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Management of the Airway by Paramedic Nurses in Out-of-Hospital Cardiac Arrest Situations

Akari Sato[1]*, Naomi Fujii[1], Rina Takeda[1]

[1]*Department of Nursing Leadership, Graduate School of Health, Osaka Metropolitan University, Osaka, Japan.*

Abstract

Effective airway management is essential during out-of-hospital cardiac arrest (OHCA) to ensure adequate ventilation and oxygenation. Advanced airway techniques, including the use of a supraglottic airway device (SAD) or endotracheal tube (ETT), typically follow initial bag-valve-mask (BVM) ventilation, with emergency front-of-neck access reserved as a last-resort option. Over time, and particularly during the COVID-19 pandemic, EMS airway management protocols have evolved. This study aimed to evaluate how these protocol changes affected airway management practices and the success rates of different techniques. We performed an observational analysis using data from the ARREST registry spanning 2019–2023. All adult OHCA patients receiving resuscitation from EMS were included, while cases involving helicopter emergency medical services were excluded. Trends in the use of airway devices during resuscitation and their first-pass success rates were analyzed. The proportion of cases in which an SAD was used increased, while ETT usage declined. Specifically, SADs were used in 59% of cases (95% CI: 57–60%), ETTs in 21% (95% CI: 19–22%), and BVM alone in 14% (95% CI: 13–15%). First-pass success for ETT placement improved from 53% to 68%, whereas SAD first-pass success remained consistently high at 93%. During CPR performed by ambulance nurses, the use of SADs rose and ETT use declined. Although ETT first-pass success improved, it remained below guideline-recommended standards for prehospital intubation. SAD placement demonstrated high first-pass success, supporting current Dutch EMS guidelines that prioritize SADs as the primary advanced airway device during resuscitation. Nonetheless, further training and skill development in intubation are necessary for selected OHCA patients.

Keywords: Out-of-Hospital Cardiac Arrest (OHCA), Airway management, Supraglottic Airway Device (SAD), Endotracheal Intubation (ETT)

Introduction

Cardiopulmonary resuscitation (CPR) primarily aims to maintain blood oxygenation and circulation to vital organs, thereby preventing ischemic injury [1]. Establishing a patent airway is the first step in ensuring adequate oxygenation. Upon arrival at an OHCA scene, EMS personnel initiate chest compressions and BVM ventilation. While BVM ventilation can be rapidly applied, it requires continuous attention, and airway management can remain challenging even for experienced providers [2,3]. Following BVM ventilation, advanced airway interventions can be attempted. Endotracheal intubation has historically been considered the "gold standard" during CPR, as it secures the airway and reduces gastric insufflation and aspiration [2,4]. However, aspiration often occurs before EMS arrival and may still occur during or after intubation, limiting its effectiveness in aspiration prevention [2,4].

Corresponding author: Akari Sato
Address: Department of Nursing Leadership, Graduate School of Health, Osaka Metropolitan University, Osaka, Japan.
E-mail: ✉ akari.sato.study@gmail.com
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Successful first-pass intubation is linked to a higher likelihood of return of spontaneous circulation (ROSC) [5]. Conversely, providers with limited intubation experience may prolong interruptions to chest compressions, resulting in extended apnea periods and poorer survival outcomes [6,7].
SADs offer an effective alternative for ventilating many patients and require less technical skill to insert and maintain proficiency [8–11]. Comparative studies have found that SADs may yield similar, or occasionally superior, survival outcomes relative to ETTs, prompting many national and international EMS protocols to shift toward SADs for OHCA advanced airway management [4,12–17]. These shifts may influence provider experience and success rates with airway devices [18–25]. In the United States, there has been a trend toward decreased ETT use and increased SAD use, but the impact on first-pass success remains uncertain [26,27].
This study aims to examine trends in airway management by Dutch EMS during CPR over time. Understanding the effects of protocol changes on airway strategy selection and performance can help identify potential needs for targeted training, alternative approaches, or device innovations.

Methods

Study setting
In the Netherlands, suspected out-of-hospital cardiac arrest (OHCA) cases prompt dispatch of two advanced life support (ALS) ambulances, each staffed with an ambulance nurse and a driver. Ambulance nurses are qualified to manage the airway using techniques such as bag-valve-mask (BVM) ventilation, supraglottic airway device (SAD) insertion, endotracheal intubation (ETT), and emergency front-of-neck access (eFONA). In parallel, volunteer responders and other first responders are mobilized to deliver early basic life support (BLS) and defibrillation [28,29].
Certain OHCA scenarios trigger Helicopter Emergency Medical Services (HEMS) deployment [30]. This includes patients with suspected airway compromise, children (<18 years), pregnant patients, or those with arrest due to trauma, drowning, or electrocution. HEMS is also activated when ground EMS is expected to arrive after more than ten minutes. From October 2022, HEMS were additionally used in the ARREST study region for witnessed OHCA patients aged 18–50 as part of the ON-SCENE trial [31].
All ambulance nurses operate under national protocols consistent with the Dutch and European Resuscitation Council (ERC) guidelines [32]. The 2014 national protocol introduced SAD use and allowed providers to choose the advanced airway device based on clinical judgment or regional policy [15]. During the study period, no adjunct devices (e.g., video laryngoscopes or gum elastic bougies) were employed. COVID-19 temporarily modified these guidelines: between April and June 2020, EMS were instructed to skip BVM ventilation and place an SAD (primary) or ETT (secondary) [33]. From June 2020, these modifications applied only to suspected COVID-19 patients, and all pandemic-related changes were lifted by September 2021 [34,35]. The direct SAD approach, bypassing BVM, remains uncommon outside of COVID-19-specific guidance. The updated 2023 guidelines, effective May 1, 2023, recommend ETT only when SAD is ineffective or unachievable [17], reflecting the 2021 ERC guidance that ETT should be attempted only in systems achieving ≥95% success within two attempts [32].

Study design and data source
This observational study used the ARREST registry, a prospective database capturing all suspected OHCA events in North-Holland since 2005, covering roughly 2.7 million residents [36,37]. ARREST systematically collects Utstein-recommended OHCA variables from multiple sources, including dispatch centers, volunteer responder systems, AED recordings, EMS defibrillators, EMS run sheets, EMS questionnaires, and hospital records [36,38]. Survivors provide informed consent for full dataset inclusion; if consent is declined or unobtainable, a limited anonymized dataset is used. For deceased patients, full data inclusion is allowed without consent.
Airway-specific data collection started in 2019. HEMS dispatch and arrival were systematically recorded from October 2022 onward; for earlier cases, ARREST data were retrospectively matched with HEMS records to confirm HEMS involvement during CPR. Approximately 15% of pre-October 2022 patients (~1034) had anonymized data preventing matching; these cases were retained because the expected number affected by HEMS (~66) was small.
Ambulance nurses reported airway management details via EMS questionnaires, including the order of successfully placed devices, first-pass success for ETT and SAD, and the final airway device used. First-pass success was defined as achieving effective ventilation on the initial attempt. Subsequent successful placements following an unsuccessful first attempt were recorded in sequence. The definitive airway was the device in place at prehospital CPR termination or at emergency department arrival during ongoing CPR.
The study did not fall under the Medical Research Involving Human Subjects Act, as confirmed by the Amsterdam UMC Medical Ethics Review Board (W17_089).

Patient selection

All consecutive adult patients (aged ≥18 years) who experienced OHCA and received attempted resuscitation by EMS were considered for inclusion. Resuscitation by EMS was defined as either performing at least one two-minute cycle of CPR or delivering at least one shock using an EMS defibrillator. Patients were excluded if HEMS was primarily dispatched due to the cause of cardiac arrest or if HEMS arrived secondarily and were documented on scene, as they might have performed airway interventions.

Objectives

The primary objective was to determine, by year from 2019 to 2023, the proportion of adult OHCA patients receiving BVM, SAD, ETT, or eFONA as the definitive airway during CPR. A secondary objective was to compare the first-pass success rates of SAD and ETT placement during resuscitation, also by year. This study was not intended to evaluate the impact of airway strategies on patient outcomes.

Sample size considerations

No prospective sample size calculation was performed, as the cohort size was determined by the available cases in the registry during the study period. Post hoc, we assessed the study's ability to detect a clinically meaningful 5% change in the use of specific airway devices over five years [39]. With 5,222 patients analyzed, the study had 80% power to identify a 5.6% increase or decrease (two-sided) at an alpha of 0.05.

Statistical analysis

Sample size feasibility was assessed using Stata/BE 17.0 (StataCorp LLC). Statistical analyses were conducted with SPSS® version 28.0 (IBM® SPSS®, Chicago, IL). Categorical variables were summarized as percentages, while continuous variables were expressed as means with standard deviations or medians with interquartile ranges. Temporal trends in airway device use were evaluated using chi-square tests for trend. Proportions for the primary outcome were reported with 95% confidence intervals (CI). Differences between airway groups for categorical data were tested using chi-square tests; when expected cell counts were ≤5, Fisher's exact test (for two groups) or Fisher-Freeman-Halton exact test (for multiple groups) was applied. Continuous variables across airway groups were compared using Kruskal-Wallis tests.

Due to the very low number of patients with eFONA (n=4), these cases were excluded post hoc to reduce the risk of patient re-identification.

Results

Between 2019 and 2023, 13,098 suspected OHCA cases were recorded. Resuscitation was attempted by EMS in 6,248 cases. After excluding pediatric cases, instances where HEMS was primarily or secondarily present, and eFONA cases, 5,222 patients were included for analysis **(Figure 1)**. Among these, 59 percent (95 percent CI: 57–60 percent) received an SAD as the definitive airway, 14 percent (95 percent CI: 13–15 percent) had BVM ventilation, and 21 percent (95 percent CI: 19–22 percent) underwent ETT placement by EMS at the conclusion of CPR **(Table 1)**.

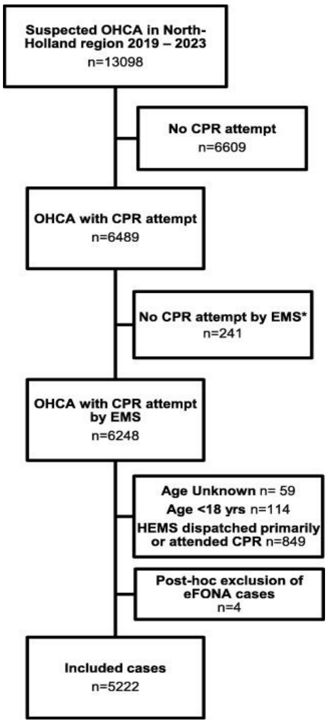

Figure 1. Patient inclusion flowchart. CPR= cardiopulmonary resuscitation; eFONA= emergency front-of-neck access; EMS= Emergency Medical Services; HEMS= Helicopter Emergency Medical Services; OHCA= out-of-hospital cardiac arrest. *Cases where return of spontaneous circulation (ROSC) occurred due to successful defibrillation by an AED prior to EMS arrival

Table 1. Patient baseline characteristics according to the type of definitive airway used

	ETT	SAD	BVM	Unknown	Statistics	Total
Adult OHCA with CPR attempt, *n* (%; 95% CI)	1072 (21; 19–22)	3062 (59; 57–60)	711 (14; 13–15)	377 (7; 7–8)		**5222**
Male sex, *n* (%)	742 (69)	2130 (70)	521 (73)	267 (71)	$p = 0.225$	**3660 (70)**
Missing	0	1 (0)	0	1 (0)		**2 (0)**
Age in years, Median (IQR)	72 (62–80)	70 (60–78)	67 (55 – 76)	71 (60–79)	$p < 0.001$	**70 (60–78)**
First rhythm, *n* (%)					$p < 0.001$	
Shockable (VF/VT)	340 (32)	873 (29)	301 (42)	102 (27)		**1616 (31)**
PEA	329 (31)	978 (32)	116 (16)	90 (24)		**1513 (29)**
Asystole	291 (27)	910 (30)	119 (17)	104 (28)		**1424 (27)**
EMS Witnessed*	71 (7)	226 (7)	149 (21)	55 (15)		**501 (10)**
Unknown**	41 (4)	75 (2)	26 (4)	26 (7)		**168 (3)**
Cause of arrest, *n* (%)					$p = 0.347$	
Medical	1063 (99)	3032 (99)	705 (99)	370 (98)		**5170 (99)**
Drug overdose	9 (1)	30 (1)	6 (1)	7 (2)		**52 (1)**
Arrest witness, *n* (%)					$p < 0.001$	
Bystander	676 (63)	1773 (58)	372 (52)	161 (43)		**2982 (57)**
EMS	71 (7)	229 (8)	151 (21)	57 (15)		**508 (10)**
None	312 (29)	1033 (34)	178 (25)	128 (34)		**1651 (32)**
Missing	13 (1)	27 (1)	10 (1)	31 (8)		**81 (2)**
BLS before EMS arrival, *n* (%)	865 (81)	2470 (81)	564 (79)	291 (77)	$p = 0.812$	**4190 (80)**
Missing	5 (1)	16 (1)	3 (0)	21 (6)		**45 (1)**
AED before ambulance arrival, *n* (%)	609 (57)	1690 (55)	382 (54)	200 (53)	$p = 0.540$	**2881 (55)**
Missing	7 (1)	14 (1)	1 (0)	11 (3)		**33 (1)**
AED/ EMS defibrillation, *n* (%)	501 (47)	1300 (43)	459 (65)	175 (46)	$p < 0.001$	**2435 (47)**
Missing	3 (0)	10 (0)	1 (0)	17 (5)		**31 (1)**
ROSC before transportation, *n* (%)					$p < 0.001$	

13

Yes	360 (34)	867 (28)	425 (60)	94 (25)		**1746 (33)**
No	224 (21)	700 (23)	32 (5)	41 (11)		**997 (19)**
N/A***	479 (45)	1474 (48)	251 (35)	217 (58)		**2421 (46)**
Missing	9 (1)	21 (1)	3 (0)	25 (7)		**58 (1)**
Result prehospital CPR, *n* (%)					$p < 0.001$	
ROSC	287 (27)	622 (20)	394 (55)	81 (22)		**1384 (27)**
Transport to hospital continuing CPR	290 (27)	946 (31)	87 (12)	68 (18)		**1391 (27)**
Deceased	486 (45)	1479 (48)	227 (32)	205 (54)		**2397 (46)**
Missing	9 (1)	15 (1)	3 (0)	23 (6)		**50 (1)**
Alert to start CPR by EMS mm:ss, Median (IQR)	10:49 (8:47–13:25)	11:25 (9:21–13:54)	11:26 (9:06–13:53)	11:24 (9:29–13:44)	$p < 0.001$	**11:16 (9:14–13:47)**
Missing	133 (12)	346 (11)	159 (22)	107 (28)		**745 (14)**
Alert to ROSC mm:ss, Median (IQR)	23:30 (18:24–28:38)	23:30 (18:36–29:10)	15:36 (12:09–22:32)	22:32 (13:52–33:59)	$p < 0.001$	**22:26 (16:49–28:27)**
Missing or no ROSC	712 (66)	2140 (70)	401 (56)	288 (76)		**3541 (68)**
Start CPR by EMS to ROSC mm:ss, Median (IQR)	12:06 (8:21–17:30)	11:56 (7:55–17:14)	4:09 (1:55–10:31)	9:03 (3:25–18:03)	$p < 0.001$	**10:54 (6:03–16:45)**
Missing or no ROSC	712 (66)	2140 (70)	405 (57)	291 (77)		**3548 (68)**

Abbreviations: AED= automated external defibrillator; BLS= basic life support; BVM= bag-valve-mask; CPR= cardiopulmonary resuscitation; EMS= emergency medical services; ETT= endotracheal tube; IQR= interquartile range; SAD= supraglottic airway device; OHCA= out-of-hospital cardiac arrest; ROSC= return of spontaneous circulation; VF= ventricular fibrillation; VT= ventricular tachycardia.
*For cases witnessed by EMS, the initial rhythm displayed on the ambulance monitor may not reflect the true first recorded rhythm during the arrest.
**For some cases, the first monitored rhythm was either missing or could not be clearly classified.
***N/A (not applicable): applies to patients where ROSC prior to transport could not occur, such as EMS-witnessed arrests or cases where EMS determined that transport was unnecessary.

Patients for whom BVM was maintained as the final airway device were generally younger than those who received advanced airway management, with median ages of 67 versus 71 years. This group also had a higher proportion of EMS-witnessed arrests (21% compared with 7%), more frequently presented with a shockable initial rhythm (42% versus 29%), and achieved return of spontaneous circulation (ROSC) more often (55% versus 22%; **Table 1**). The median duration from the start of CPR by EMS to ROSC was shorter in the BVM group at 4 minutes 9 seconds (IQR 1:55–10:31) versus 11 minutes 56 seconds (IQR 8:03–17:19) for patients managed with an advanced airway. Among those whose resuscitation ended with BVM, an attempt to insert an advanced airway occurred in 120 patients (17%), comprising 13% SAD attempts and 11% ETT attempts, whereas no attempt was made in 568 patients (80%). In 23 cases (3%), data on airway attempts were not recorded **(Table 2)**.

Table 2. Airway characteristics of included cases stratified by definitive airway device

	ETT	**BVM**	**Unknown**	**SAD**	**Statistics**	**Total**
Adult OHCA with CPR attempt, *n* (%; 95% CI)	1072 (21; 19–22)	711 (14; 13–15)	377 (7; 7–8)	3062 (59; 57–60)		5222
SAD attempted, *n* (%)	112 (10)	90 (13)	7 (2)	3062 (100)	$p < 0.001$	3271 (63)
Missing	40 (4)	23 (3)	365 (97)	0		428 (8)
First pass success SAD, *n* (% of attempted)	44 (39)	1 (1)	4 (57)	3002 (98)	$p < 0.001$	3051 (93)
Tube attempted, *n* (%)	1072 (100)	75 (11)	11 (3)	498 (16)	$p < 0.001$	1656 (32)
Missing	0	24 (3)	358 (95)	180 (6)		562 (11)
First pass success tube, *n* (% of attempted)	1017 (95)	0 (0)	4 (36)	3 (1)	$p < 0.001$	1024 (62)
Order of successful airway devices, *n* (%)					$p < 0.001$	
BVM	0	708 (100)	0	0		708 (14)
BVM + SAD	0	0	0	1996 (65)		1996 (38)
BVM + ETT	871 (81)	0	0	0		871 (17)
BVM + SAD + ETT	39 (4)	0	0	0		39 (1)
BVM + ETT + SAD	0	0	0	2 (0)		2 (0)

SAD	0	0	0	1003 (33)	1003 (19)
SAD + ETT	5 (1)	0	0	0	5 (0)
ETT	38 (4)	0	0	0	38 (1)
ETT + SAD	0	0	0	1 (0)	1 (0)
Missing	119 (11)	3 (0)	377 (100)	60 (2)	559 (11)

BVM= bag-valve-mask, CPR= cardiopulmonary resuscitation, ETT= endotracheal tube, SAD= supraglottic airway device, OHCA= out-of-hospital cardiac arrest.

Patients receiving an SAD had lower occurrences of witnessed arrest (65 percent vs. 70 percent), AED or EMS defibrillation (43% vs. 47%), ROSC prior to transport (28% vs. 34%), and arrival at hospital with ROSC (20 percent vs. 27 percent) compared with those managed with an ETT, while ongoing CPR during transport was more frequent with an SAD (31% vs. 27%). Baseline characteristics of OHCA patients over time are provided in Supplementary Table A. First-attempt success for SAD insertion was high at 93% and remained stable across the years **(Table 3, Figure 2A)**. In 44 instances (representing 1% of successful SAD cases), intubation was subsequently performed and succeeded. Overall, first-pass intubation success averaged 62%, showing a trend toward improvement over the years (from 53% in 2019 to 68 percent in 2023), even as the proportion of cases where intubation was attempted declined (61% in 2019 to 29 percent in 2023; **Figure 2B**).

Table 3. Airway characteristics of included cases stratified by year of arrest

	2023	**2022**	**2021**	**2020**	**2019**	**Statistics**	**Total**
Adult OHCA with CPR attempt, *n* (%)	1007 (19)	1093 (21)	1111 (21)	1000 (19)	1011 (19)		5222
SAD attempted, *n* (%)	627 (62)	685 (63)	801 (72)	694 (69)	463 (46)	$p < 0.001$	3270 (63)
Missing	84 (8)	86 (8)	95 (9)	61 (6)	103 (10)		429 (8)
First pass success SAD, *n* (% of attempted)	578 (92)	647 (95)	740 (92)	650 (94)	436 (94)	$p = 0.378$ (X20.378 (X	3051 (93)
Tube attempted, *n* (%)	291 (29)	288 (26)	211 (19)	249 (25)	617 (61)	$p < 0.001$	1656 (32)
Missing	80 (8)	90 (8)	99 (9)	107 (11)	186 (18)		562 (11)
First pass success tube, *n* (% of attempted)	197 (68)	197 (68)	144 (68)	161 (65)	325 (53)	$p < 0.001$	1024 (62)
Definitive device, *n* (%; 95% CI)						$p < 0.001$	
BVM	132 (13; 11–15)	158 (15; 13–17)	121 (11; 9–13)	131 (13; 11–15)	169 (17; 15–19)		711 (14; 13–15)
SAD	581 (58; 55–61)	644 (59; 56–62)	752 (68; 65–70)	651 (65; 62–68)	434 (43; 40–46)		3062 (59; 57–60)
ETT	209 (21; 18–23)	211 (19; 17–22)	156 (14; 12–16)	167 (17; 15–19)	329 (33; 30–36)		1072 (21; 19–22)
Unknown (missing)	85 (8; 7–10)	80 (7; 6–9)	82 (7; 6–9)	51 (5; 4–7)	79 (8; 6–10)		377 (7; 7–8)
Order of successful airway devices, *n* (%)						$p = 0.005$	
BVM	130 (13)	157 (14)	121 (11)	131 (13)	169 (17)		708 (14)
BVM + SAD	533 (53)	530 (49)	244 (22)	257 (26)	432 (43)		1996 (38)
BVM + ETT	195 (19)	161 (15)	71 (6)	119 (12)	325 (32)		871 (17)
BVM + SAD + ETT	9 (1)	15 (1)	5 (1)	7 (1)	3 (0)		39 (1)
BVM + ETT + SAD	0 (0)	1 (0)	1 (0)	0 (0)	0 (0)		2 (0)
SAD	46 (5)	99 (9)	488 (44)	370 (37)	0 (0)		1003 (19)
SAD + ETT	1 (0)	0 (0)	1 (0)	3 (0)	0 (0)		5 (0)
ETT	1 (0)	12 (1)	10 (1)	15 (2)	0 (0)		38 (1)
ETT + SAD	0 (0)	0 (0)	1 (0)	0 (0)	0 (0)		1 (0)
Missing	92 (9)	118 (11)	169 (15)	98 (10)	82 (8)		559 (11)

BVM= bag-valve-mask, CPR= cardiopulmonary resuscitation, ETT= endotracheal tube, SAD= supraglottic airway device, OHCA= out-of-hospital cardiac arrest.

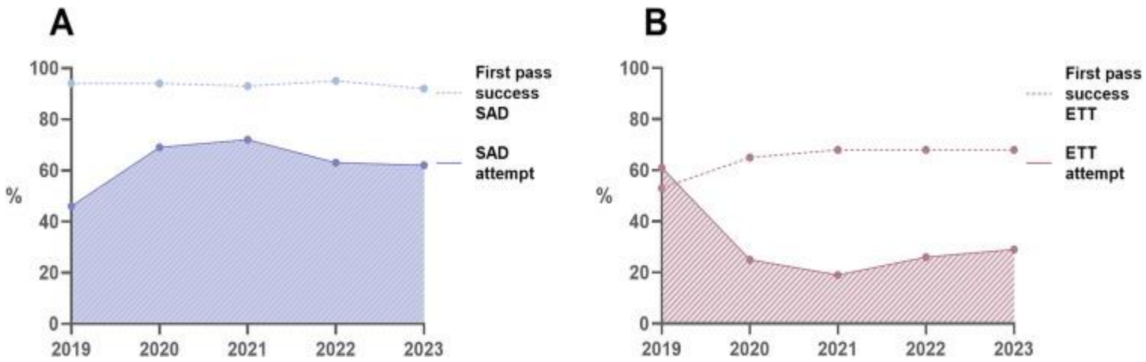

Figure 2. Trends in airway management over the years: (A) shows the proportion of patients in whom an SAD was attempted and successfully inserted on the first pass, and (B) shows the proportion of patients in whom an ETT was attempted and successfully placed on the first pass. ETT refers to endotracheal tube, and SAD to supraglottic airway device. Among OHCA patients, the most frequently successful airway approach was BVM ventilation, followed by SAD placement (38 percent). During the period of airway-related COVID restrictions, direct SAD placement partially replaced strategies that initially relied on BVM ventilation, and this approach continued even after the restrictions were lifted. Direct ETT insertion as an initial advanced airway strategy was not commonly used during the COVID period. The sequence of successful airway management approaches is summarized in a Sankey diagram (Figure 3). In one case from the BVM group, an SAD was successfully placed, followed by an unsuccessful intubation attempt, after which BVM was resumed without further advanced airway attempts. Among patients whose first advanced airway was a successfully placed ETT, three later received a successfully placed SAD; in one case, the switch was likely due to esophageal intubation indicated by persistently low end-tidal CO_2, while no further details were available for the remaining two cases

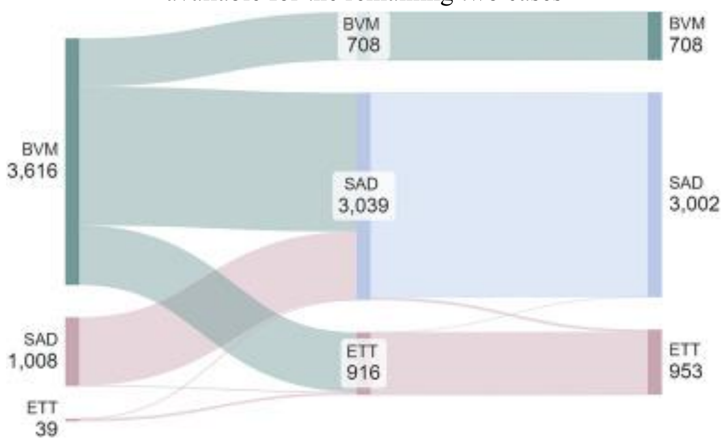

Figure 3. Sankey diagram showing the sequence of successful airway management, with BVM indicating bag-valve-mask, ETT for endotracheal tube, and SAD for supraglottic airway device

Discussion

Between 2019 and 2023, the use of ETT as the definitive airway decreased from 33 percent (95 percent CI: 30–36 percent) to 21 percent (95 percent CI: 18–23 percent), whereas SAD usage increased from 43 percent (95 percent CI: 40–46 percent) to 58 percent (95 percent CI: 55–61 percent). Over the same period, ETT first-pass success improved from 53 percent in 2019 to 68 percent in 2023, despite fewer intubation attempts, while SAD first-pass success remained consistently high at an average of 93%. Similar findings during the COVID-19 pandemic, reported by Armour *et al.*, showed that reduced ETT attempts did not negatively impact intubation success [40]. COVID-19 restrictions led to decreased ETT use and increased SAD use, as also observed in a meta-analysis by Kim *et al.* evaluating prehospital airway management during the pandemic [41], and this pattern persisted even after returning to pre-pandemic guidelines. In this study, the enforced use of primary SAD placement may have allowed EMS nurses to gain more experience and shifted preference toward SAD as the initial airway device. Post-pandemic, selection may have occurred both in patient complexity and among EMS providers with higher intubation skills, contributing to the observed improvement in ETT first-pass success.

Although the current ambulance protocol primarily recommends SAD insertion before ETT, only 10 percent of patients ultimately managed with ETT underwent an initial SAD attempt. While the proportion of patients receiving an SAD attempt increased from 46 percent in 2019 to 62 percent in 2023, at least 29 percent of patients in 2023 did not have an SAD attempt even after the protocol update in May 2023. The rationale for airway device selection was not recorded; EMS providers may have deemed SAD unsuitable due to factors such as aspiration, which occurs in up to 32% of OHCA cases, with oral fluids often prompting deviation from the SAD-first approach as reported in the AIRWAYS-2 trial [4,13,42–45]. Paramedics are roughly five times more likely to use an ETT than SAD in cases of regurgitation. However, the incidence of regurgitation and aspiration does not significantly differ between SAD and ETT during OHCA [4], supporting the notion that primary SAD attempts remain a reasonable strategy. Previous research by Berdowski demonstrated that full implementation of national resuscitation guidelines can take up to 1.5 years, suggesting potential improvements in adherence over time [46].
This study has several limitations. First, airway management strategies and success rates were self-reported by ambulance nurses, introducing potential bias, likely inflating first-pass success. Variability in the definition of first-pass success may have further contributed to this bias [47]. Second, the study describes EMS airway management processes without evaluating the reasons behind device selection or patient outcomes, limiting conclusions regarding the appropriateness of airway choices. Nonetheless, the findings may guide targeted airway management training or development of new strategies and devices.
Although the results support primary SAD attempts for EMS, intubation remains necessary for certain patients, including those with failed SAD placement (~3%) or those who required ETT after initial SAD success (1%). Improving ETT first-pass success is critical, as over one-third of patients were not intubated successfully on the first attempt. First-pass ETT success in OHCA ranges from 51 percent to 90 percent, depending on definition, setting, and provider training [3,4,13,23,48–50]. The current cohort's success falls within this range but is not considered "high" per 2021 ERC guidelines. Ongoing intubation training is essential, and adjuncts such as bougies or videolaryngoscopy should be considered [51,52]. Videolaryngoscopy has been shown to enhance first-pass success for less experienced providers and is associated with improved survival [53–57].
Future randomized trials should examine the impact of videolaryngoscopy versus direct laryngoscopy on first-pass success and outcomes. Additionally, comparing primary SAD versus BVM-first strategies on ventilation effectiveness and outcomes warrants further investigation, as ventilation quality is the ultimate goal of airway management, not the device itself [58,59].

Conclusion

In recent years, the primary advanced airway device in OHCA shifted from ETT to SAD. First-pass success for SADs remained high, and few patients required intubation after initial SAD placement. Interestingly, ETT first-pass success improved despite fewer intubation attempts. These findings support continued use of primary SAD strategies by EMS, though intubation remains essential for a subset of patients, highlighting the need for strategies to improve ETT first-pass success.

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