

ORIGINAL ARTICLE

Intraosseous or Intravenous Vascular Access for Out-of-Hospital Cardiac Arrest

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METHODS

We conducted a randomized clinical trial to compare the effectiveness of initial attempts at intraosseous or intravenous vascular access in adults who had nontraumatic out-of-hospital cardiac arrest. The primary outcome was a sustained return of spontaneous circulation. Key secondary outcomes were survival at 30 days and survival at 30 days with a favorable neurologic outcome, defined by a score of 0 to 3 on the modified Rankin scale (scores range from 0 to 6, with higher scores indicating greater disability).

METHODS

TRIAL DESIGN AND OVERSIGHT

This investigator-initiated, randomized, parallel-group superiority trial was conducted through emergency medical service agencies in all five regions of Denmark, covering 5.9 million inhabitants. Cardiac arrests in Denmark are generally attended by a primary ambulance unit and a physician-manned unit.¹² The physician may terminate resuscitation on scene.

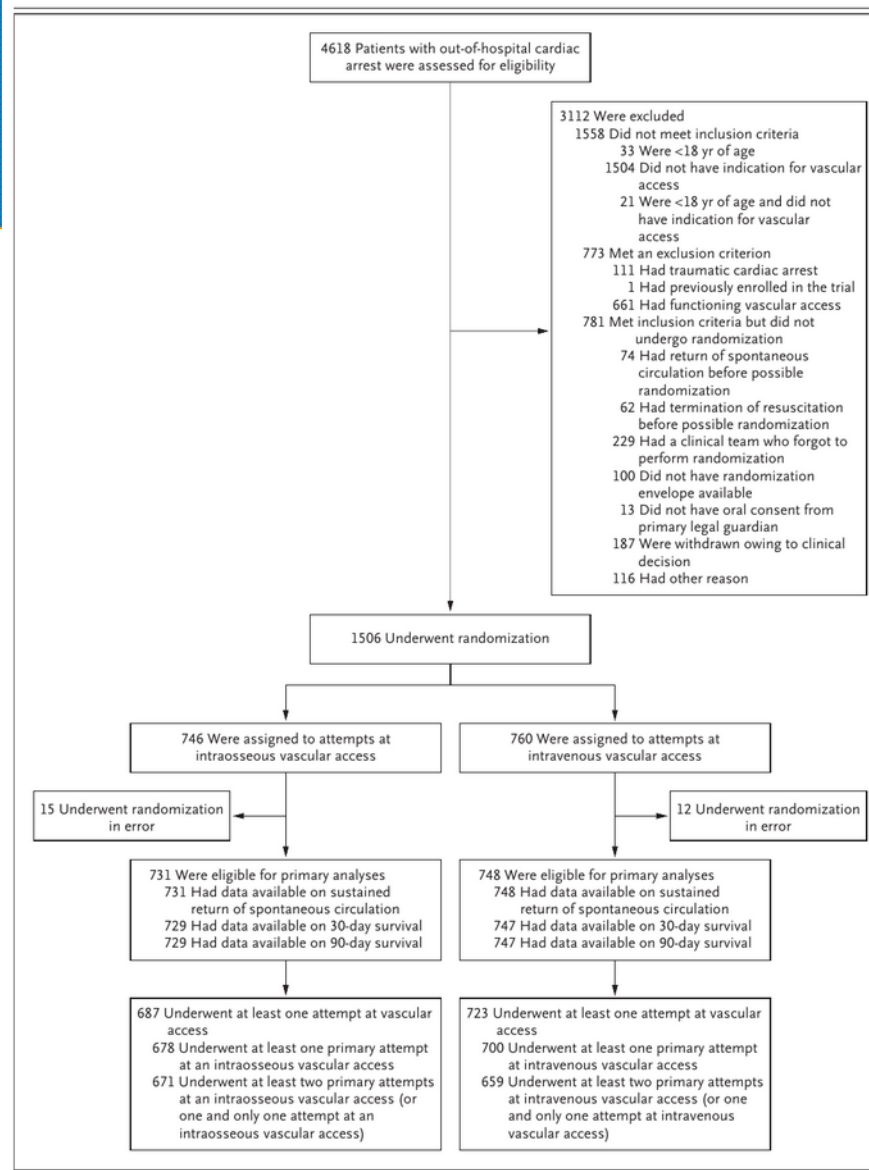


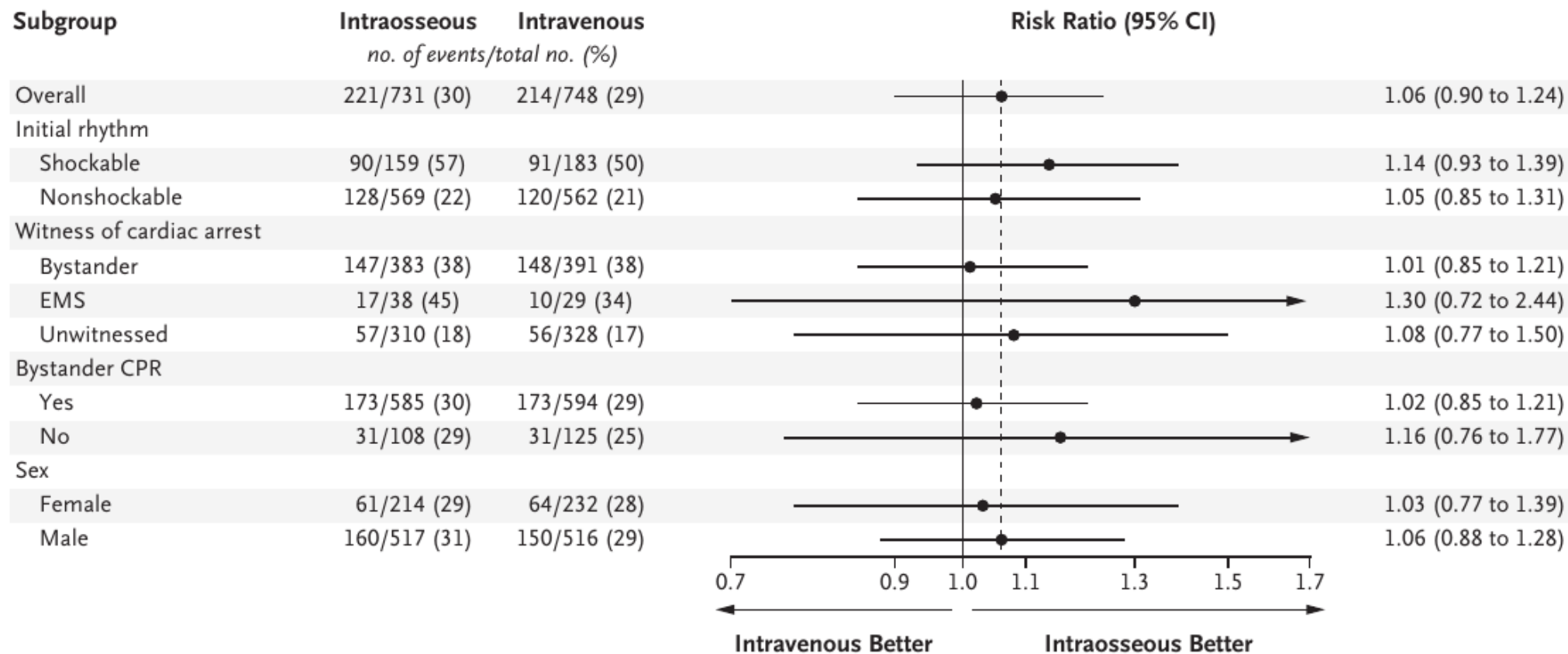
Table 2. Procedural Outcomes.

Outcome	Intraosseous Access	Intravenous Access
According to trial-group assignment		
No. of patients	731	748
Successful vascular access on first attempt — no. (%)	623 (85)	456 (61)
Successful vascular access on first or second attempt — no. (%)	669 (92)	595 (80)
Median time from first unit arrival on scene to successful vascular access (IQR) — min*	6 (4–10)	6 (4–10)
Median time to first successful vascular access (IQR) — min*†	14 (10–17)	14 (10–18)
Epinephrine administered during the cardiac arrest — no. (%)	615 (84)	621 (83)
Median time to first dose of epinephrine (IQR) — min†‡	15 (12–19)	15 (12–20)
Including only patients who underwent any attempts at vascular access§		
No. of patients	687	723
Successful vascular access on first attempt — no. (%)	623 (91)	456 (63)
Successful vascular access on first or second attempt — no. (%)	669 (97)	595 (82)
Median time from first unit arrival on scene to successful vascular access (IQR) — min¶	6 (4–10)	6 (4–10)
Median time to first successful vascular access (IQR) — min†¶	14 (10–17)	14 (10–18)
Epinephrine administered during the cardiac arrest — no. (%)	615 (90)	621 (86)
Median time to first dose of epinephrine (IQR) — min†‡	15 (12–19)	15 (12–20)

Table 3. Outcomes According to Trial-Group Assignment.*

Outcome	Intraosseous Access (N = 731)	Intravenous Access (N = 748)	Risk Ratio (95% CI)	Difference (95% CI)
Primary outcome: sustained return of spontaneous circulation — no. (%)	221 (30)	214 (29)	1.06 (0.90 to 1.24) [†]	1.6 (−3.0 to 6.3) ^{†‡}
30-Day outcomes				
Survival — no. (%) [§]	85 (12)	75 (10)	1.16 (0.87 to 1.56)	1.6 (−1.6 to 4.8) [‡]
Survival with a favorable neurologic outcome — no. (%) [¶]	67 (9)	59 (8)	1.16 (0.83 to 1.62)	1.3 (−1.6 to 4.2) [‡]
EQ-5D-5L score, as assessed by the patient	68±20	64±21	—	4 (−2 to 11) ^{**}
EQ-5D-5L score, index value	63±31	63±26	—	0 (−9 to 9) ^{**}
90-Day outcomes				
Survival — no. (%) ^{††}	82 (11)	71 (10)	1.18 (0.88 to 1.60)	1.7 (−1.4 to 4.9) [‡]
Survival with a favorable neurologic outcome — no. (%) [¶]	75 (10)	64 (9)	1.20 (0.88 to 1.65)	1.7 (−1.3 to 4.8) [‡]
EQ-5D-5L score, as assessed by the patient	78±19	74±20	—	3 (−3 to 10) ^{**}
EQ-5D-5L score, index value	82±24	81±23	—	1 (−6 to 9) ^{**}

A Risk Ratio for Sustained Return of Spontaneous Circulation



COMPARISON OF HUMERAL AND TIBIAL INTRAOSSEOUS ACCESS

Among the 731 patients in the intraosseous-access group, 361 were randomly assigned to undergo humeral vascular access and 370 to undergo tibial vascular access. Demographic, clinical, and event characteristics of the patients at baseline are provided in Tables S16 and S17. Adherence to the assigned access method is detailed in Figure S9. A summary of interventions that were used at the time of cardiac arrest is provided in Table S18.

Time-related procedural outcomes are provided in Tables S19 and S20. The incidence of successful establishment of vascular access on the first or second attempt was 90% among the patients who underwent humeral access and 93% among those who underwent tibial access. The incidence of displacement, as assessed by the clinician, was 5% and 1%, respectively (Table S21).

A sustained return of spontaneous circulation occurred in 108 patients (30%) in the humeral-access group and in 113 patients (31%) in the tibial-access group (risk ratio, 0.98; 95% CI, 0.79 to 1.22). Results for the 30-day and 90-day outcomes are provided in Table S22.

CT scans were obtained in 32 patients who underwent humeral access and in 35 of those who underwent tibial access. The catheter was considered to be correctly positioned in the bone marrow in 23 patients (71%) in the humeral-access group and in all 35 patients (100%) in the tibial-access group (Tables S23 and S24). Half the patients in the humeral-access group had catheters that were bent at the time of CT as compared with 11% of the patients in the tibial-access group.