\pm$ 37.6	94 (77–105)	75 (67–93)	<0.001	<0.001	<0.001	0.004
Operative time, min	253.4 $\pm$ 49.8	196.5 $\pm$ 54.5	160 (140–190)	<0.001	<0.001	<0.001	0.02
Ventilation time, h	6.5 (4–11)	7 (4.5–14.5)	8 (6–11)	0.223			
Drainage volume, mL	190 (130–320)	125 (80–280)	190 (125–260)	0.292			
Freedom from postoperative analgesics, days	4 (3–5)	4 (3–5)	3 (3–4)	0.007	0.903	0.009	0.016
Postoperative hospital stay, days	7 (6–9)	7 (7–9.5)	6 (5–7)	<0.001	0.675	0.001	0.001

Abbreviations: BSA, body surface area; CPB, cardiopulmonary bypass.

Data are reported as mean $\pm$ SD or median (IQR) depending on the normality of the distribution.

Results: The CPB and operation times were 90 (72 to 115) min and 180 (150 to 220) min, respectively. Total drainage volume was 190 (120 to 290) mL. No endoscopic failure or major complications were recorded. After excluding factors causing bias, the CUSUM_{CPBtime} analysis for the remaining 131 patients included 3 phases. Phase 1 was the initial learning period (cases 1 to 34), phase 2 represented the technical competence period (cases 35 to 54), and phase 3 was the challenging period (cases 55 to 131)



Conclusions: The Hanoi ASD procedure is safe and feasible for repairing ASD in patients weighing ≥ 20 kg. According to the learning curve analysis, 34 cases were required to achieve technical efficiency, and 54 cases were required to address highly challenging cases.

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