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Data Article

Data supporting the use of end-tidal carbon dioxide (ETCO2) measurement to guide management of cardiac arrest: A systematic review

Edison F. Paiva [a], James H. Paxton [b,*], Brian J. O'Neil [b]

[a] University of São Paulo School of Medicine, Butantã, São Paulo 03178-200, Brazil
[b] Wayne State University School of Medicine, Detroit, MI 48201, USA

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ABSTRACT

The data presented in this article are related to the research article, "The Use of End-Tidal Carbon Dioxide ($ETCO_2$) Measurement to Guide Management of Cardiac Arrest: A Systematic Review" [1]. This article is a systematic review and meta-analysis of existing data on the subject of whether any level of end-tidal carbon dioxide ($ETCO_2$) measured during cardiopulmonary resuscitation (CPR) correlates with return of spontaneous circulation (ROSC) or survival in adult patients experiencing cardiac arrest in any setting. These data are made publicly available to enable critical or extended analyses.

* Corresponding author.
E-mail address: james.paxton@wayne.edu (J.H. Paxton).

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Specifications Table

Subject area	*Cardiac arrest, clinical evidence*
More specific subject area	*The utility of end-tidal carbon dioxide measurement as it correlates with return of spontaneous circulation (ROSC) or survival in adults experiencing cardiac arrest in any setting.*
Type of data	*Table, Figures*
How data was acquired	*Review of primary articles pertaining to end-tidal carbon dioxide measurement as it correlates with return of spontaneous circulation (ROSC) or survival in adults experiencing cardiac arrest in any setting.*
Data format	*Analyzed data*
Experimental factors	*Description of the published literature on end-tidal carbon dioxide measurement as it correlates with return of spontaneous circulation (ROSC) or survival in adults experiencing cardiac arrest in any setting.*
Experimental features	*Systematic review*
Data source location	*Original English-language articles identified from search of Embase, MEDLINE, and Cochrane Databases.*
Data accessibility	*Data are available with this article*

Value of the data

- These data describe evidence available in the English-language medical literature pertaining to end-tidal carbon dioxide measurement as it correlates with return of spontaneous circulation (ROSC) or survival to hospital discharge in adult patients experiencing cardiac arrest in any setting.
- These data allow other researchers to extend the statistical analyses.

1. Data

These data report findings determined through the 2015 Consensus on Science and Treatment Recommendations process, managed by the International Liaison Committee on Resuscitation (www.ilcor.org/seers). These data include those studies that were considered to be most relevant in the determination of the utility of end-tidal carbon dioxide (ETCO2) measurement in the management of cardiac arrest in any setting. These data have been reported as the results of this effort to describe the use of ETCO2 in adult cardiac arrest, and are provided in a summary article describing their utility for adult patient experiencing cardiac arrest in any clinical setting [1]. A total of 17 full-text articles were included in the qualitative synthesis [2–18], and 5 articles were included in the quantitative analysis [3–7]. Fig. 1 shows a flow diagram of search results, including those full-text articles that were included in the qualitative synthesis and the quantitative analysis. Fig. 2 shows a Forest plot of the correlation between $ETCO_2$ and ROSC. Fig. 3 shows a Forest plot of the correlation between specific $ETCO_2$ levels and survival to hospital discharge. Table 1 shows the characteristics of the included studies. Table 2 shows a summary of findings, including $ETCO_2$ level higher or lower than 10- or 20-mmHg for predicting outcome following cardiac arrest.

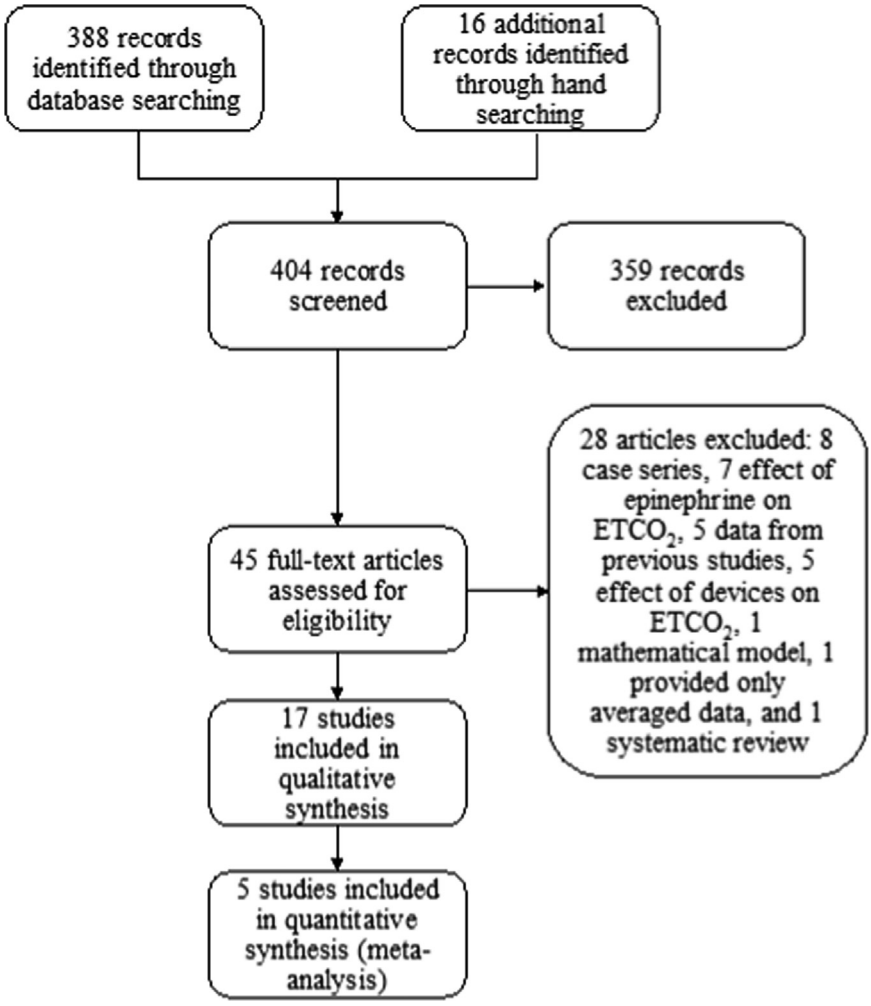

Fig. 1. Flow diagram of search results.

2. Experimental design, materials and methods

This review includes information on resuscitation questions developed through the 2015 Consensus on Science and Treatment Recommendations (CoSTR) development process, managed by the International Liaison Committee on Resuscitation (ILCOR) [19]. The questions were developed by ILCOR Task Force members, utilizing strict conflict of interest guidelines [20]. In general, each question was assigned to two experts to complete a detailed structured review of the literature, and complete a detailed evidence evaluation. Evidence evaluations are discussed

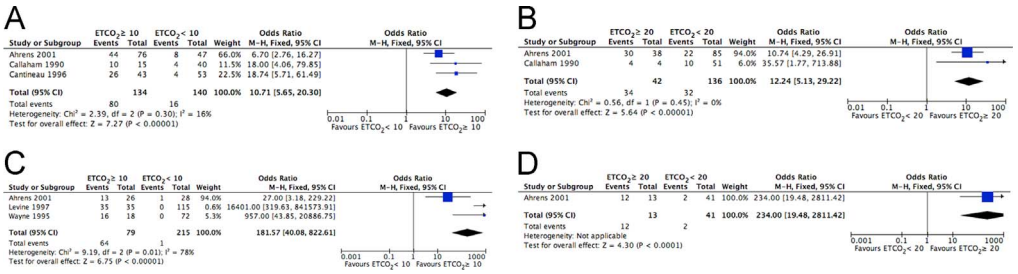

Fig. 2. Forest plot of the correlation between $ETCO_2$ and ROSC: A. Initial $ETCO_2 \geq 10$ mmHg; B. Initial $ETCO_2 \geq 20$ mmHg; C. 20-min $ETCO_2 \geq 10$ mmHg; D. 20-min $ETCO_2 \geq 20$ mmHg.

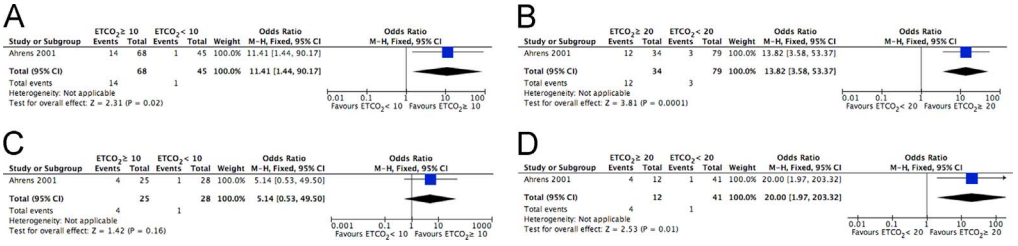

Fig. 3. Forest plot of the correlation between specific $ETCO_2$ levels and survival to hospital discharge: A. Initial $ETCO_2 \geq 10$ mmHg; B. Initial $ETCO_2 \geq 20$ mmHg; C. 20-min $ETCO_2 \geq 10$ mmHg; D. 20-min $ETCO_2 \geq 20$ mmHg.

Table 1
Characteristics of the included studies.

Study year	Design	*N*	Population	VF/VT (%)	Asystole/ PEA (%)	$ETCO_2$ measurement	Time of $ETCO_2$ measurement (cut-off, mmHg)	Outcome (s)	Results	Potential bias	Included in meta-analysis	ROSC/ Survival
Ahrens 2001	Prospective cohort	127	IHCA and Helicopter	76.0	24.0[a]	Capnography	Initial, 5, 10, 15, 20 min, and final ($\geq$ 10 and $\geq$ 20)	ROSC STFH SHD	$ETCO_2$ $\geq$ 20 mmHg at 5 and 10 min – 94.4% of survival $ETCO_2$ $\leq$ 17.5 mmHg at 15 min – 91.9% of non-survival	Convenience sampling 14% have already achieved ROSC	Yes	43% ROSC 31.5% STFH 13.7% SHD
Callaham 1990	Prospective cohort	55	OHCA	10.9	54.5/ 34.6	Capnometry	Initial ($\geq$ 10 and $\geq$ 20)	ROSC	$ETCO_2$ $\geq$ 15 mmHg predicted ROSC (sensitivity 71% and specificity of 98%)	Rescuers not blinded Small number of patients	Yes	25.5% ROSC
Cantineau 1996	Prospective cohort	120	OHCA	6.3	90.6/3.1	Capnometry	Initial and maximum ($\geq$ 10)	ROSC	$ETCO_2$ $\geq$ 10 mmHg predicted ROSC (sensitivity 87% and specificity of 74%)	90.6% asystole	Yes	31.7% ROSC
Wayne 1995	Prospective cohort	90	OHCA	0.0	0.0/100.0	Capnography	20 min ($\geq$ 10)	ROSC SHA SHD	$ETCO_2$ $\geq$ 10 mmHg predicted ROSC (sensitivity 97.3% and specificity 100.0%)	Only PEA	Yes	17.8% ROSC 14.4% SHA 7.8% SHD
Levine 1997	Prospective cohort	150	OHCA	0.0	0.0/100.0	Capnography	20 min ($\geq$ 10)	ROSC SHD	$ETCO_2$ $\leq$ 10 mmHg predicted non-survival (sensitivity 100% and specificity of 100%)	Only PEA Includes data from Wayne's study	Yes	23.3% ROSC 10.7% SHD

Table 1 (*continued*)

Study year	Design	*N*	Population	VF/VT (%)	Asystole/ PEA (%)	$ETCO_2$ measurement	Time of $ETCO_2$ measurement (cut-off, mmHg)	Outcome (s)	Results	Potential bias	Included in meta-analysis	ROSC/ Survival
Sanders 1989	Prospective cohort	35	IHCA	47.3	27.1/25.6	Capnometry	Average ($\geq$ 10)	ROSC SHD	All patients with ROSC had average $ETCO_2$ $\geq$ 10 mmHg	Small number of patients	No	25.7% ROSC 8.6% SHD
Salen 2001	Prospective cohort	53	IHCA	0.0	0.0/100.0	Capnography	Initial ($\geq$ 16)	SHA	$ETCO_2$ $\geq$ 16 mmHg associated with survival to admission	Convenience sampling Small number of patients	No	11.3% SHA
Eckstein 2011	Retrospective cohort	3121	OHCA	16.9	NA	Capnography	Initial ($\geq$ 10 and $\geq$ 20)	ROSC	$ETCO_2$ $\geq$ 10 mmHg associated with ROSC (OR 4.79; 95% CI 3.10 to 4.42)[c]	Retrospective large study, but an unreliable OR is provided	No	22.4% ROSC
Asplin 1995	Prospective cohort	27	OHCA	48.2	NA	Capnography	1 and 2 min (No specific cut-off)	ROSC SHD	Higher $ETCO_2$ levels in ROSC vs. non-ROSC (23.0 vs. 13.2 at 1 min, 26.8 vs. 15.4 at 2 min)	Convenience sampling Small number of patients	No	51.9% ROSC 11.1% SHD
Grmec 2001	Prospective cohort	139	OHCA	40.3	51.8/7.9	Capnometry	Initial, final and average ($\geq$ 10)	ROSC SHD	$ETCO_2$ $\geq$ 10 mmHg predicted ROSC (sensitivity 100.0% and specificity of 74.1%, 81.4%, and 90.0%, respectively for initial, average, and final $ETCO_2$)	–	No	38.1% ROSC 16.6% SHD

Grmec 2003	Prospective cohort	185	OHCA	76.2	23.8[b]	Capnometry	Initial, final and average ($\geq$ 10)	ROSC SID	Average and final $ETCO_2$ higher in ROSC patients. Initial $ETCO_2$ higher in ROSC patients only if cardiac origin	Includes data from Grmec 2001	No	64.3% ROSC 24.3% SID
Grmec 2007	Prospective cohort	389	OHCA	40.1	40.9/19.0	Capnometry	Initial, final and average ($\geq$ 10)	ROSC SHA SHD	Initial $ETCO_2$ $\geq$ 10 mmHg associated with ROSC	Includes data from Grmec 2003	No	60.9% ROSC 50.1% SHA 21.1% SHD
Heradstveit 2012	Retrospective cohort	575	OHCA	34.4	46.3/19.3	Capnography	Average, minimum and maximum (No specific cut-off)	ROSC SHA	$ETCO_2$ higher in ROSC patients	Retrospective	No	49.7% ROSC 40.4% SHA
Kolar 2008	Retrospective cohort	737	OHCA	41.2	38.4/ 20.4	Capnometry	20 min ($\geq$ 14.3)	ROSC SHA SHD	$ETCO_2$ $\geq$ 14.3 mmHg predicted ROSC (sensitivity 100% and specificity 100%),	Retrospective Includes data from Grmec 2001, 2003, and 2007	No	59.4% ROSC 54.6% SHA 23.1% SHD
Lah 2011	Prospective cohort	114	OHCA	55.3	44.7[b]	Capnometry	Initial and every 1 min (No specific cut-off)	ROSC SID SHD	Higher initial $ETCO_2$ for those with ROSC if primary cardiac arrest (34.6 vs. 24.7 mmHg)	Comparison between asphyxial and cardiac origin of the arrest	No	63.2% ROSC 52.6% SID 29.8% SHD
Mauer 1998	Prospective cohort	120	OHCA	49.1	17.9/33.0	Capnometry	Initial and every 2 min ($\geq$ 15.0)	ROSC SHA SHD	All admitted patients had an $ETCO_2$ $\geq$ 15 mmHg	$ETCO_2$ was a secondary endpoint	No	57.5% ROSC 27.5% SHA 10.8% SHD

Table 1 (*continued*)

Study year	Design	*N*	Population	VF/VT (%)	Asystole/ PEA (%)	$ETCO_2$ measurement	Time of $ETCO_2$ measurement (cut-off, mmHg)	Outcome (s)	Results	Potential bias	Included in meta-analysis	ROSC/ Survival
Rognås 2014	Prospective cohort	271	OHCA	NA	NA	Capnography	Initial ($\geq$ 10)	ROSC	4/22 patients with $ETCO_2$ $\leq$ 10 mmHg had ROSC. No specific cut-off should be used during resuscitation	23% lacking measurements	No	4 of 22 patients (18.2%) had ROSC with $ETCO_2$ $\leq$ 1.3 kPa

$ETCO_2$, end-tidal CO_2; NA, not available; IHCA, in-hospital cardiac arrest; OHCA, out-of-hospital cardiac arrest; OR, odds ratio; PEA, pulseless electrical activity; ROSC, return of spontaneous circulation; VF, ventricular fibrillation; VT, ventricular tachycardia; ROSC, return of spontaneous circulation; STFH, survival to twenty-four hours following cardiac arrest; SHA, survival to hospital admission; SID, survival to intensive care unit discharge; SHD, survival to hospital discharge.

[a] Includes asystole, PEA, and 14% in supraventricular tachycardia with a pulse, after intubation and first $ETCO_2$ measurement.

[b] Includes asystole and PEA.

[c] Upper limit of confidence interval lower than OR.

Table 2
Summary of findings: $ETCO_2$ higher vs. $ETCO_2$ lower than 10 or 20 mmHg for predicting outcome following cardiac arrest.

Quality assessment							No. of patients		Effect		Quality	Importance
No. of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	$ETCO_2$ higher	$ETCO_2$ lower	Relative (95% CI)	Absolute (95% CI)		
ROSC (Initial $ETCO_2 \geq 10$ vs. < 10 mmHg)												
3[a,b,c]	observational studies	serious[d]	not serious	not serious	not serious	very strong association dose response gradient	80/134 (59.7%)	16/140 (11.4%)	OR 10.7 (5.6–20.3)	483 more per 1000 (from 326 more to 620 more)	LOW	CRITICAL
ROSC (Initial $ETCO_2 \geq 20$ vs. < 20 mmHg)												
2[a,b]	observational studies	serious[d,e]	not serious	not serious	not serious	very strong association	34/42 (81.0%)	32/136 (23.5%)	OR 12.2 (5.1–29.2)	574 more per 1000 (from 406 more to 675 more)	LOW	CRITICAL
ROSC (20 min $ETCO_2 \geq 10$ vs. < 10 mmHg)												
3[a,f,g]	observational studies	very serious[d,h]	serious[i]	not serious	not serious	very strong association all plausible residual confounding would reduce the demonstrated effect	64/79 (81.0%)	1/215 (0.5%)	OR 181.6 (40.1–822.6)	805 more per 1000 (from 351 more to 966 more)	LOW	CRITICAL
ROSC (20 min $ETCO_2 \geq 20$ vs. < 20 mmHg)												
1[a]	observational study	serious[d]	not serious	not serious	not serious	very strong association	12/13 (92.3%)	2/41 (4.9%)	OR 234,0 (19.5–2811.4)	874 more per 1000 (from 451 more to 944 more)	LOW	CRITICAL
Survival at discharge (Initial $ETCO_2 \geq 10$ vs. < 10 mmHg)												
1[a]	observational study	serious[d]	not serious	not serious	not serious	very strong association	14/68 (20.6%)	1/45 (2.2%)	OR 11.4 (1.4–90.2)	184 more per 1000 (from 9 more to 650 more)	LOW	CRITICAL

Survival at discharge (Initial $ETCO_2 \geq 20$ vs. < 20 mmHg)												
1[a]	observational study	serious[d]	not serious	not serious	not serious	very strong association	12/34 (35.3%)	3/79 (3.8%)	OR 13.8 (3.6–53.4)	315 more per 1000 (from 86 more to 640 more)	LOW	CRITICAL
Survival at discharge (20 min $ETCO_2 \geq 10$ vs. < 10 mmHg)												
1[a]	observational study	serious[d]	not serious	not serious	serious[j]	none	4/25 (16.0%)	1/28 (3.6%)	OR 5.1 (0.5–49.5)	123 more per 1000 (from 18 fewer to 611 more)	VERY LOW	CRITICAL
Survival at discharge (20 min $ETCO_2 \geq 20$ vs. < 20 mmHg)												
1[a]	observational study	serious[d]	not serious	not serious	not serious	very strong association	4/12 (33.3%)	1/41 (2.4%)	OR 20,0 (2.0–203.3)	309 more per 1000 (from 23 more to 811 more)	LOW	CRITICAL

All observational studies start with low quality ratings, and we have decided not to downgrade on risk of bias because of the very strong association between higher $ETCO_2$ levels and ROSC or survival at discharge.

[a] Ahrens [3].
[b] Callaham [4].
[c] Cantineau [5].
[d] Convenience sampling, with 14% having already achieved ROSC.
[e] Small number of patients.
[f] Levine [7].
[g] Wayne [6].
[h] Includes data from previous study.
[i] high heterogeneity ($I^2 = 78\%$).
[j] Large confidence interval that crosses 1.0.

at ILCOR meetings to reach consensus prior to publication as the Consensus on Science and Treatment Recommendations [19–22].

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This review includes information on cardiac arrest resuscitation questions developed through the 2015 CoSTR process, managed by the International Liaison Committee on Resuscitation (www.ilcor.org/seers). No additional funding or financial support was received by the investigators to perform this review.

Transparency document. Supplementary material

Transparency data associated with this article can be found in the online version at https://doi.org/10.1016/j.dib.2018.04.075.

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