

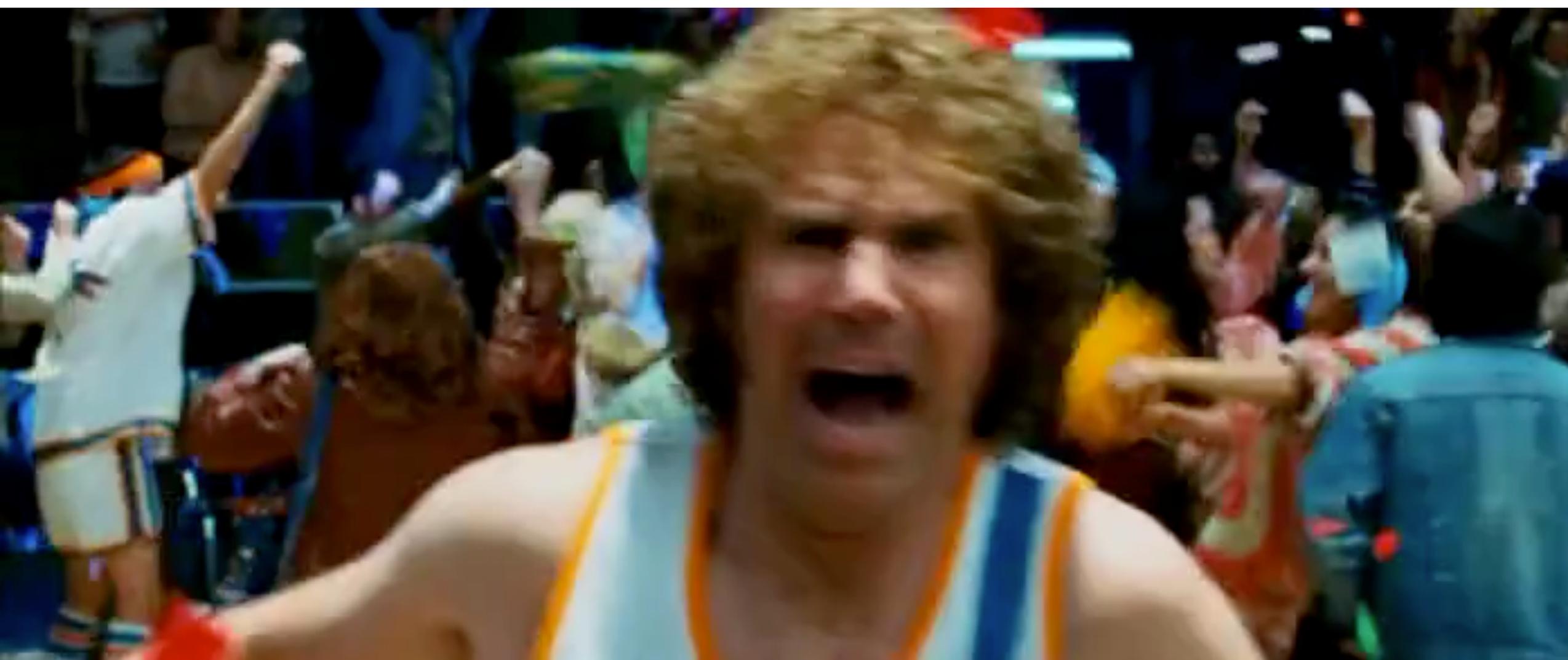
# CPRの分析 獣医の心肺蘇生に関する 重要な疑問を解明する

Kenichiro Yagi, MS, RVT, VTS (ECC), (SAIM)



**CRPはどんなイメージですか？**







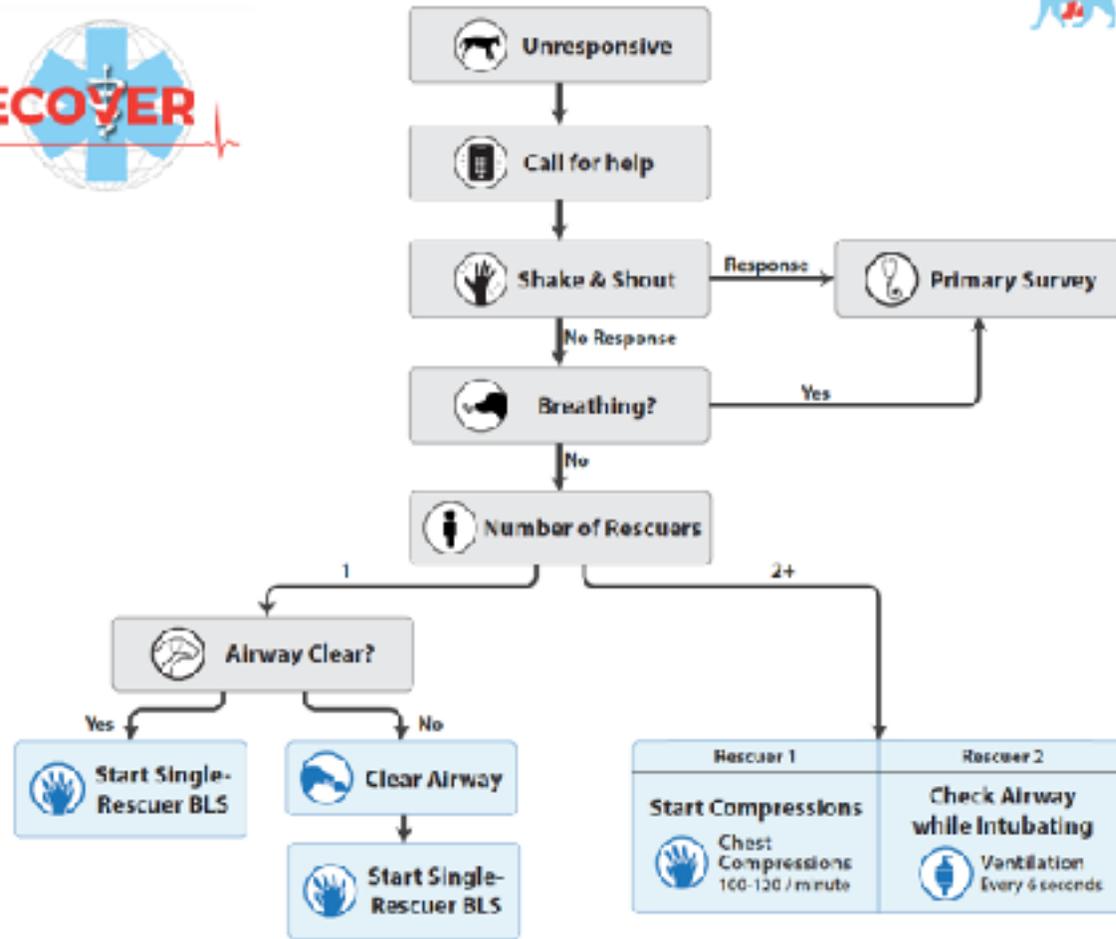
# RECOVER

## For Them And You

[Who We Are](#)

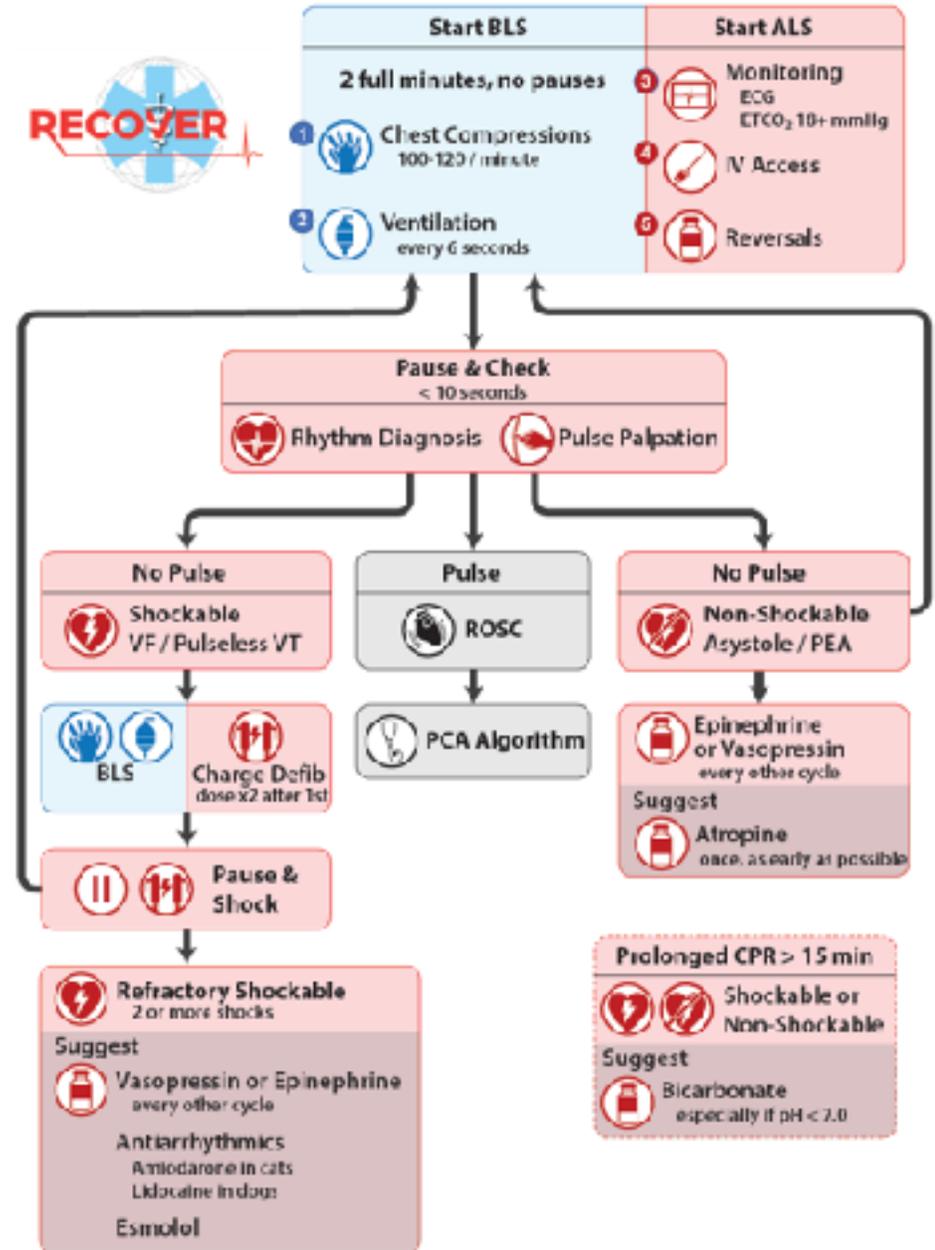
[2024 Guidelines](#)

# CPR Initial Assessment Algorithm



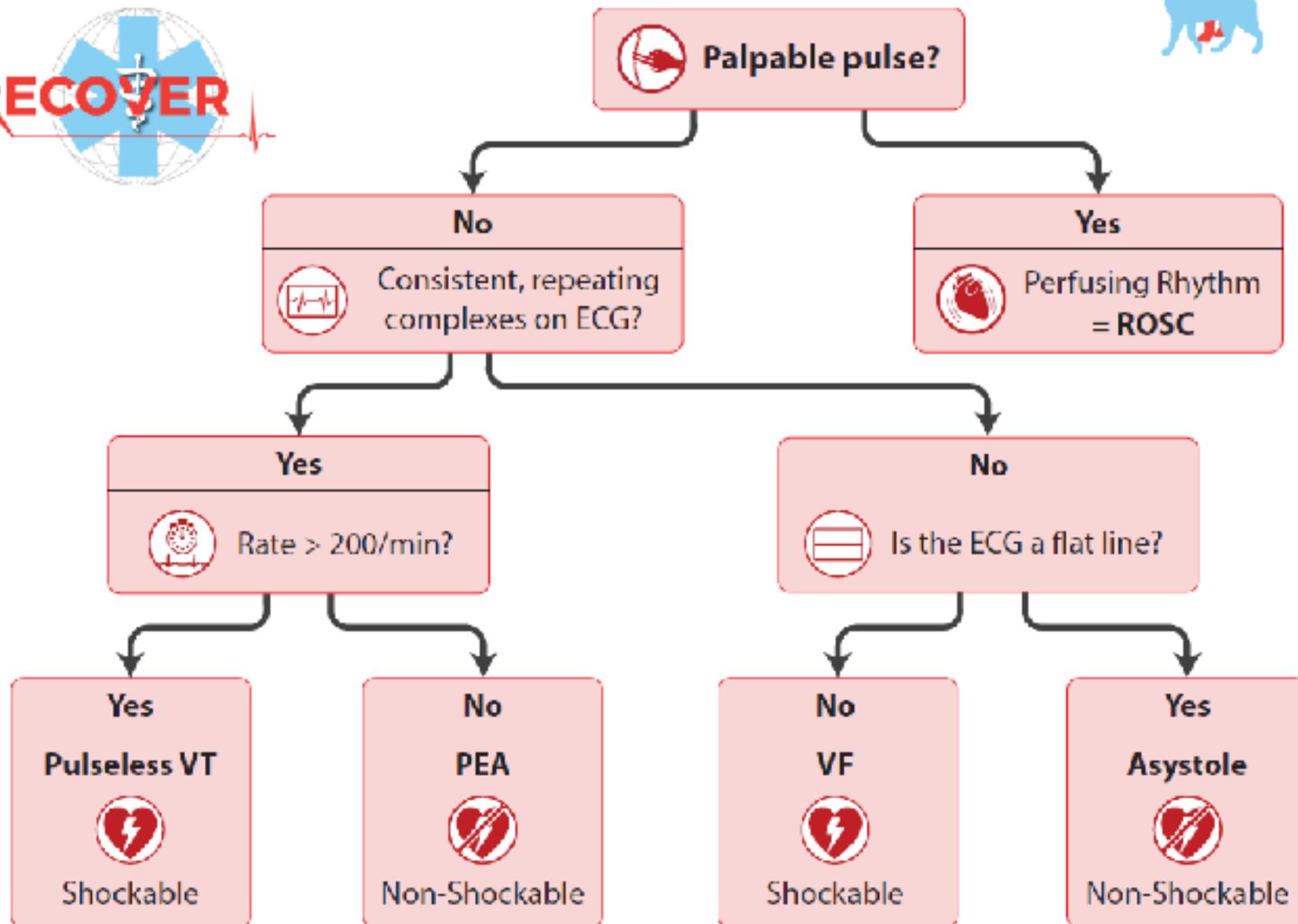
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# CPR Algorithm for Dogs and Cats



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# CPR ECG Algorithm



# CPR Dosing Chart for Dogs and Cats



		Weight (kg)	2.5	5	10	15	20	25	30	35	40	45	50
<b>DRUG</b>		<b>DOSE</b>	mL	mL	mL	mL	mL	mL	mL	mL	mL	mL	mL
<b>Arrest</b>	<b>Epinephrine</b> (1:1000; 1mg/mL)	<b>0.01 mg/kg</b>	0.03	0.05	0.1	0.15	0.2	0.25	0.3	0.35	0.4	0.45	0.5
	<b>Vasopressin</b> (20 U/mL)	<b>0.8 U/kg</b>	0.1	0.2	0.4	0.6	0.8	1	1.2	1.4	1.6	1.8	2
	<b>Atropine</b> (0.4 - 0.54 mg/mL)	<b>~ 0.05 mg/kg</b>	0.25	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5
<b>Anti-Arrhythmic</b>	<b>Amiodarone</b> (50 mg/mL)	<b>5 mg/kg</b>	0.25	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5
	<b>Lidocaine</b> (20 mg/mL)	<b>2 mg/kg</b>	0.25	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5
	<b>Esmolol*</b> (10 mg/mL)	<b>0.5 mg/kg</b>	0.13	0.25	0.5	0.75	1	1.3	1.5	1.8	2	2.3	2.5
<b>Reversal</b>	<b>Naloxone</b> (0.4 mg/mL)	<b>0.04 mg/kg</b>	0.25	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5
	<b>Flumazenil</b> (0.1 mg/mL)	<b>0.01 mg/kg</b>	0.25	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5
	<b>Atipamezole</b> (5 mg/mL)	<b>100 µg/kg</b>	0.06	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1
<b>Monophasic Defibrillation</b>	<b>External Defib (J)</b>	<b>4 - 6 J/kg</b>	10 J	20 J	40 J	60 J	80 J	100 J	120 J	140 J	160 J	180 J	200 J
	<b>Internal Defib (J)</b>	<b>0.5 - 1 J/kg</b>	2 J	3 J	5 J	8 J	10 J	15 J	15 J	20 J	20	20 J	25 J
		Weight (kg)	2.5	5	10	15	20	25	30	35	40	45	50

\*Administer esmolol 0.5 mg/kg IV or IO over 3-5 minutes followed by a CRI at 50 mcg/kg/min



## Reassessment Campaign on Veterinary Resuscitation

シンプル

簡単

知るべきことは全て知ろう

シンプル

簡単

知るべきことは全て知るう

**RECOVER**

**WE PUBLISHED THE  
2024 CPR GUIDELINES**

**SO WE HAVE THE ANSWERS  
TO ALL CPR QUESTIONS NOW?**

**WE HAVE THE ANSWERS TO  
ALL CPR QUESTIONS, RIGHT?**

CPRについて聞きたいことは何ですか？

まだ誰も応答していません。  
しばらくお待ち下さい、回答が届きます。

「長すぎる」はどれくらい？

犬と猫のCRPに違いはある？

腹部圧迫の介入は効果的？

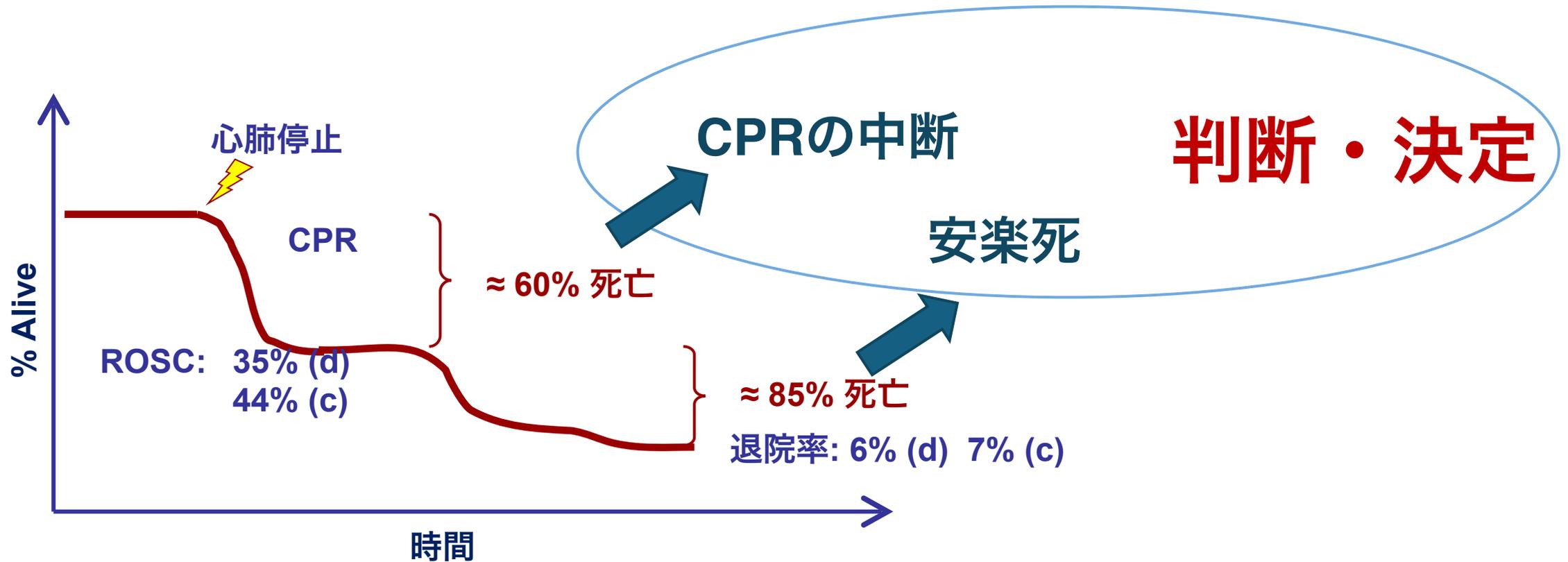
**CPR継続時間:**

長すぎるって  
どれくらい？



# ROSC後の死亡率が高い

ジョージア大学の犬161頭と猫43匹



# (神経学) 心停止時の転機予測



心肺停止中



ROSC後

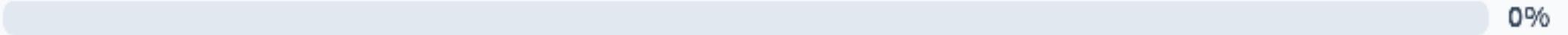
# いつまでの続けるの？



.....ガイドラインはありません

可逆的な病気の患者の場合、無駄だと判断するまでどれくらいCPRを続けますか？

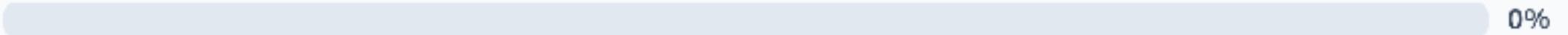
5 minutes



10 minutes



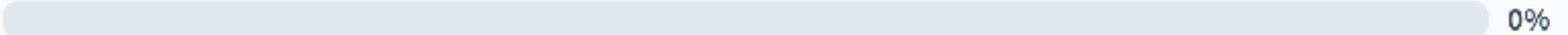
15 minutes



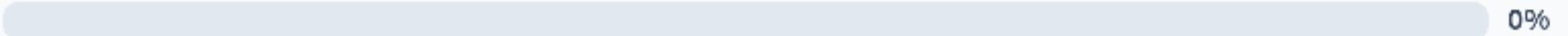
20 minutes



25 minutes



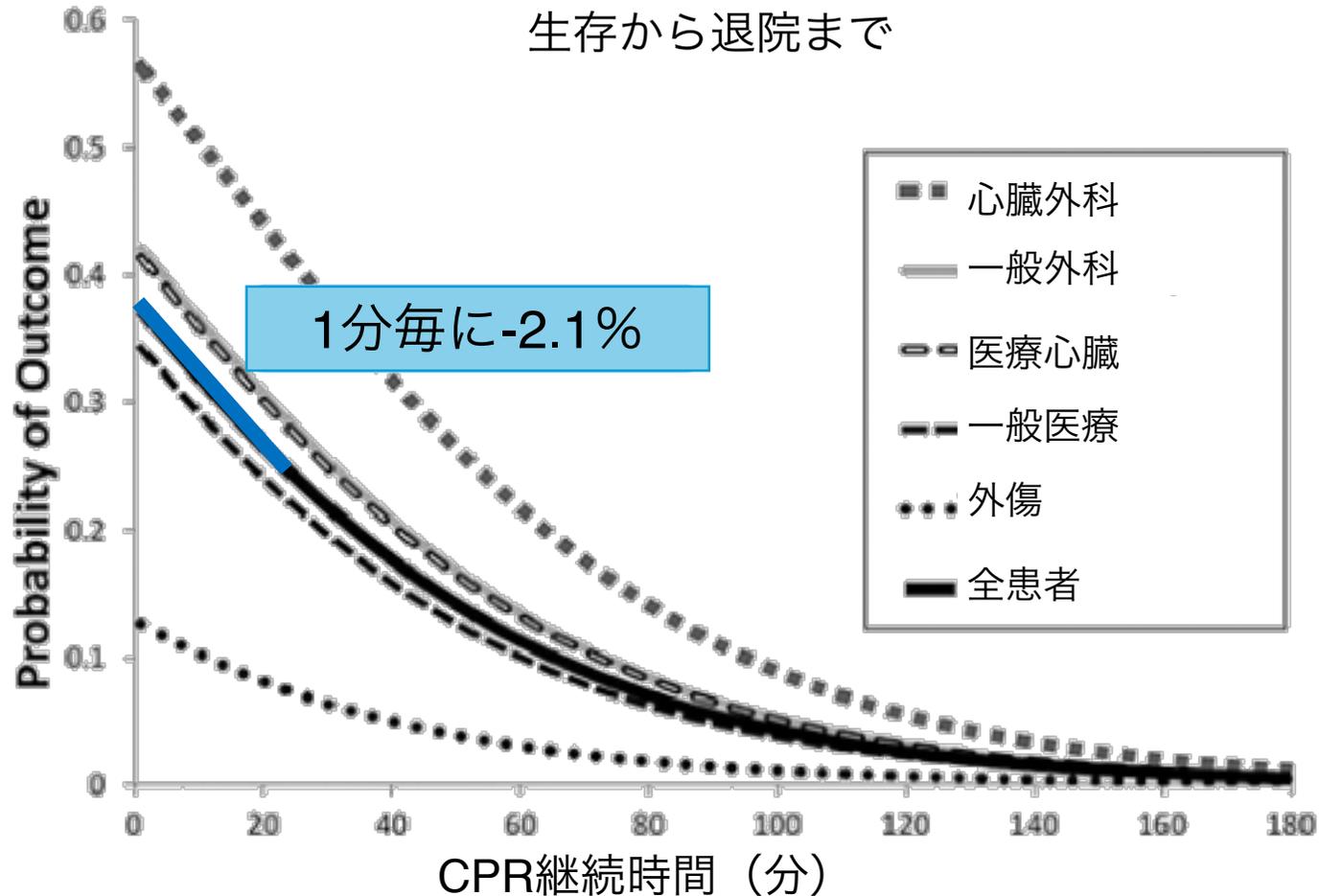
30 minutes



35 minutes or more



# CPRの持続時間は生存率とどのように関係していますか？



## CPRの持続時間と生存率

- 3419人の子供
- 小児集中治療室

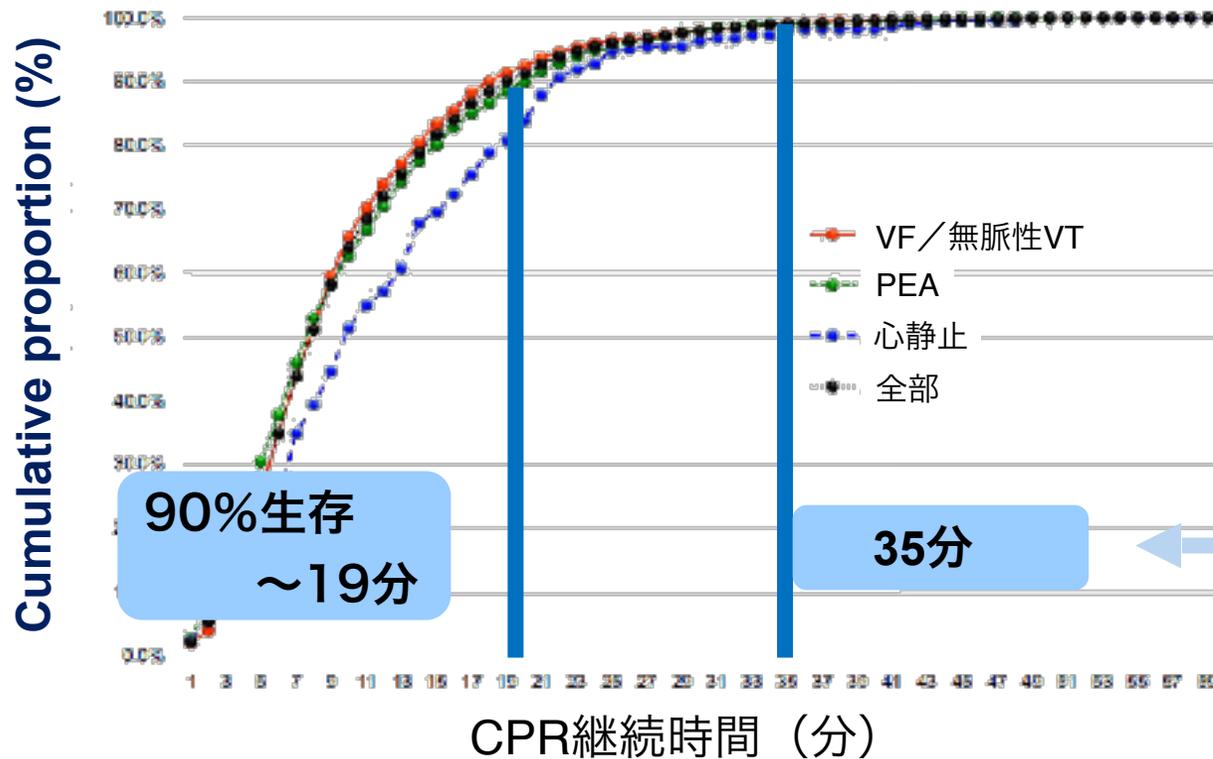


## 退院までの生存

- 1-15 分間のCPR: 41%
- 35分以上: 12%
- 全体: 27.9%

# CPRno持続時間は生存率とどのように関係していますか？

## CPRの臨界持続時間



### CPRの持続時間と生存率

- ROSCした成人17238人
- 院外CPA



### CPRの重要な持続時間

- 生存率99% (30日)
- CPC 1-2

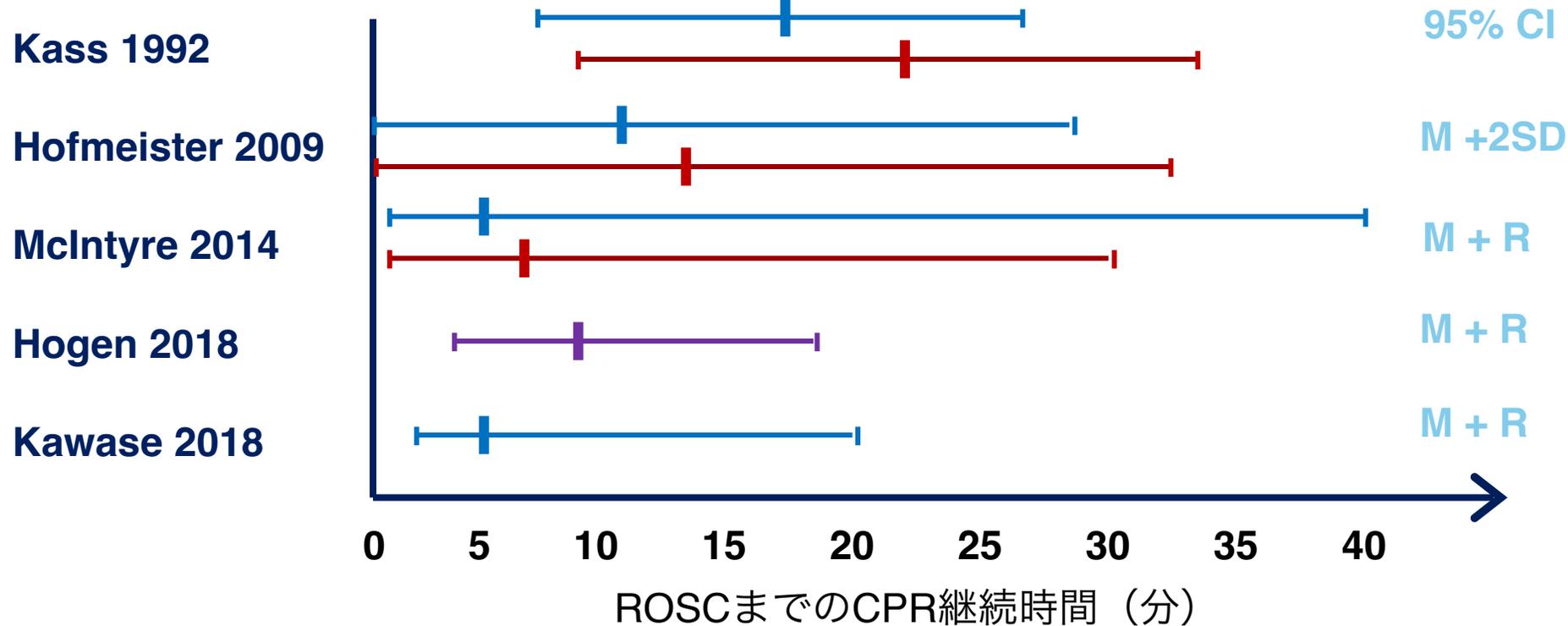
# 犬や猫はどうでしょうか？

## 6件の研究報告

- 犬206頭
- 猫63頭

## 5つの研究がCPRの継続時間を報告

- 犬：184頭
- 猫：55頭



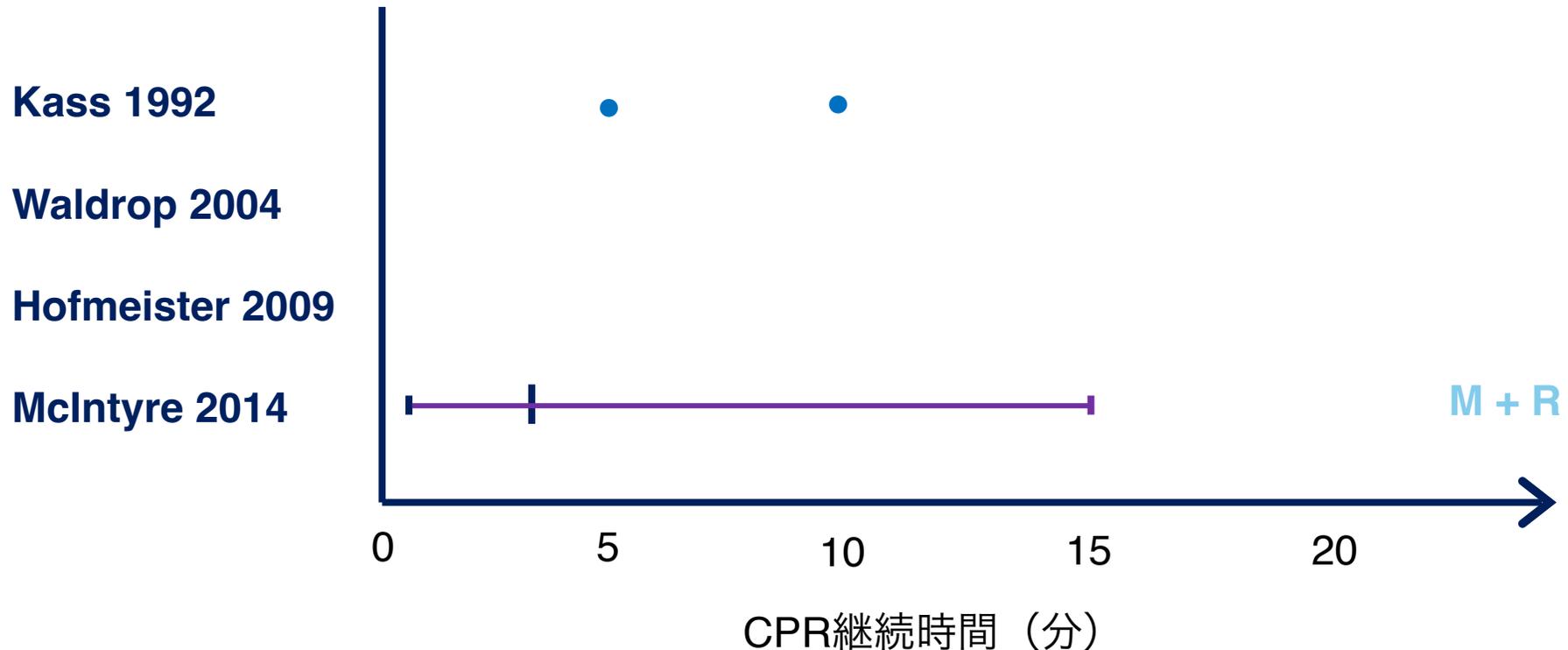
# 犬や猫はどうでしょうか？

7件の研究で生存者が報告されている

- 犬44頭
- 猫13頭

4つの研究がCPRの継続時間を報告

- 犬：29頭
- 猫：8頭

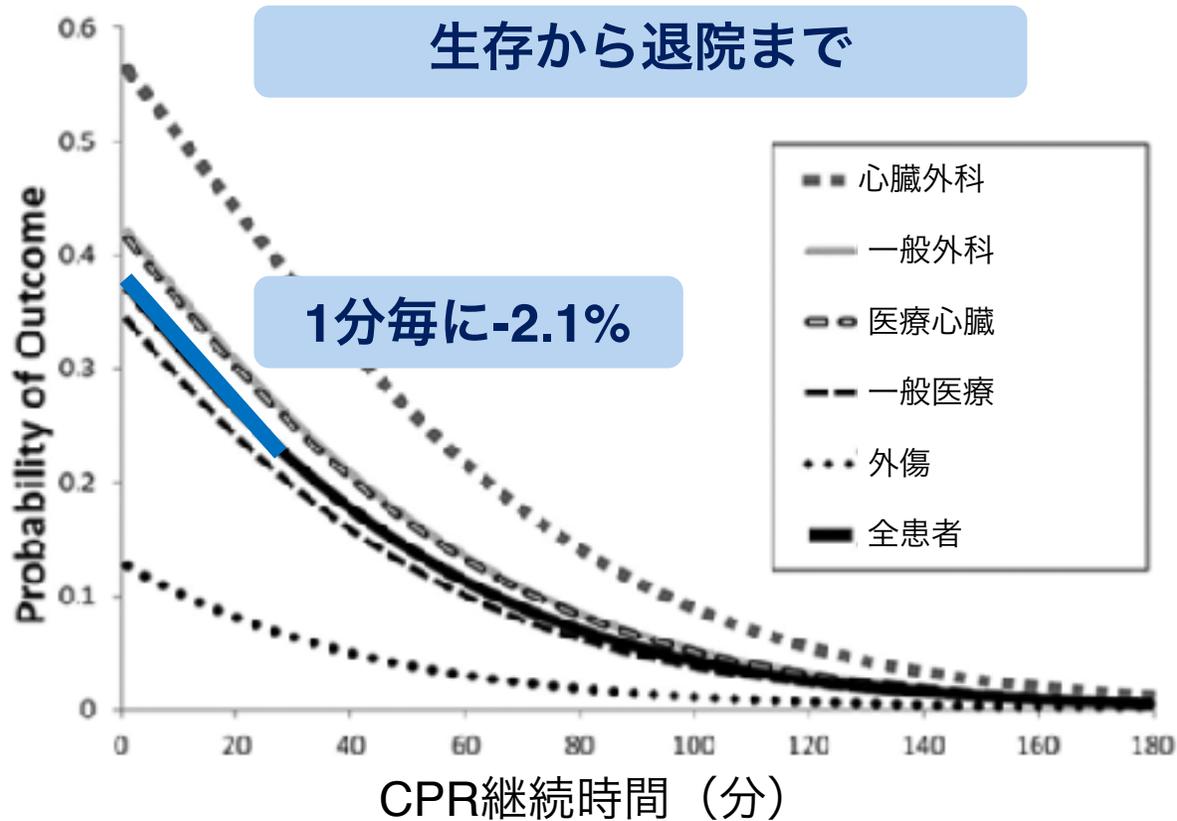


# CPRを中止する

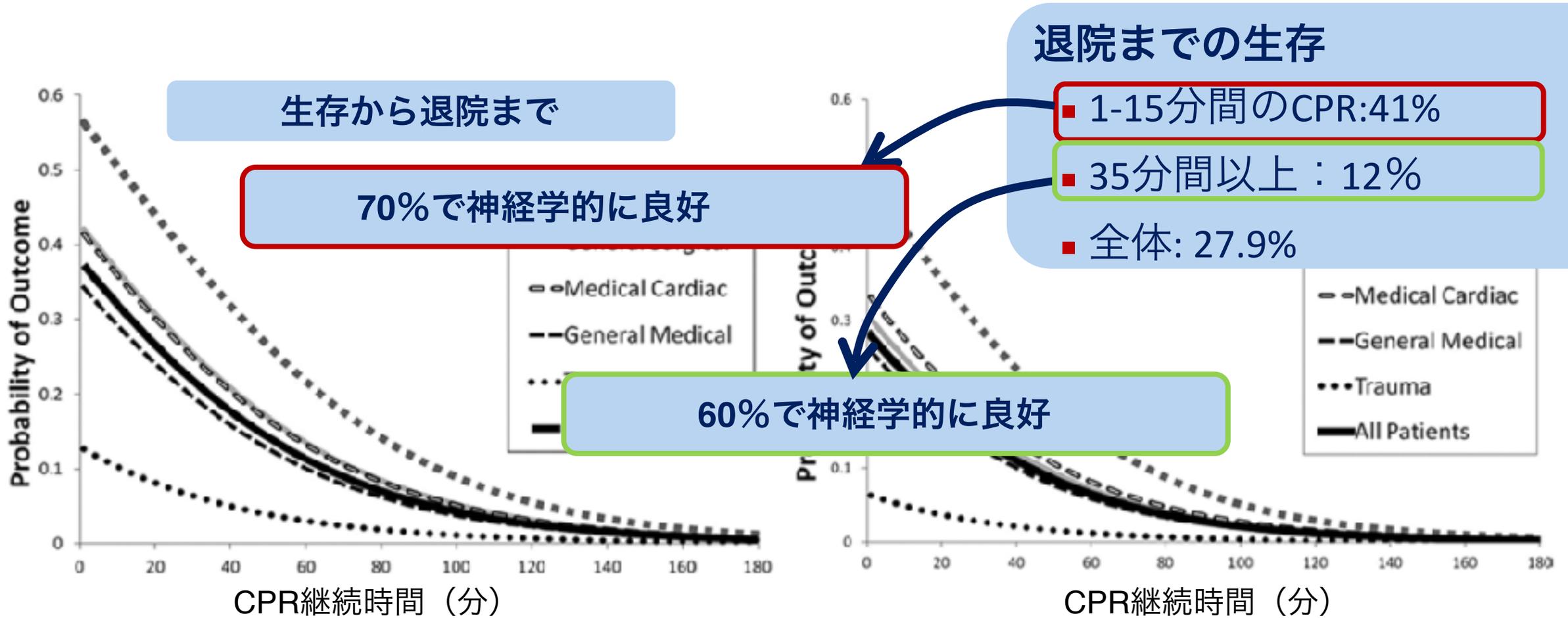
- 経済的理由
- 病気の重症度
- 無益さ

機能能力  
生活の質

# CPRの持続時間は機能的結果とどのように関連していますか？



# CPRの持続時間は機能的結果とどのように関連していますか？





# RECOVER CPR Registry

[Access Registry](#)

— [Our Process](#)

## Understanding the RECOVER CPR Registry

# Gathering Data From Around the Globe

A registry is a health-related database containing demographic and clinical information of individual animals and serving a specific health-related purpose. Registries are used for long-term data collection, while observational research projects focus on short-term data gathering.

The RECOVER initiative developed a CPR registry to collect epidemiological information on CPR in small animals. Epidemiological CPR data in dogs and cats is currently only based on observational studies conducted in single veterinary hospitals. Due to the heterogeneity of the veterinary cardiopulmonary arrest (CPA) population, data from a large number of animals are needed to determine the effects of specific variables (e.g., age) on the outcome. Important questions can be answered with registries. For example, determining the frequency of return of spontaneous circulation (ROSC) and survival rates after CPR may provide practitioners with more evidence on how long to continue the resuscitation effort. In short, the RECOVER CPR registry is a central instrument to create new knowledge of small animal CPR. The RECOVER CPR registry-based its content on the Utstein-style reporting guidelines. Accordingly, data elements are divided into those absolutely required for the data to make any sense (aka, core variables) such as animal species and survival to discharge information, and into those that cannot reliably be collected or are primarily useful as hypothesis-generating data (aka, supplemental variables), rather than essential. Examples of supplemental variables include EtCO<sub>2</sub> values or time until the first epinephrine administration. The RECOVER case report form is designed to facilitate data collection required for the registry by using the same data elements and synchronized terminology.

The RECOVER CPR registry is implemented using an electronic research data capture system developed by the NIH and data can be entered via a computer terminal or tablet by everyone that has a RECOVER CPR registry account. Registry data will be made available to any registry contributor to answer specific hypotheses, provided a respective application was submitted and approved.

いつ中止にしますか？



## CPRの中止基準

1. 不可逆的原因
2. CPRの有効性が低い（20分以上？）

$\text{EtCO}_2 < 10 \text{ mm Hg}$

3. 心臓の電気的活動の欠如が長期間（20分以上？）
4. ROSCの徴候が全くない
5. 無流動時間が長い（10分以上？）



**CPRを15分以上続けなければ、  
15分以上のデータは得られない**

**適切な患者のためにより長く**

「長すぎる」はどれくらい？

犬と猫のCRPに違いはある？

腹部圧迫の介入は効果的？



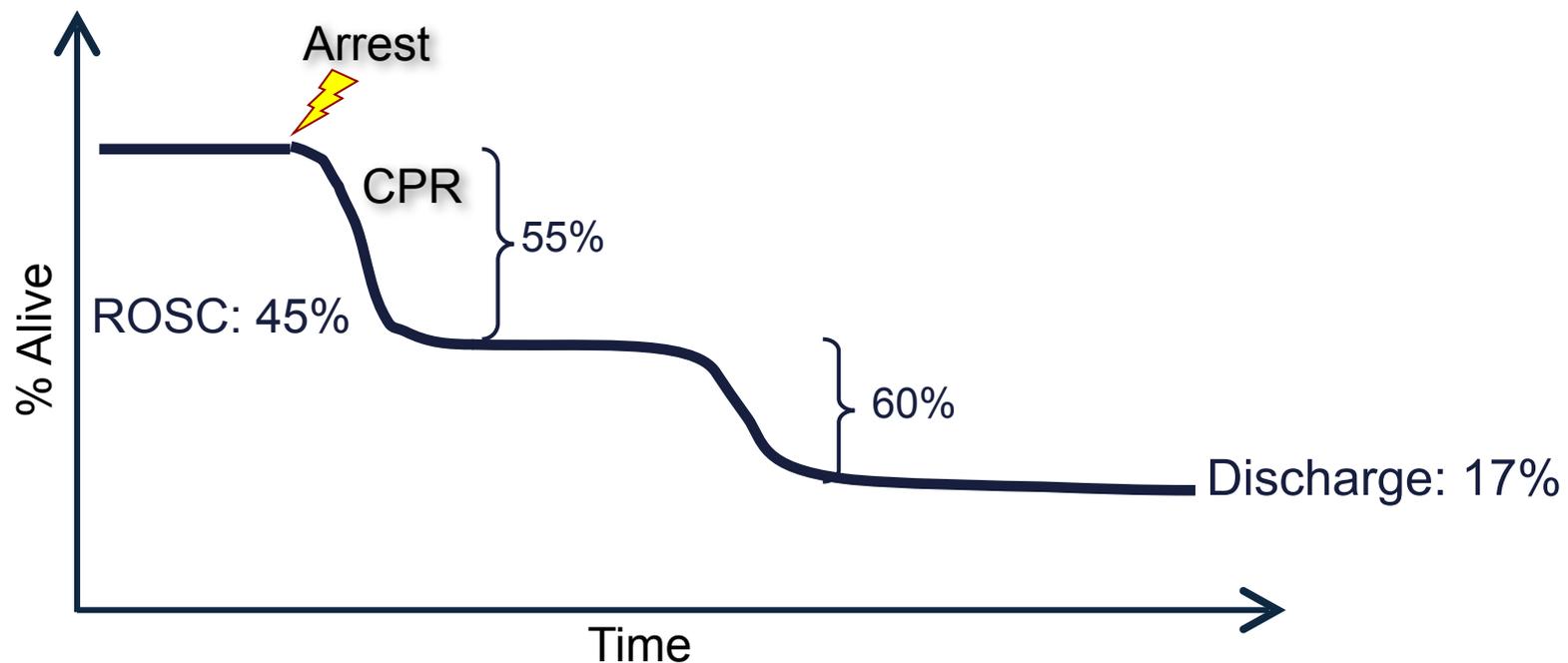
犬と比べて、猫の心肺蘇生はどう違うの？

まだ誰も回答していない

頑張ってください！回答はもうすぐです。

# 心肺停止の疫学

院内CPA 14,720 people

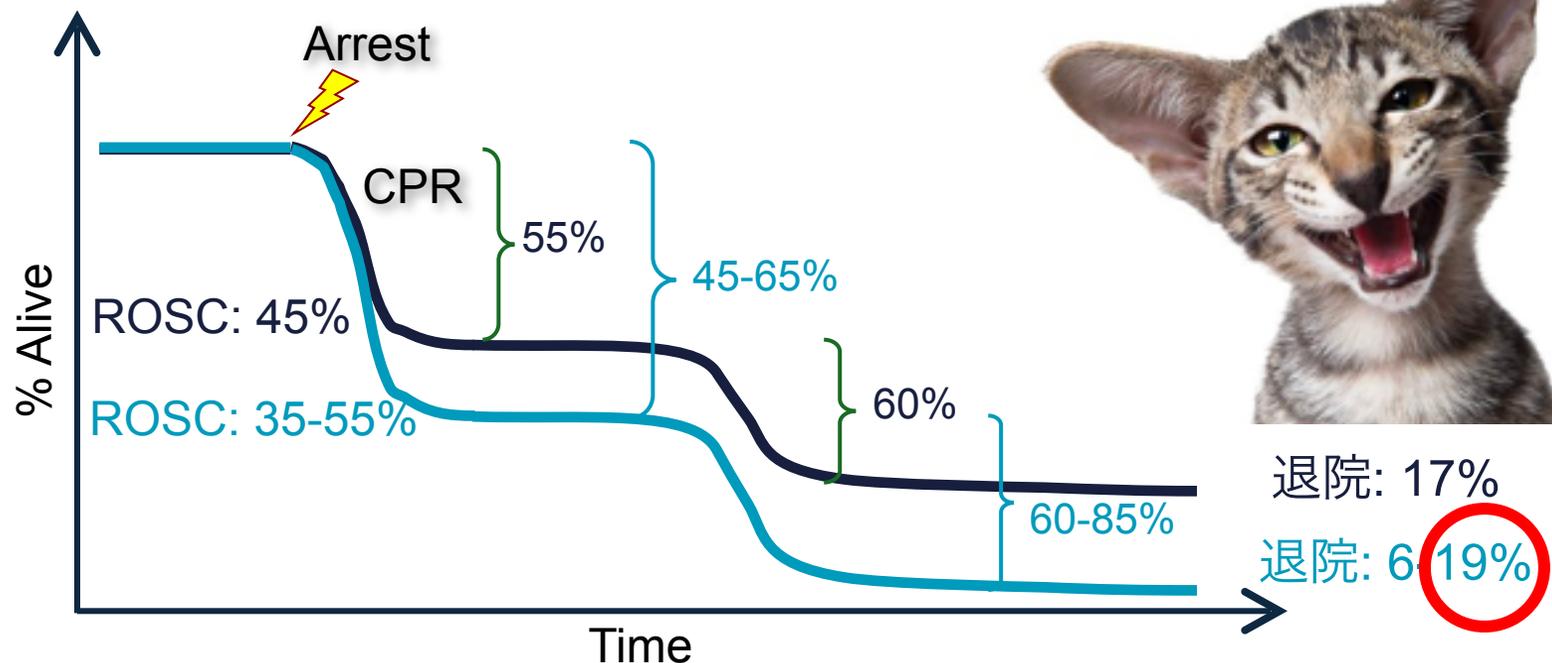


Peberdy et al., Resuscitation 2003  
Hofmeister et al., JAVMA 2009  
Hoehne et al., Frontiers, 2019



# 心肺停止の疫学

院内CPA 14,720 people  
院内CPA 333 dogs and 90 cats



Peberdy et al., Resuscitation 2003  
Hofmeister et al., JAVMA 2009  
Hoehne et al., Frontiers, 2019

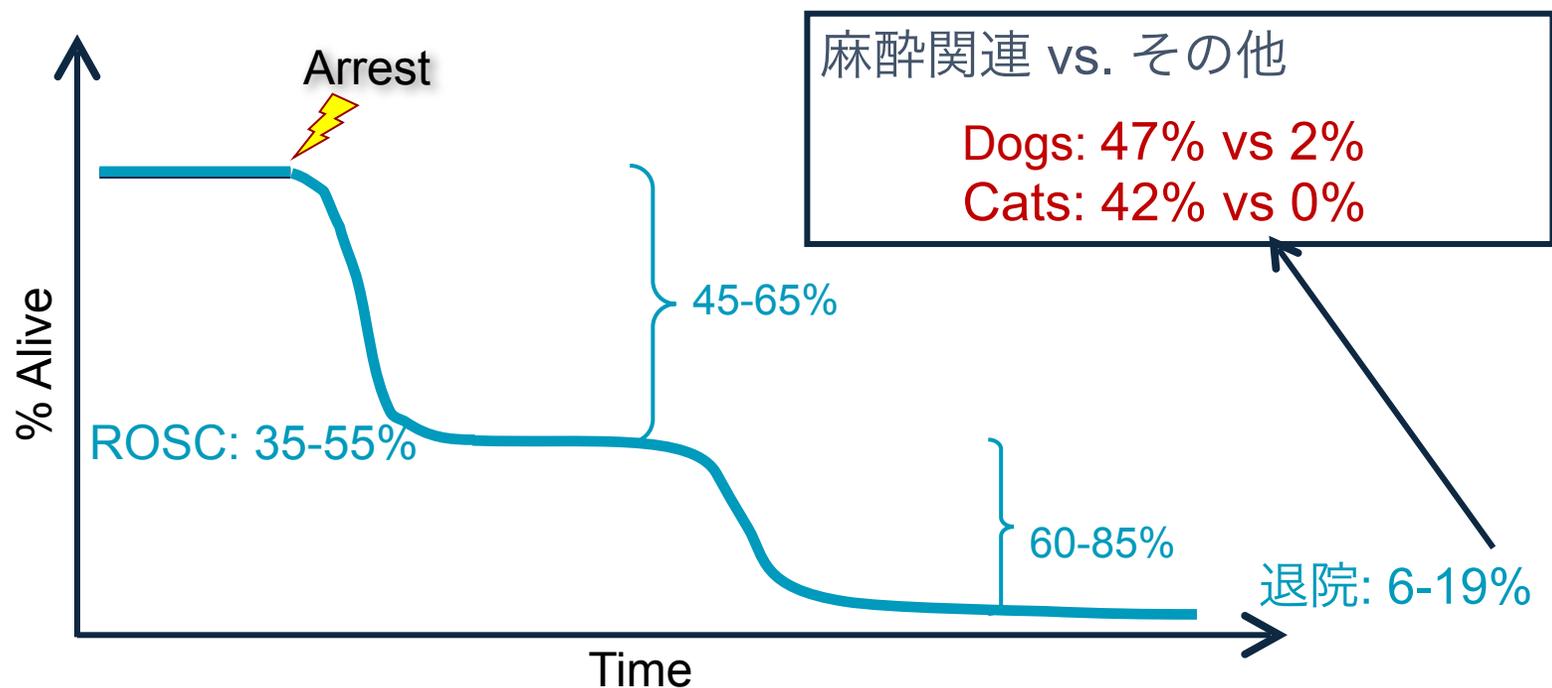


# 心肺停止の疫学

麻酔 -> 14.82倍生存率が高い

猫 -> 4.87倍生存率が高い

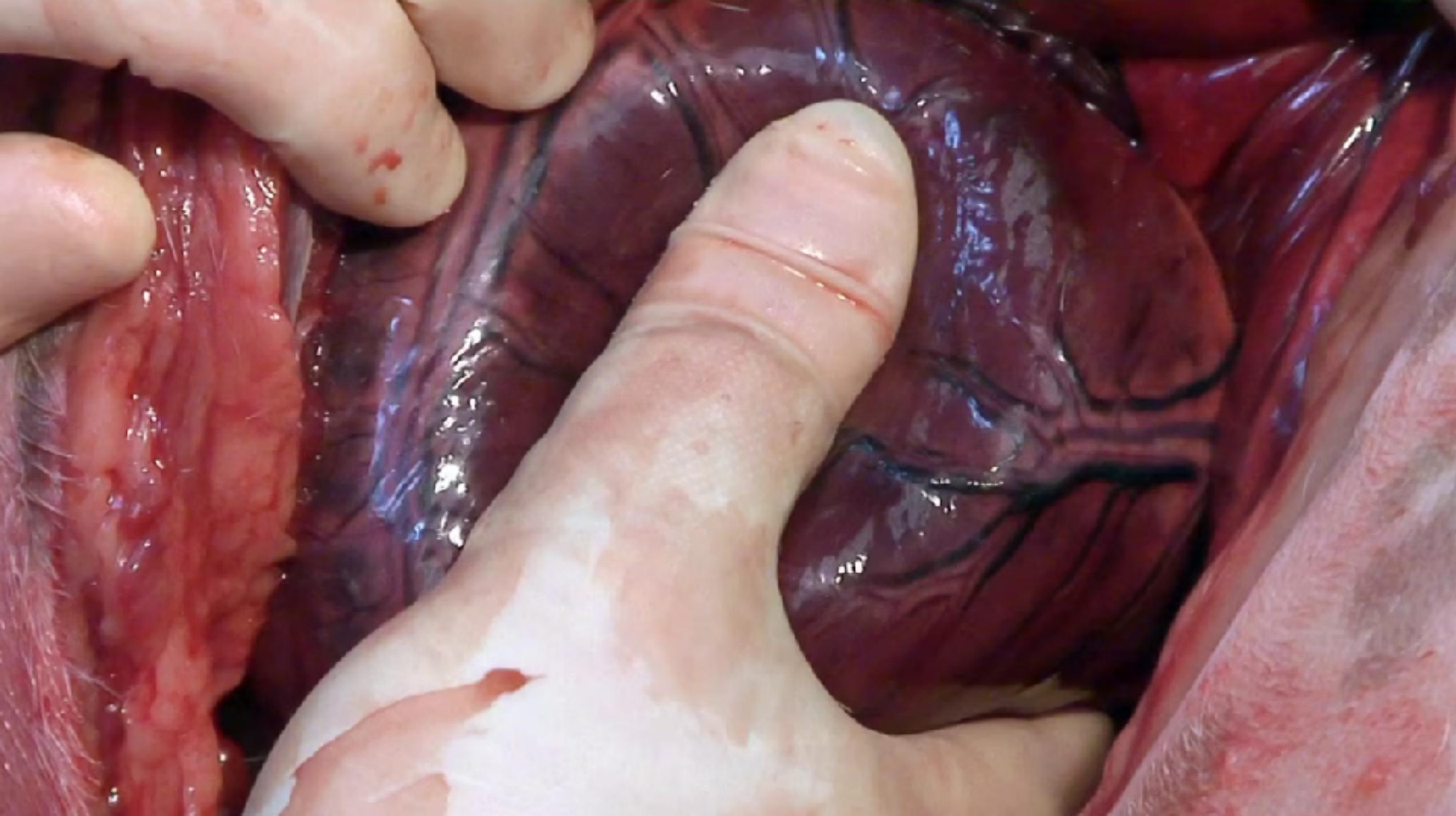
院内CPA 333 dogs and 90 cats

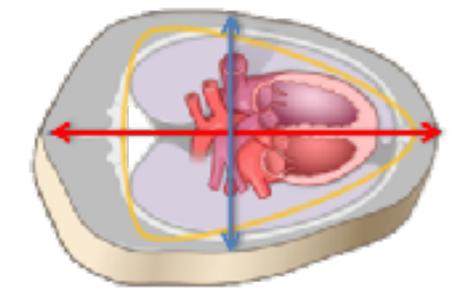
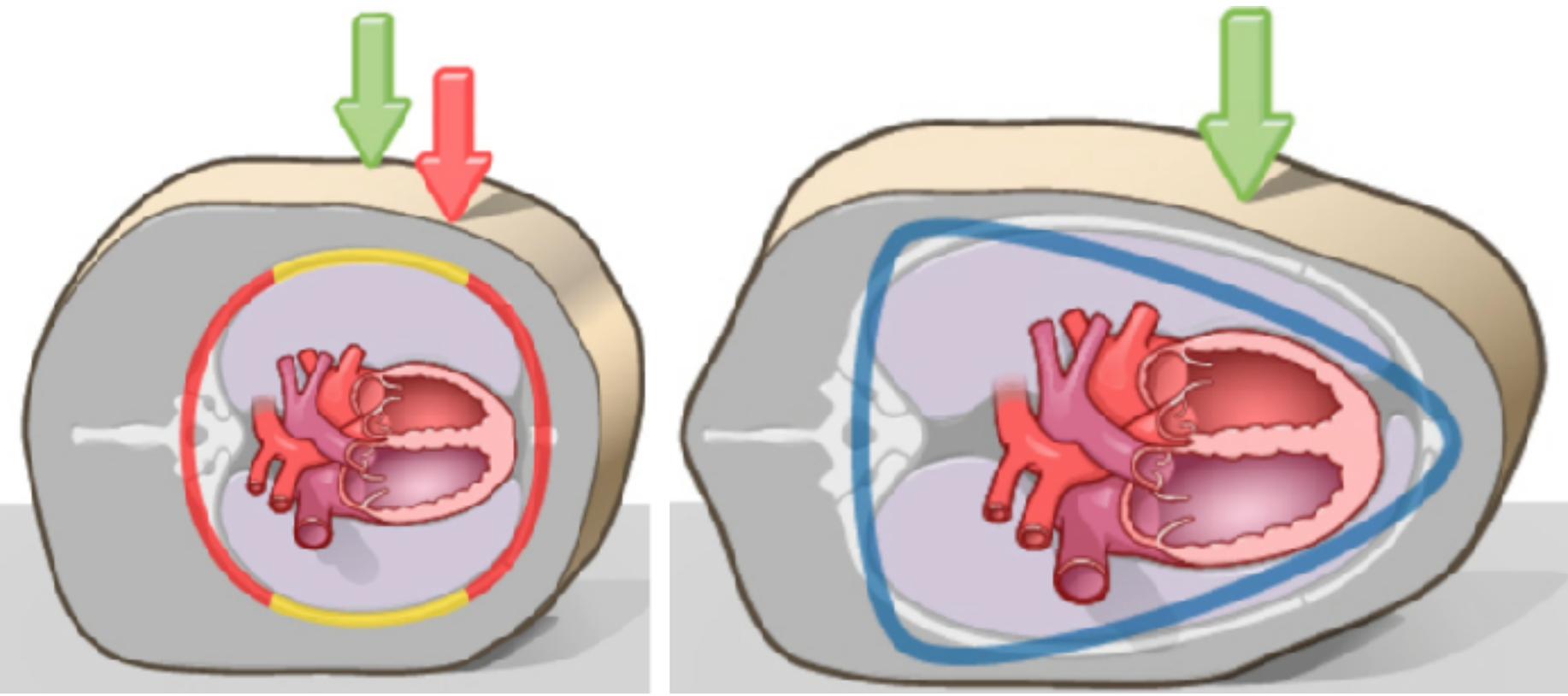


Peberdy et al., Resuscitation 2003  
Hofmeister et al., JAVMA 2009  
Hoehne et al., Frontiers, 2019



**血液を循環させる最善の方法とは？**



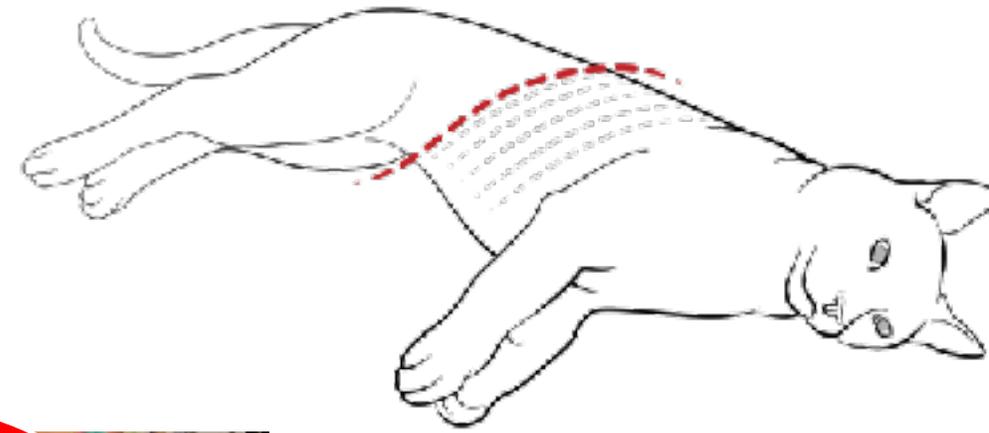


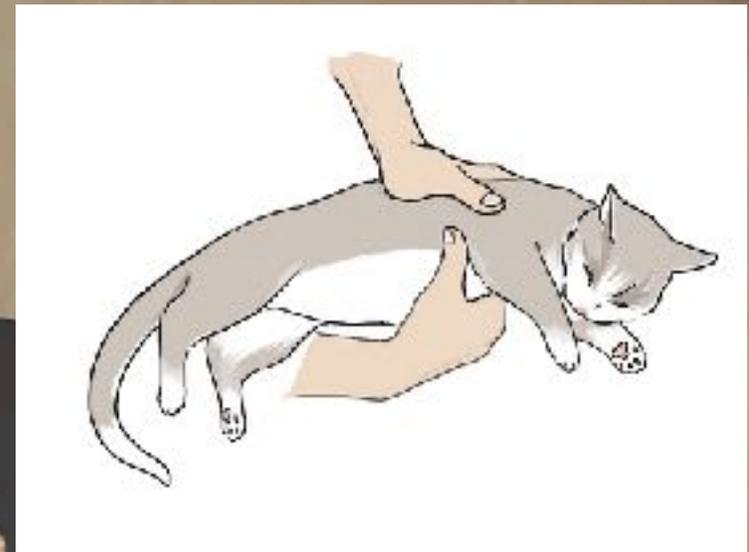
# 猫と小型犬



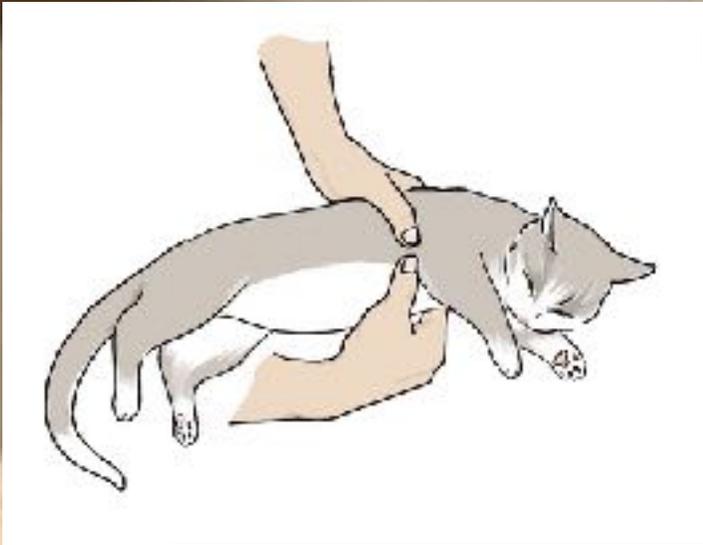
# 小型犬と猫の圧迫

- 心臓の直上で手を当てる
- 最大限に心臓ポンプ作用を活用





Model created by:  
<https://jspbb.or.jp/>



Model created by:  
<https://jspbb.or.jp/>



一般社団法人

日本ペットBLS防災学会

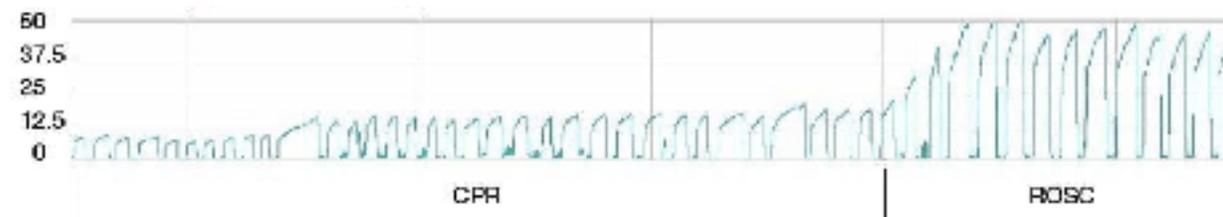
JAPAN SOCIETY OF PET BLS AND BOSH



Model created by:  
<https://jspbb.or.jp/>

# ETCO<sub>2</sub> ガイドライン

- **気管挿管の確認 (>12 mmHg)**
  - <5 mmHgなら気管挿管を目視で確認する
- **圧迫の質を評価**
  - **目標: ETCO<sub>2</sub> > 18 mmHg. もし低いなら...**
    - 圧縮の質を評価する：レート、深さ、反動/傾き、場所、姿勢など
    - 正しい換気を確認する：RR=10/分（呼吸間隔6秒）
  - 特に猫では、圧迫が効果的である可能性が高い。
- **ROSCの指標**
  - 突然15 mmHg以上の上昇 or 35 mmHg以上
  - 確実に脈を確認するまで圧迫を続ける



ORIGINAL RESEARCH article

Front. Vet. Sci., 09 December 2019

Sec. Veterinary Emergency and Critical Care Medicine

Volume 6 - 2019 | <https://doi.org/10.3389/fvets.2019.00439>

## Prospective Evaluation of Cardiopulmonary Resuscitation Performed in Dogs and Cats According to the RECOVER Guidelines. Part 2: Patient Outcomes and CPR Practice Since Guideline Implementation



Sabrina N. Hoehne<sup>1†</sup>



Kate Hopper<sup>2</sup>



Steven E. Epstein<sup>2</sup>

	Dogs	Cats
ROSC 率	44%	55%
生存率	7%	19%

ETCO<sub>2</sub> 最大 23 mmHg

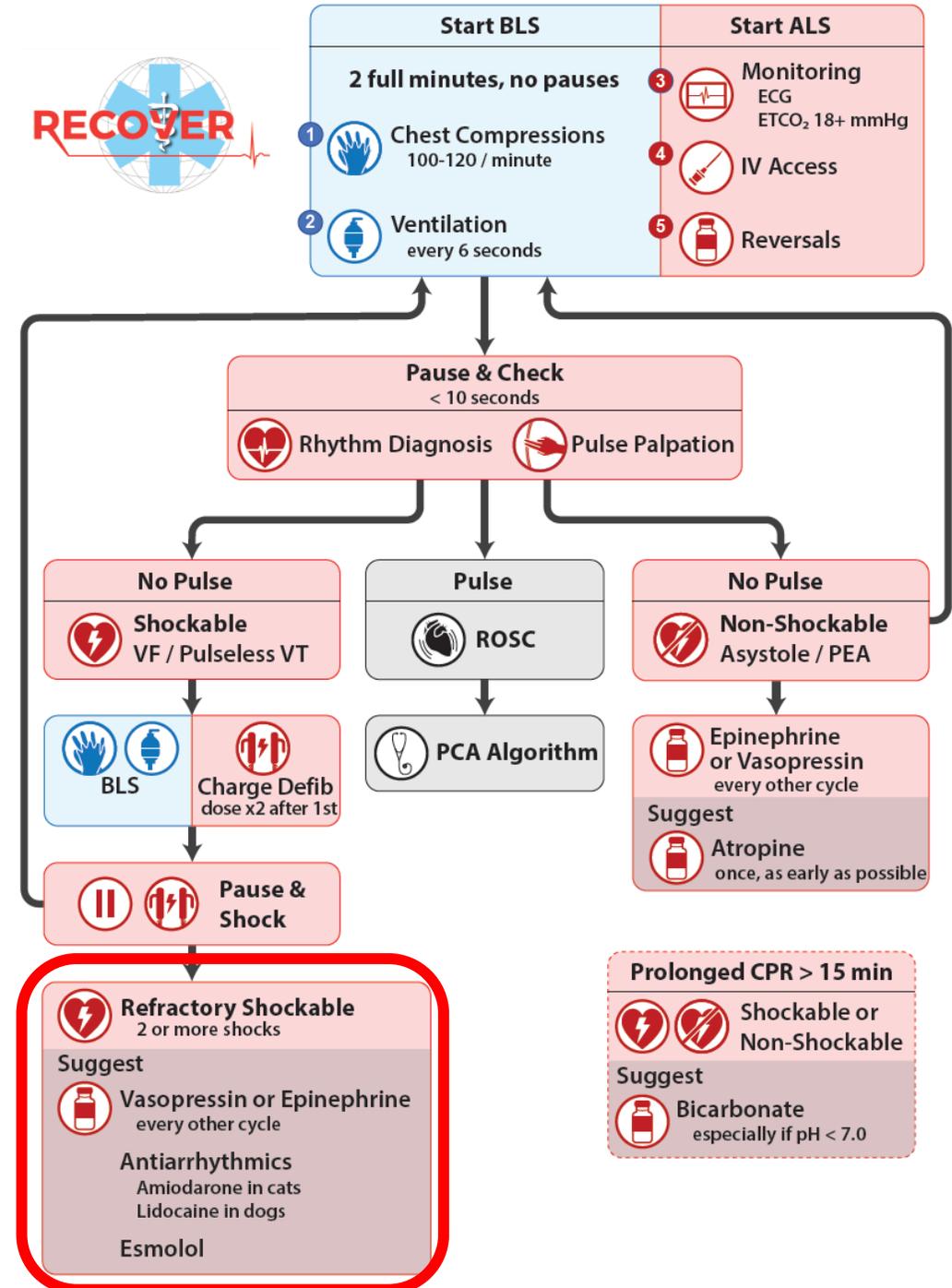
**Refractory Shockable**  
2 or more shocks

**Suggest**

**Vasopressin or Epinephrine**  
every other cycle

**Antiarrhythmics**  
Amiodarone in cats  
Lidocaine in dogs

**Esmolol**



# 犬における抗不整脈薬

アミオダロン  
(Polysorbate 80含有)

低血圧  
徐脈  
房室ブロック

リドカインが推奨

▶ J Cardiovasc Pharmacol. 1982 May Jun;4(3):375-80. doi: 10.1097/00005344-198205000-00006.

## Hypotensive action of commercial intravenous amiodarone and polysorbate 80 in dogs

W B Gough, R H Zeiler, P Barroca, N El Sherif

PMID: 6177932 DOI: 10.1097/00005344-198205000-00006



JOURNAL OF  
**VETERINARY INTERNAL MEDICINE**  
Open Access

Open Access

## Adverse Effects of Intravenous Amiodarone in 5 Dogs

R.F. Cober, K.F. Schober, N. Hildebrandt, F. Sikorska, S.C. Biesen

First published: 19 May 2009 | <https://doi.org/10.1111/j.1939-1676.2009.0314.x> | Citations: 19

✉ Corresponding author: Dr Richard F. Cober, DVM, Department of Veterinary Clinical Sciences, College of Veterinary Medicine, The Ohio State University, 601 Vernon L. Harp Street, Columbus, OH 43210; e-mail: [cober.1@osu.edu](mailto:cober.1@osu.edu).

# 猫における抗不整脈薬

中枢神経毒性

痙攣

筋力低下

眠気

発作

昏睡（重度）

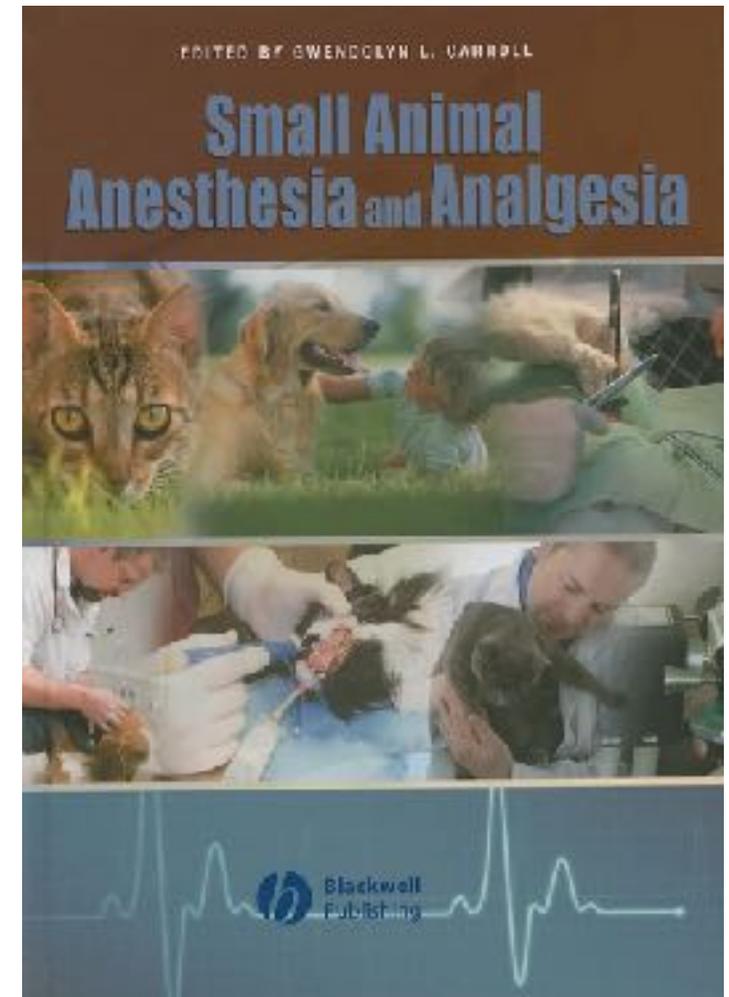
~6mg/kg

肝臓のグルクロン酸抱合の低下

Anesthesiology  
63:289-290, 1986

*Toxicity and Resuscitation in Lidocaine-  
or Bupivacaine-infused Cats*

H. S. Chadwick, M.D.\*



# 猫におけるアップデート

- 猫は血流を作りやすいため、EtCO<sub>2</sub>の目標値は高めに設定
- 過剰な圧迫は避ける、両手法は危険
- リドカインの代わりにアミオダロンを使用
- 開胸は閉鎖胸部圧迫だけでは効果がない場合にもあまり考慮されないが、犬では早期に考慮される。

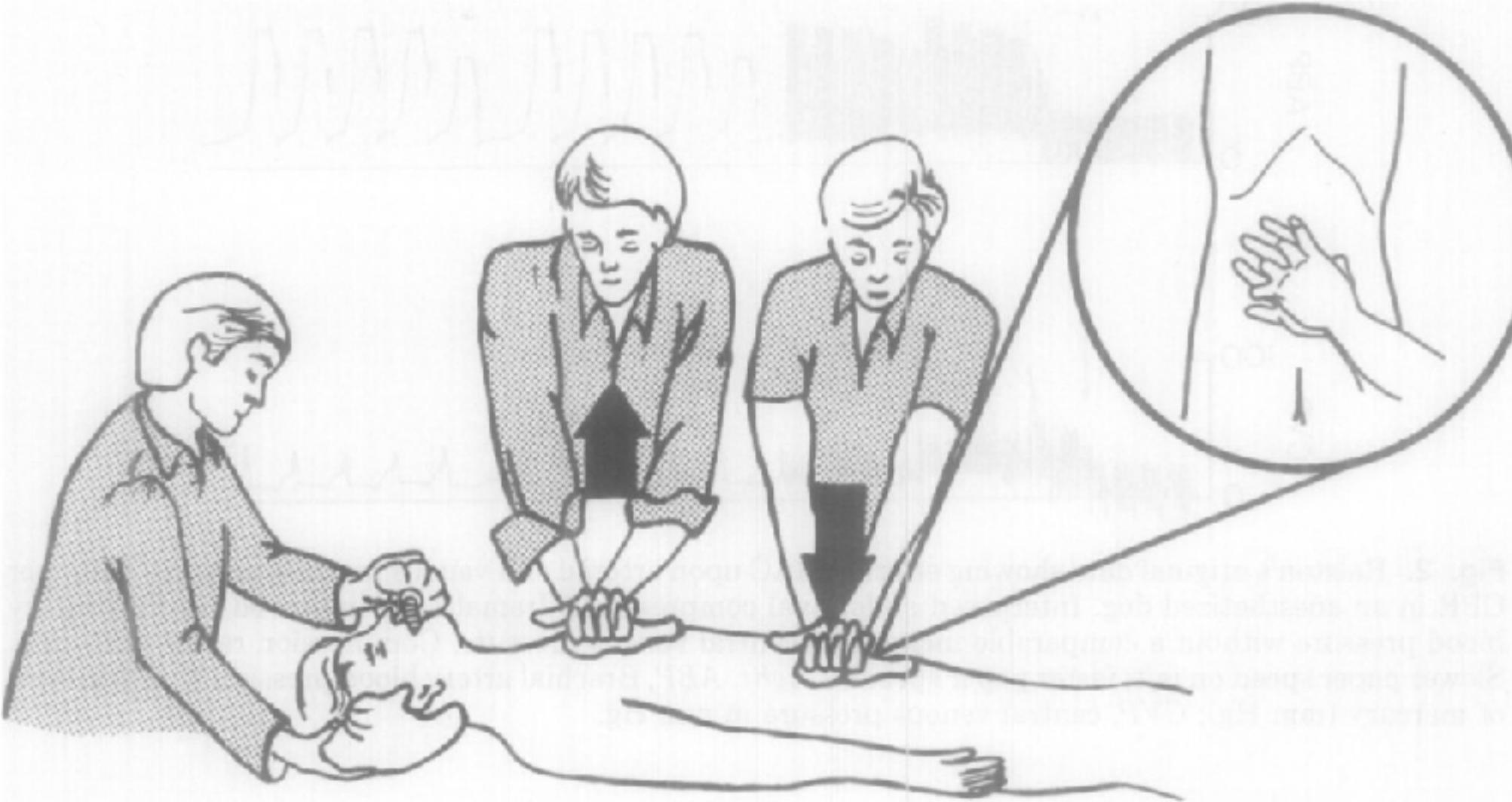


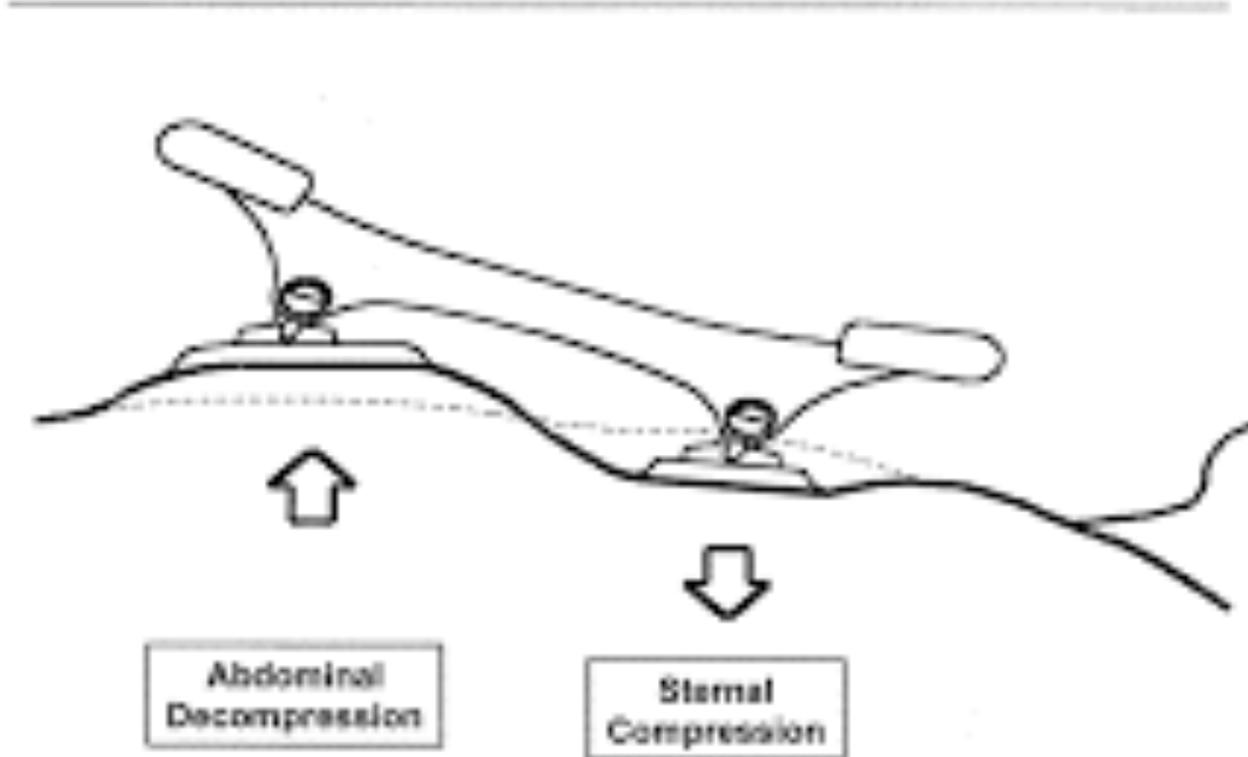
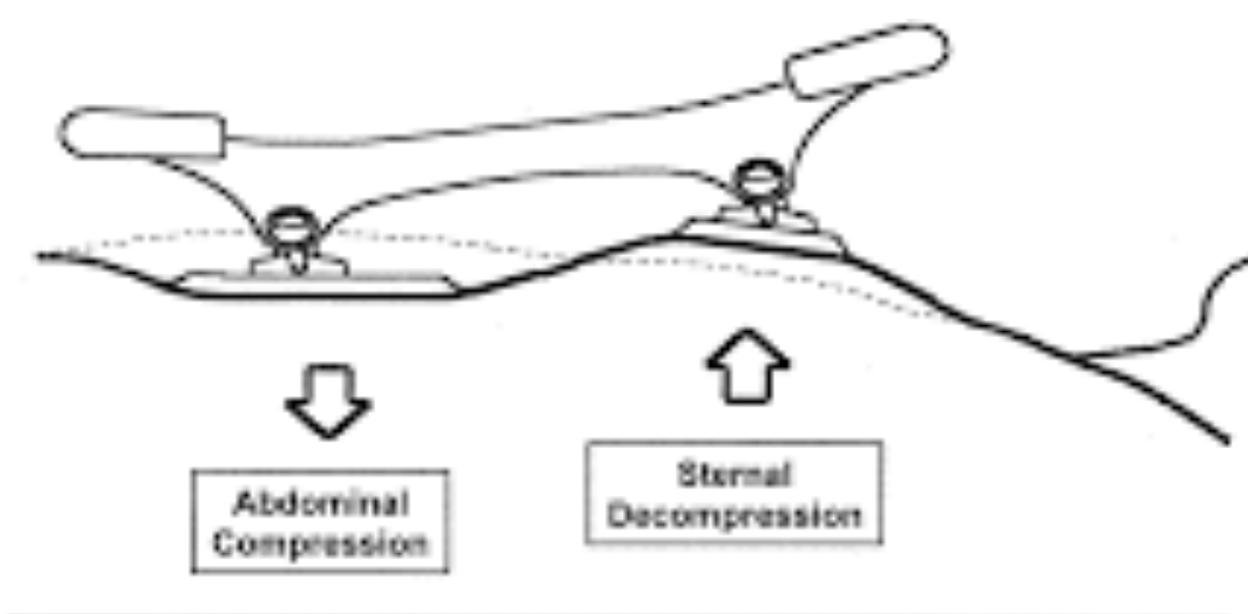
「長すぎる」はどれくらい？

犬と猫のCRPに違いはある？

腹部圧迫の介入は効果的？

# Interposed Abdominal Compressions (腹部圧迫の併用)



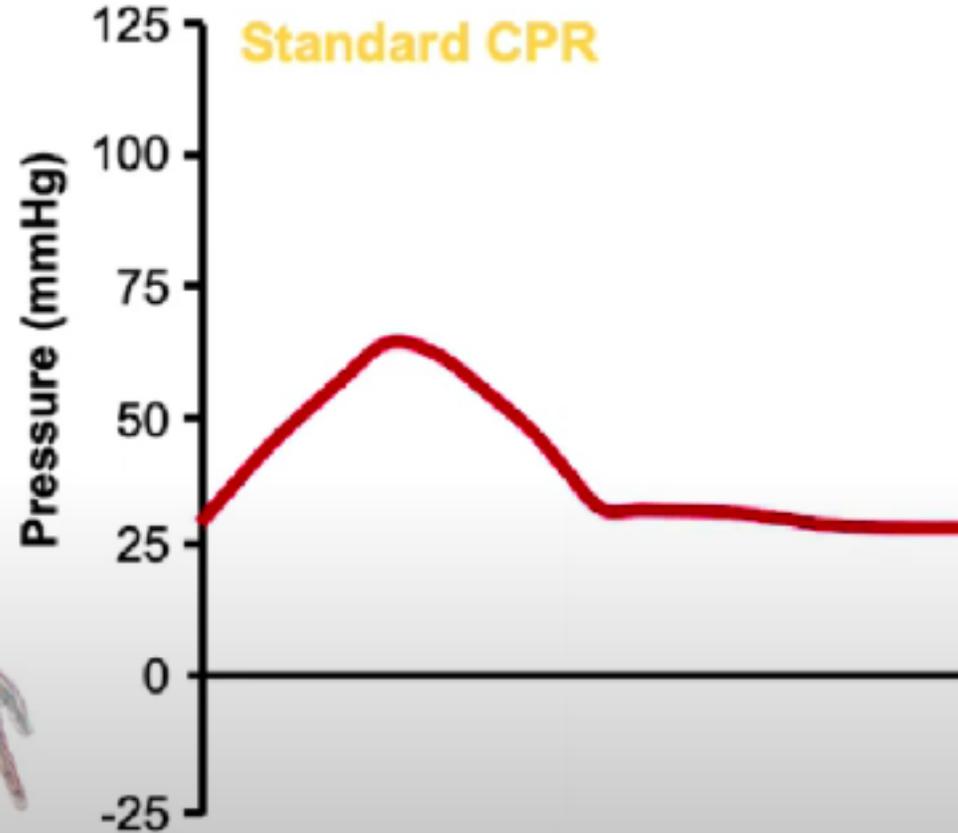
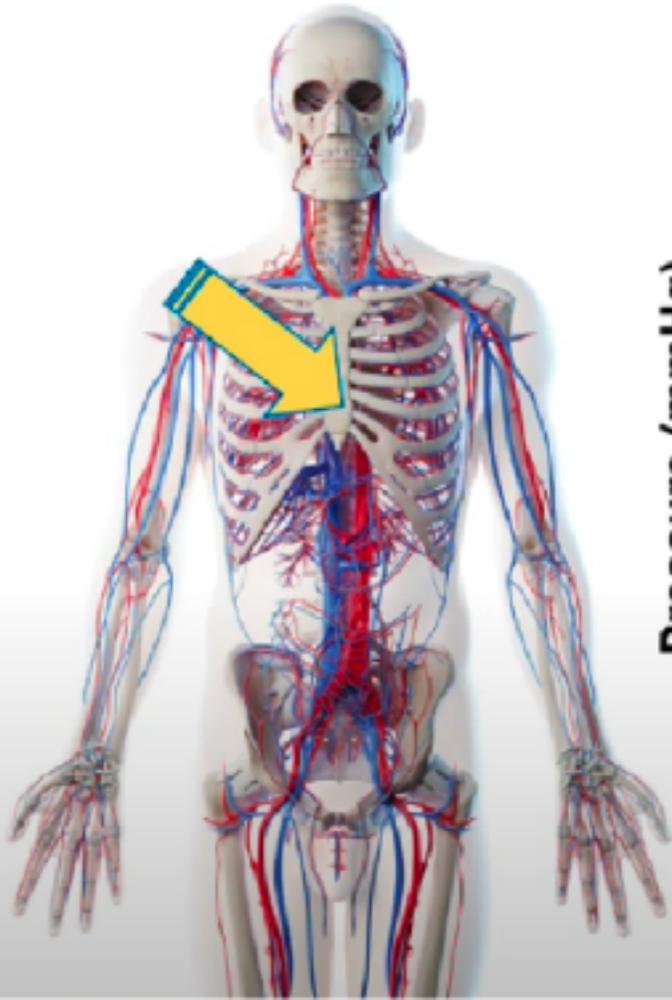


# IAC Physiology – Human



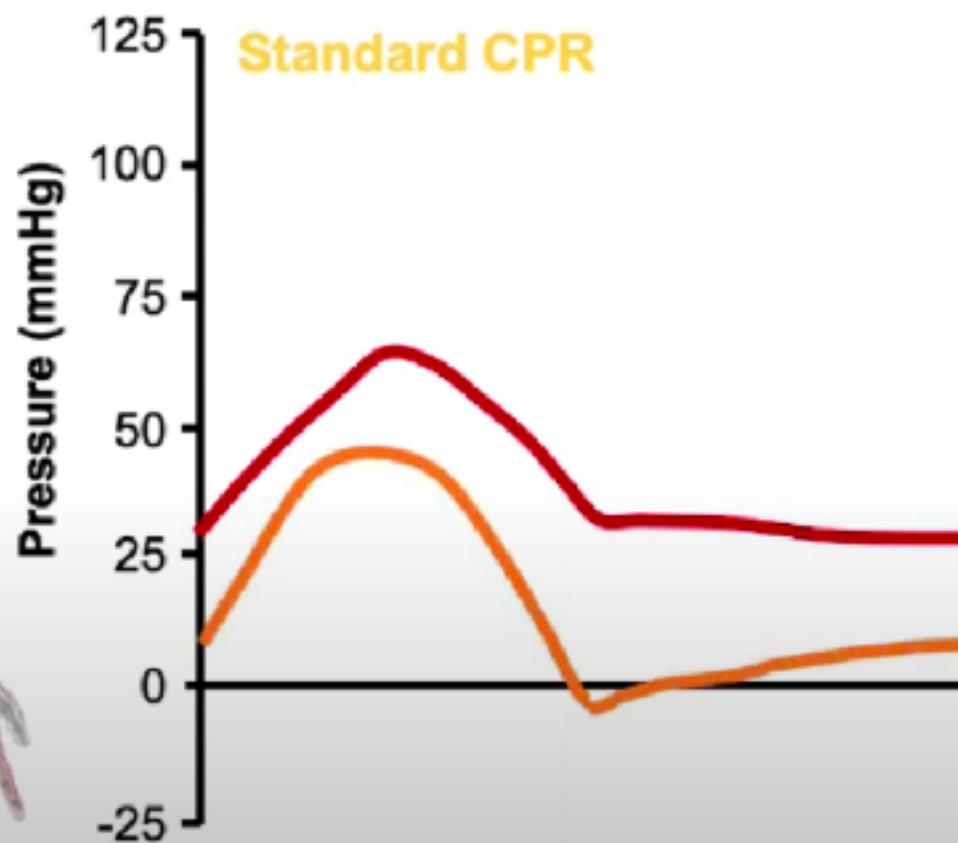
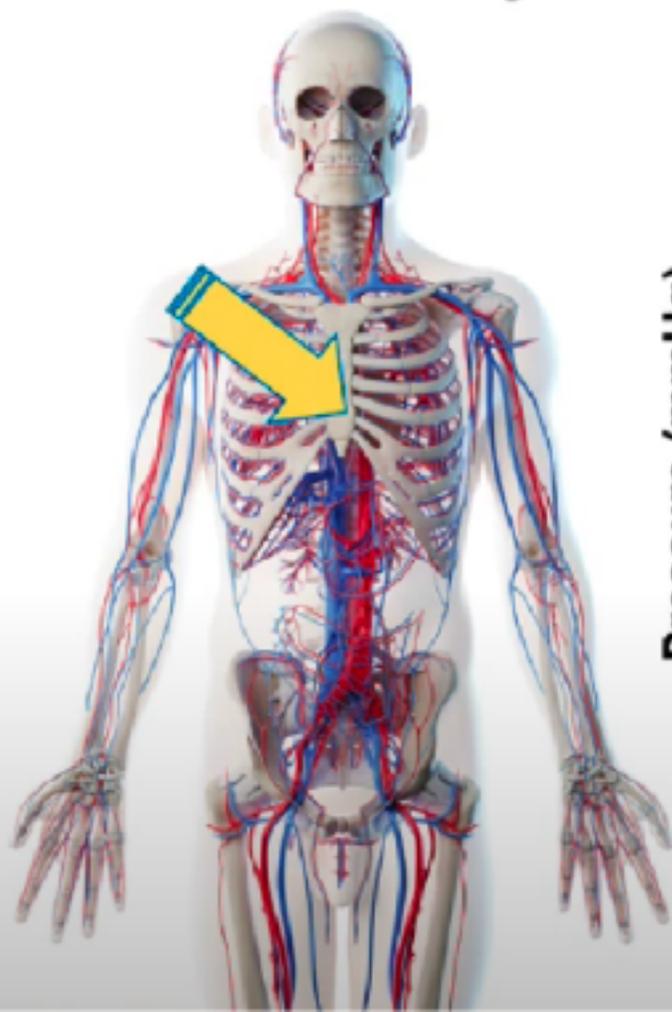
**Aortic Pressure**

# IAC Physiology – Human



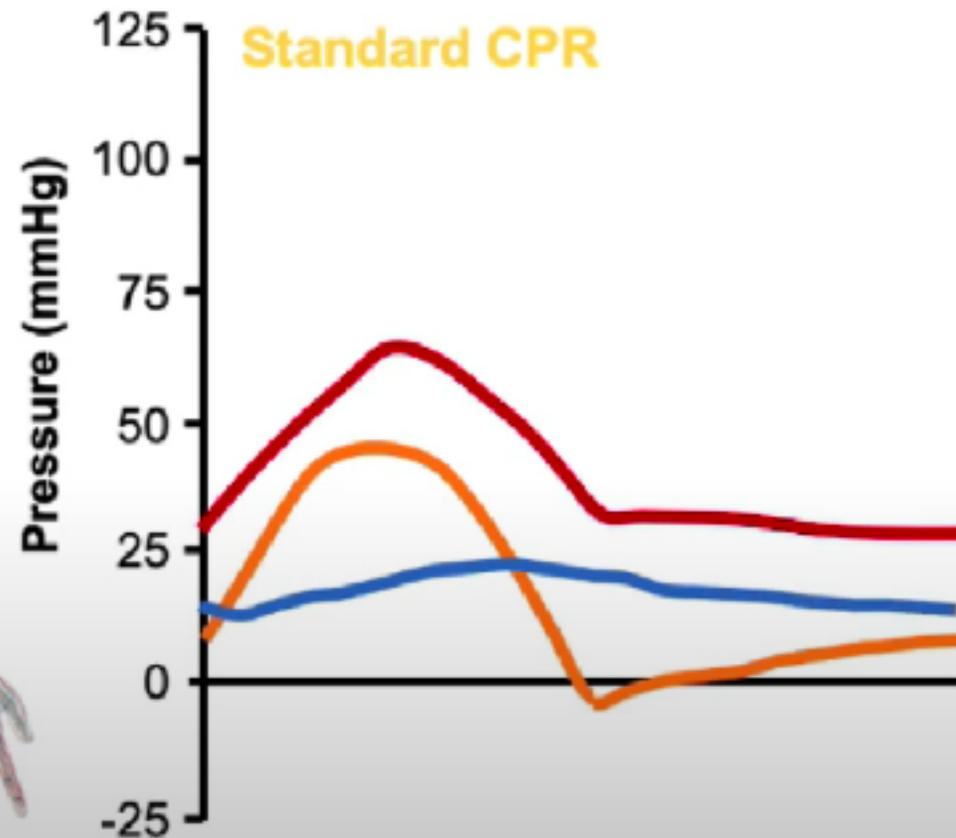
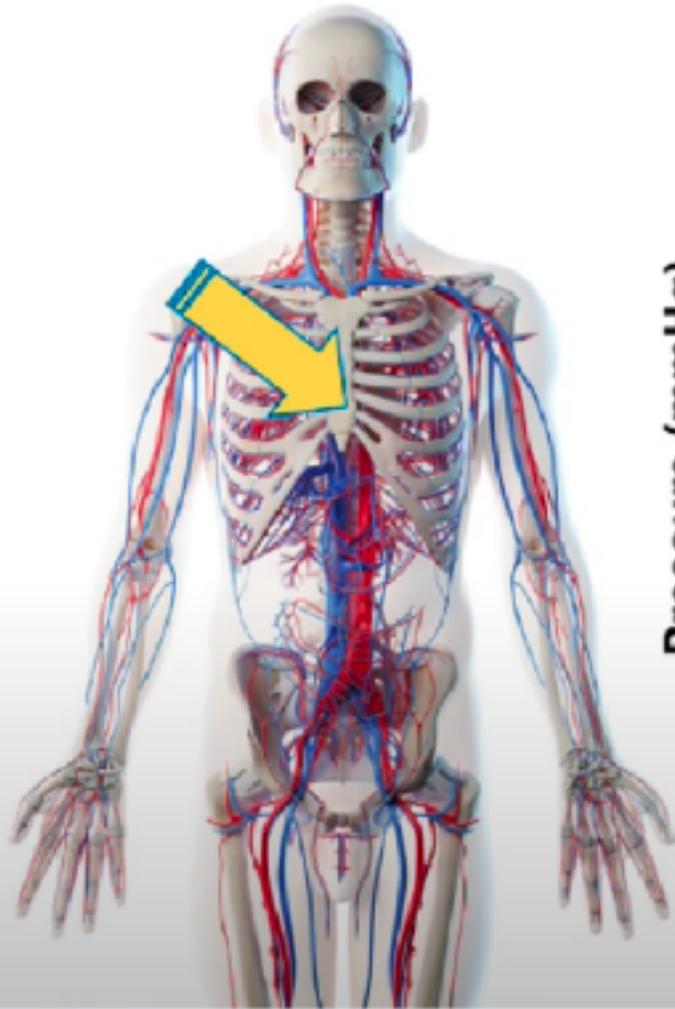
# IAC Physiology – Human

**Aortic Pressure**  
**Right Heart Pressure**



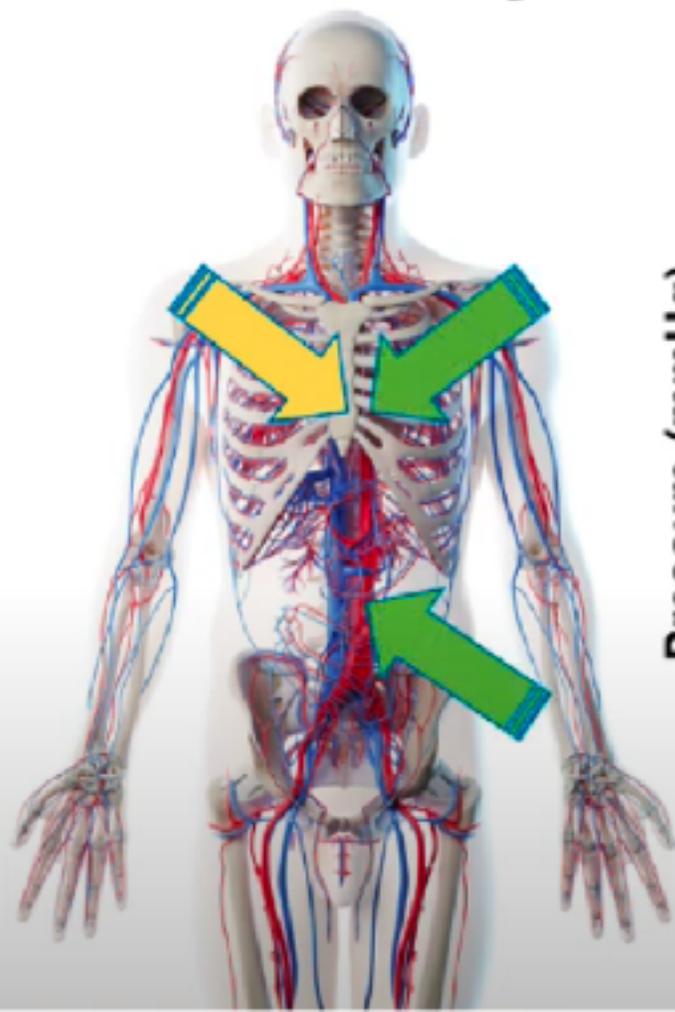
# IAC Physiology – Human

**Aortic Pressure**  
**Right Heart Pressure**  
**CVC Pressure**

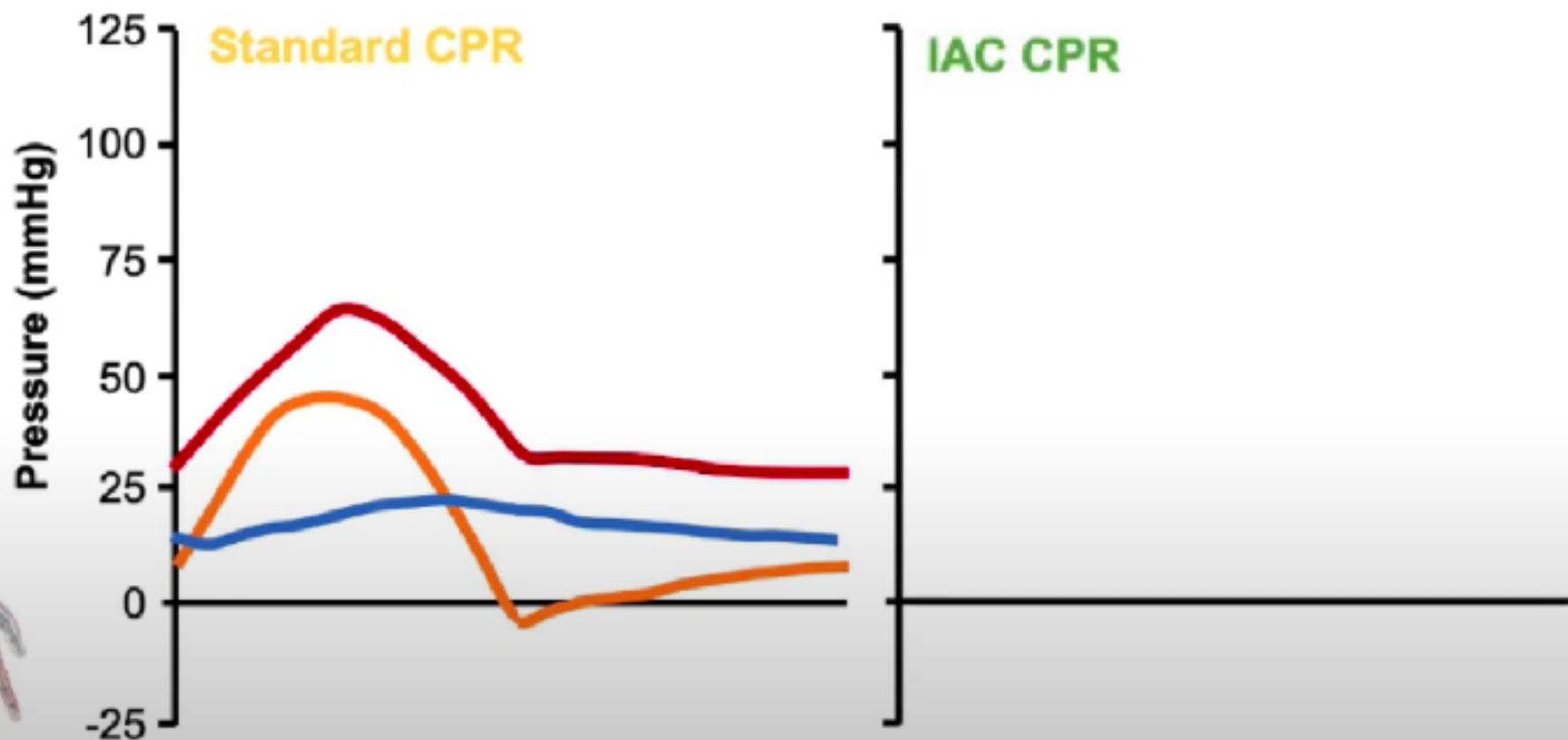


# IAC Physiology – Human

**Aortic Pressure**  
**Right Heart Pressure**  
**CVC Pressure**

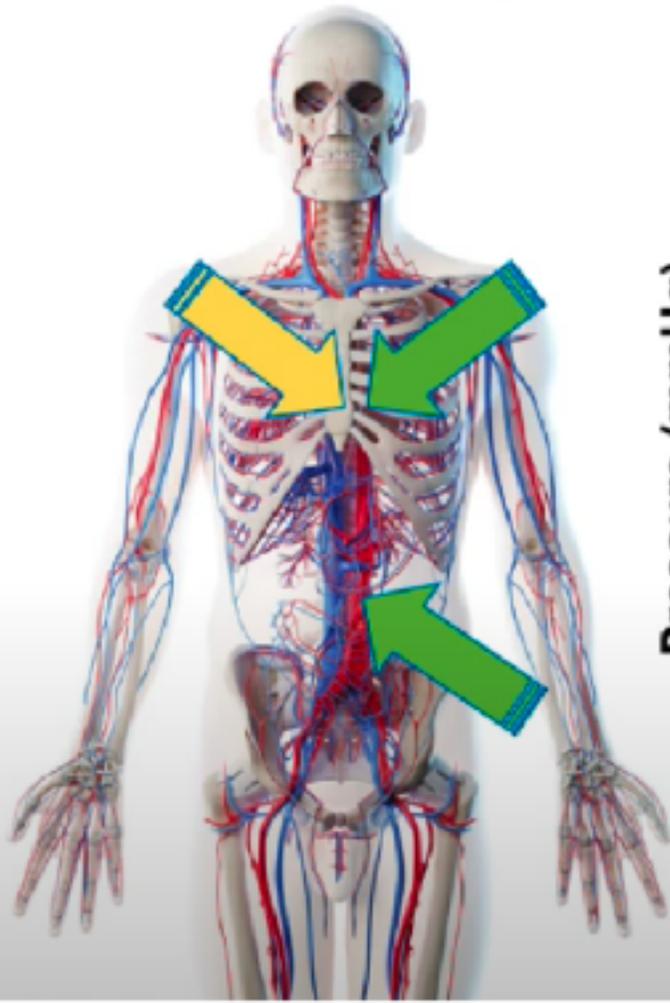


**Standard CPR**

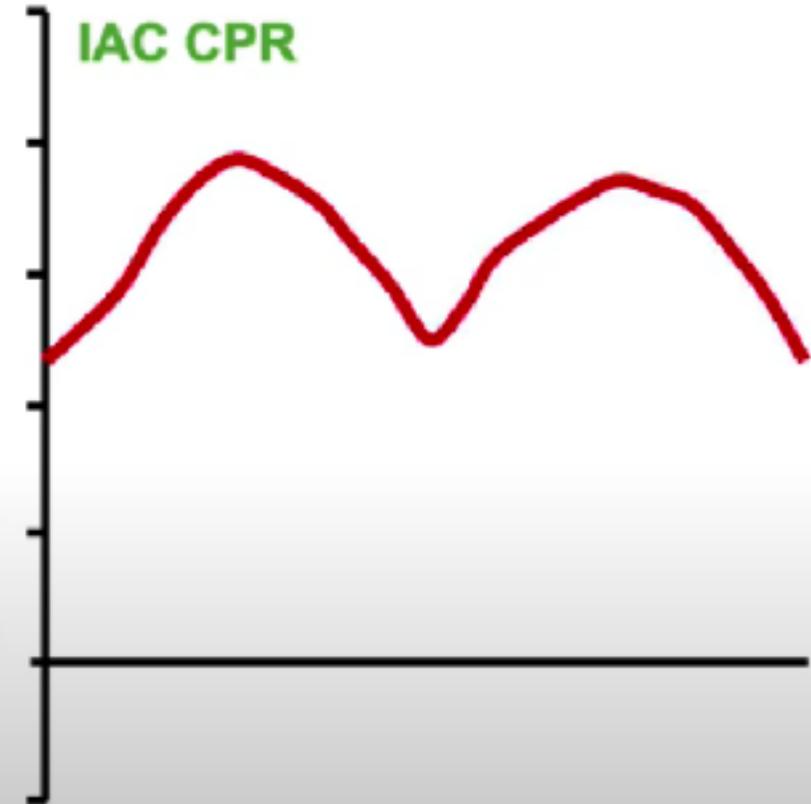
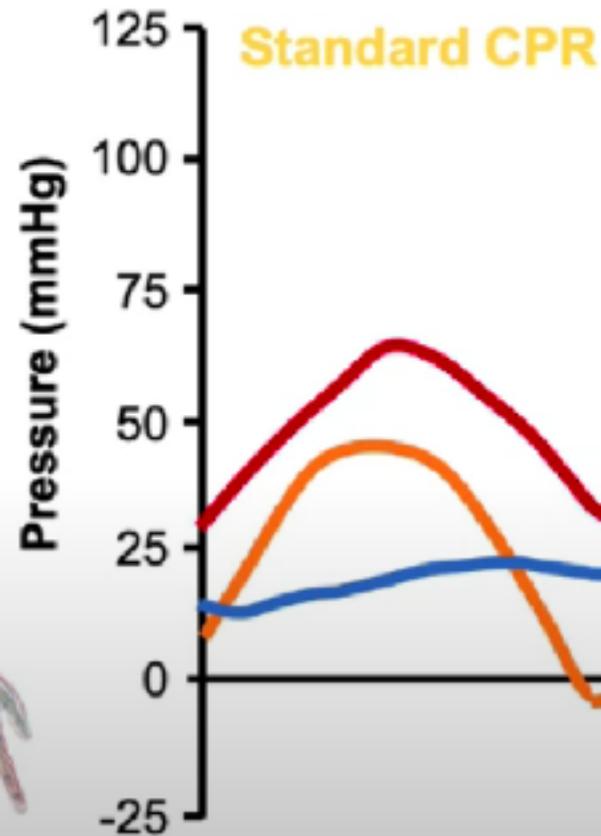


**IAC CPR**

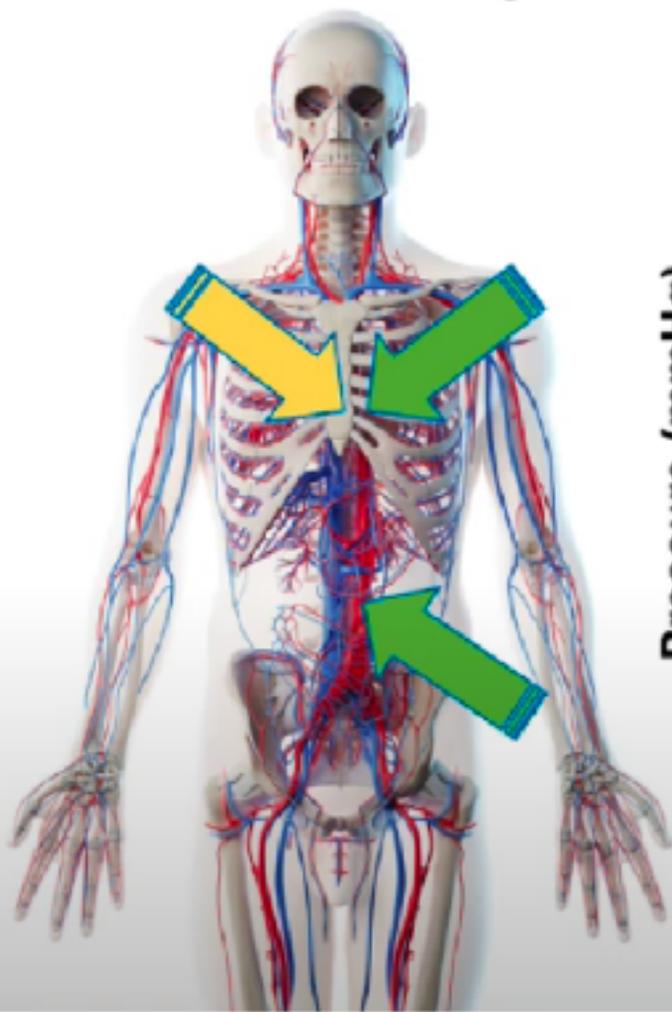
# IAC Physiology – Human



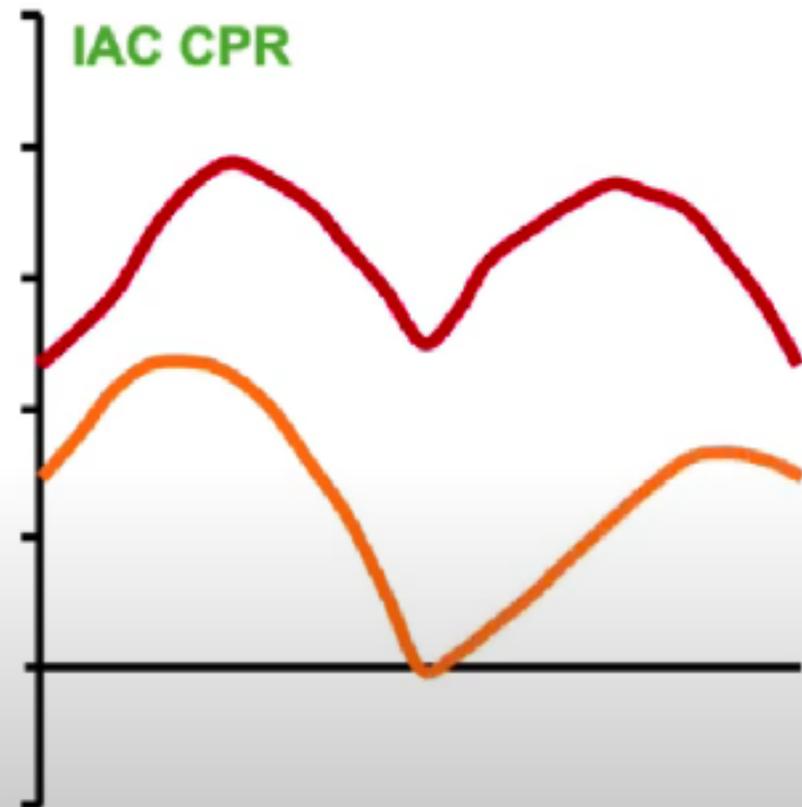
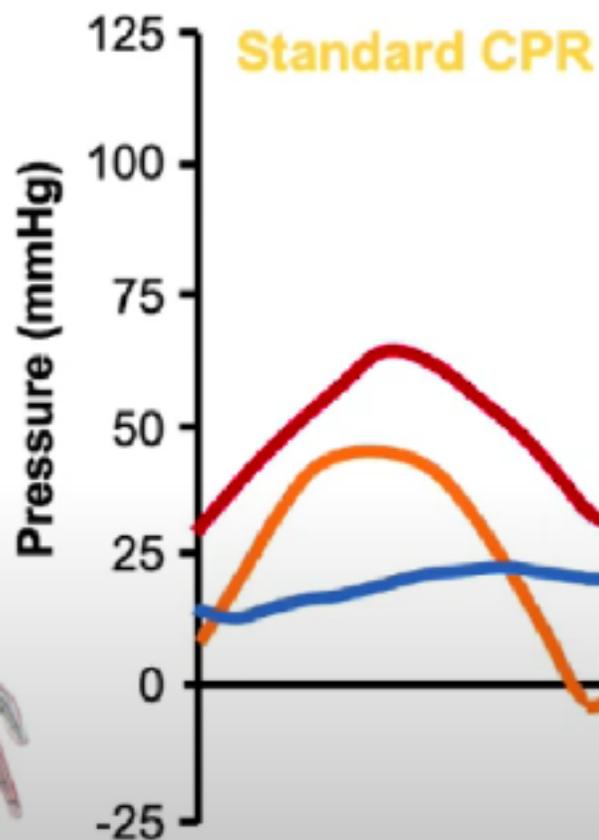
**Aortic Pressure**  
**Right Heart Pressure**  
**CVC Pressure**



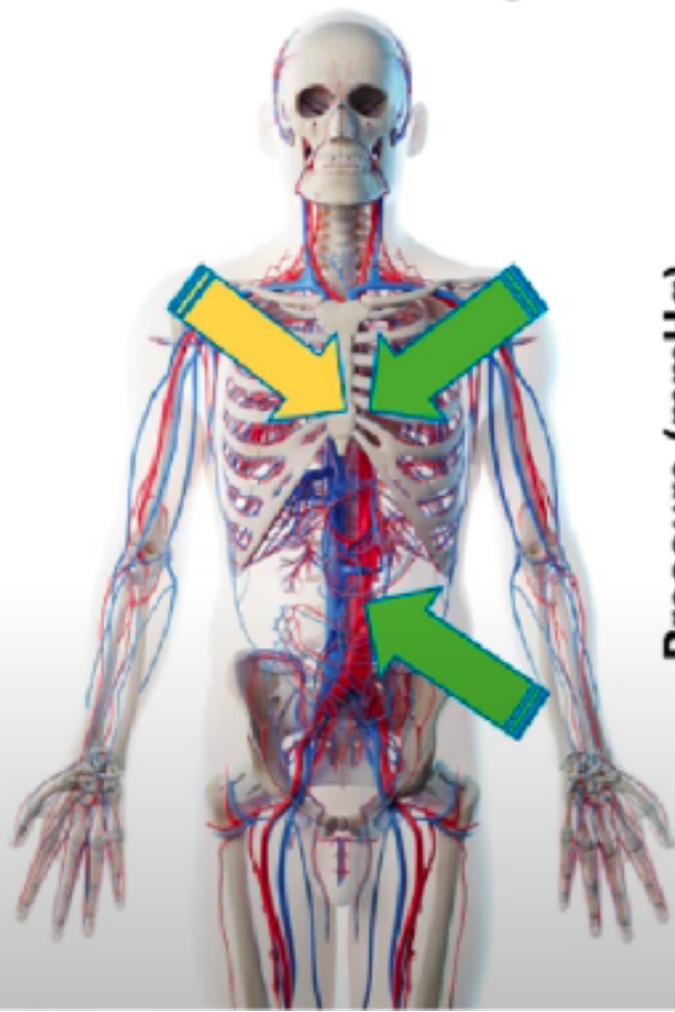
# IAC Physiology – Human



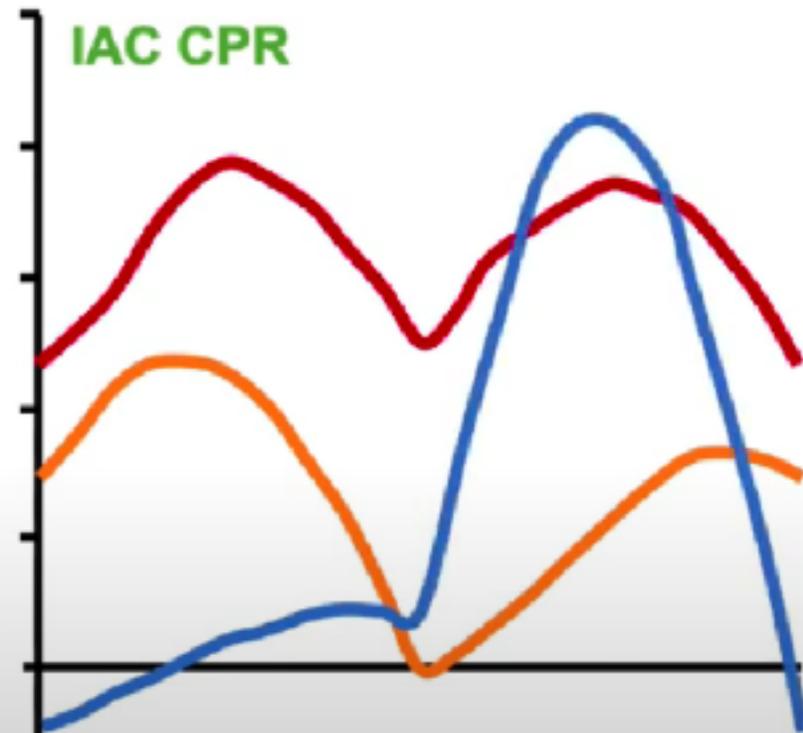
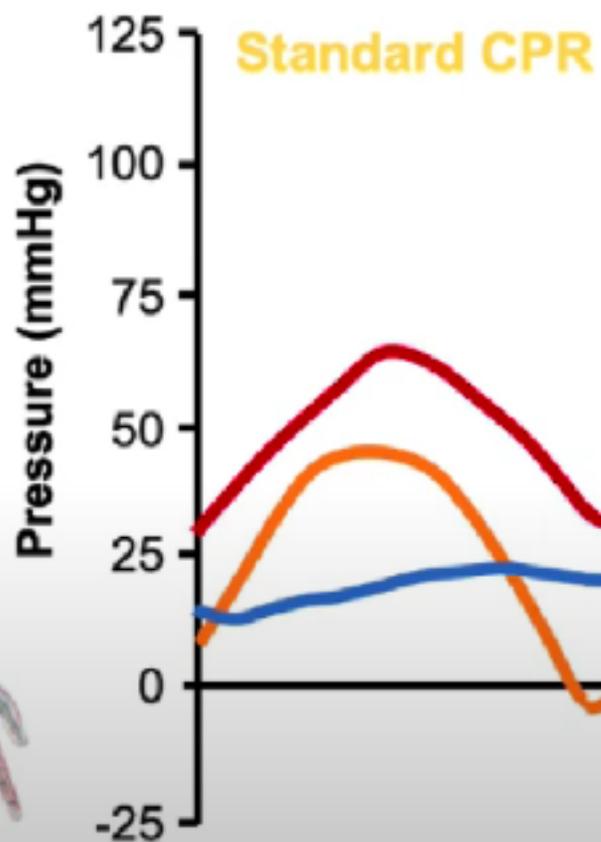
**Aortic Pressure**  
**Right Heart Pressure**  
**CVC Pressure**



# IAC Physiology – Human

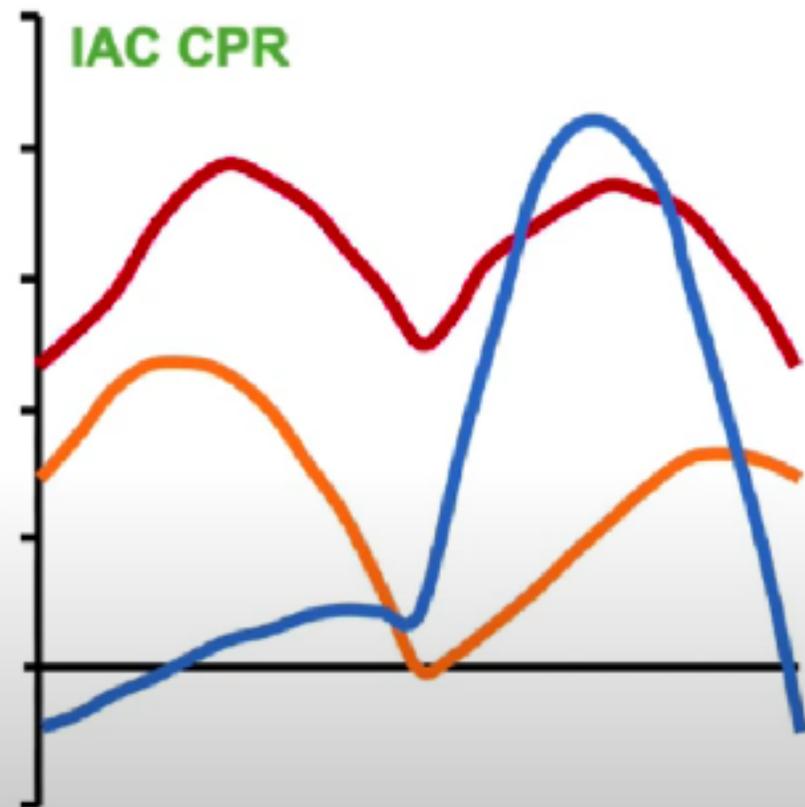
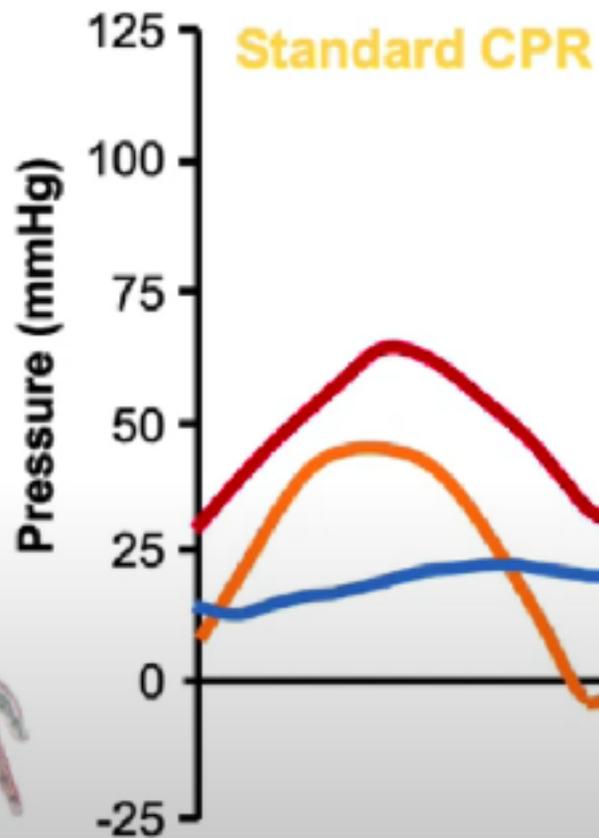
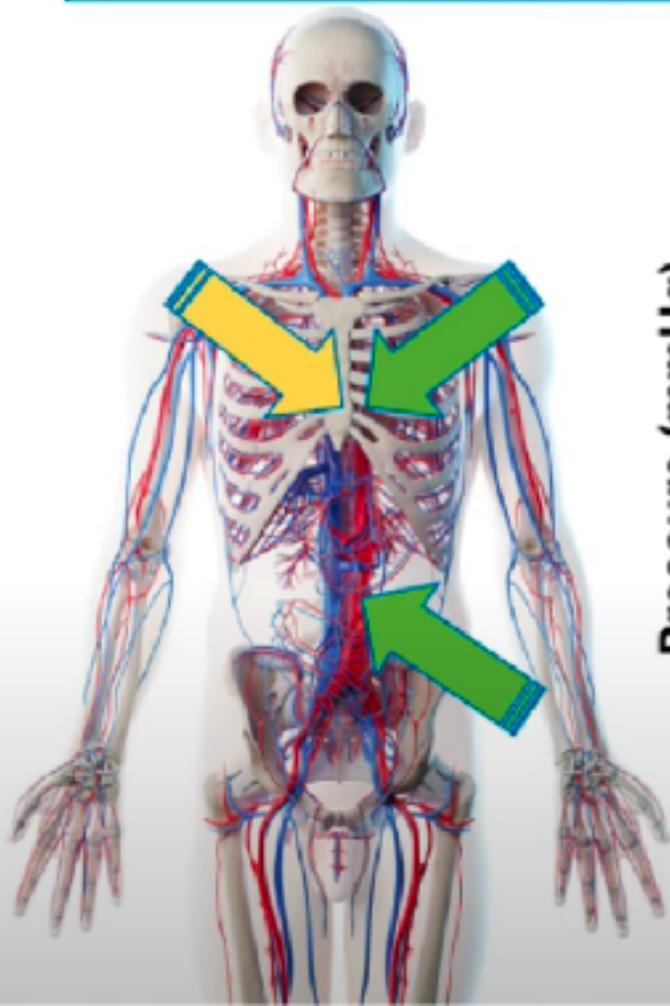


**Aortic Pressure**  
**Right Heart Pressure**  
**CVC Pressure**



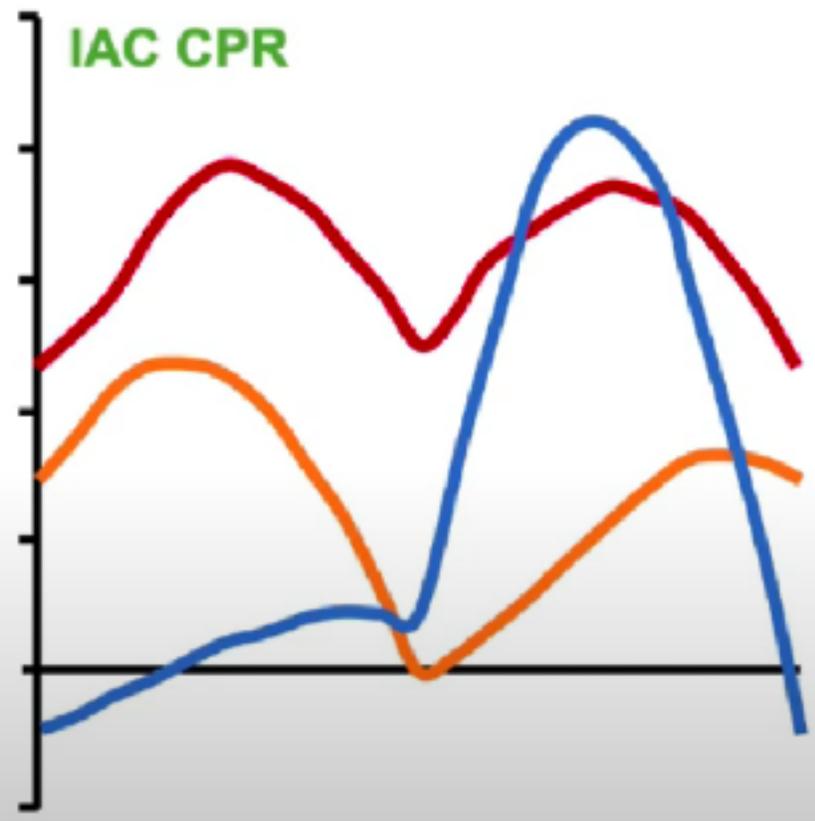
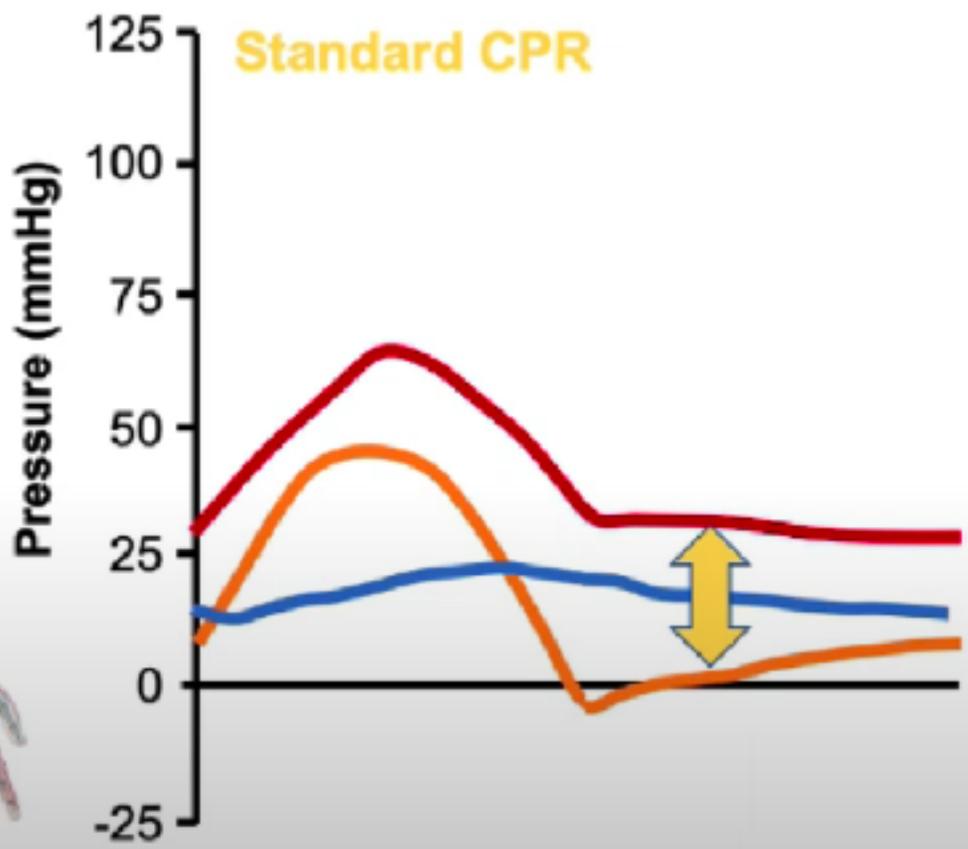
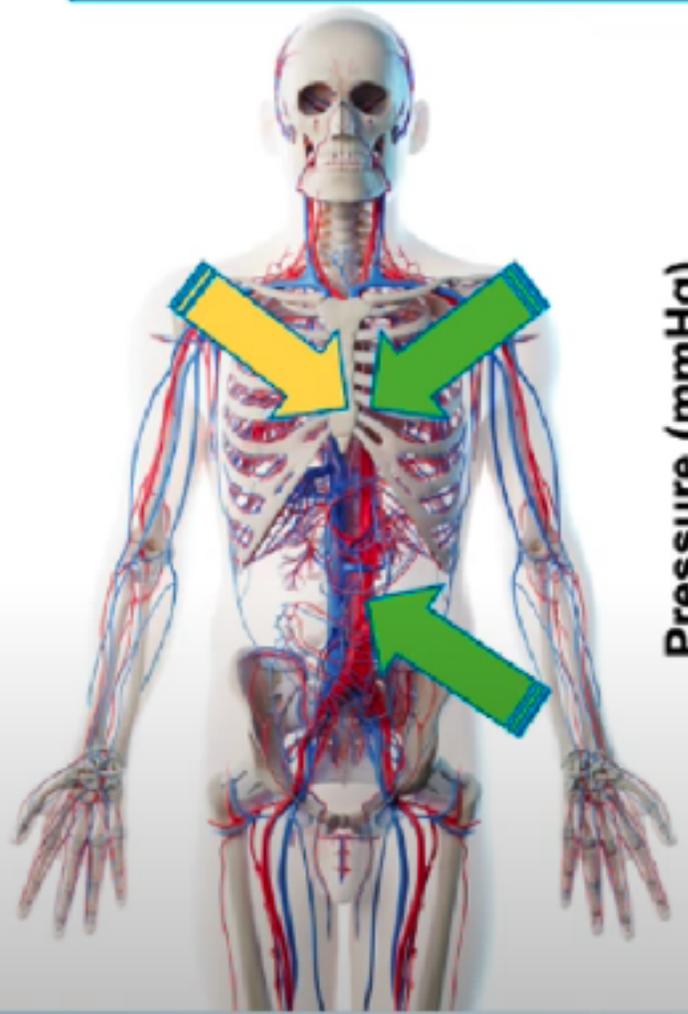
$$\text{CoPP} = P_{\text{ao-D}} - P_{\text{RA-D}}$$

**Aortic Pressure**  
**Right Heart Pressure**  
**CVC Pressure**

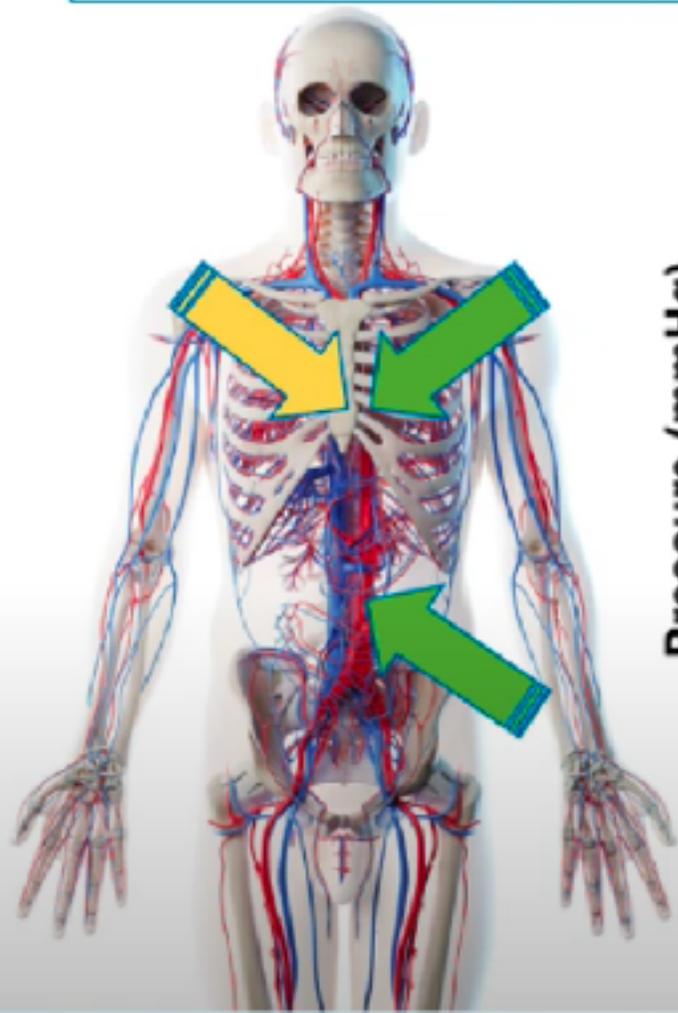


$$\text{CoPP} = P_{\text{ao-D}} - P_{\text{RA-D}}$$

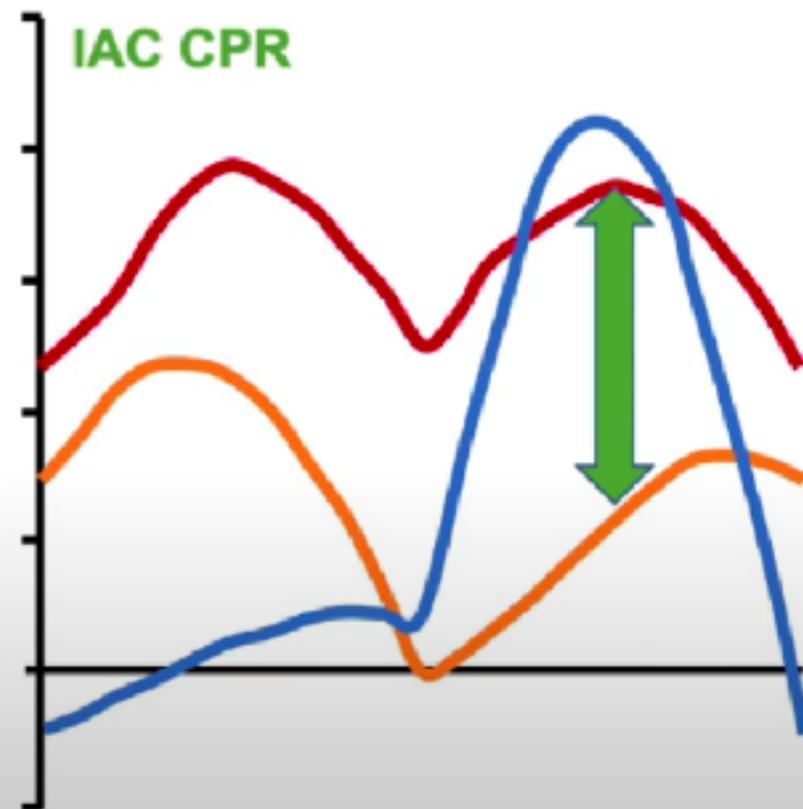
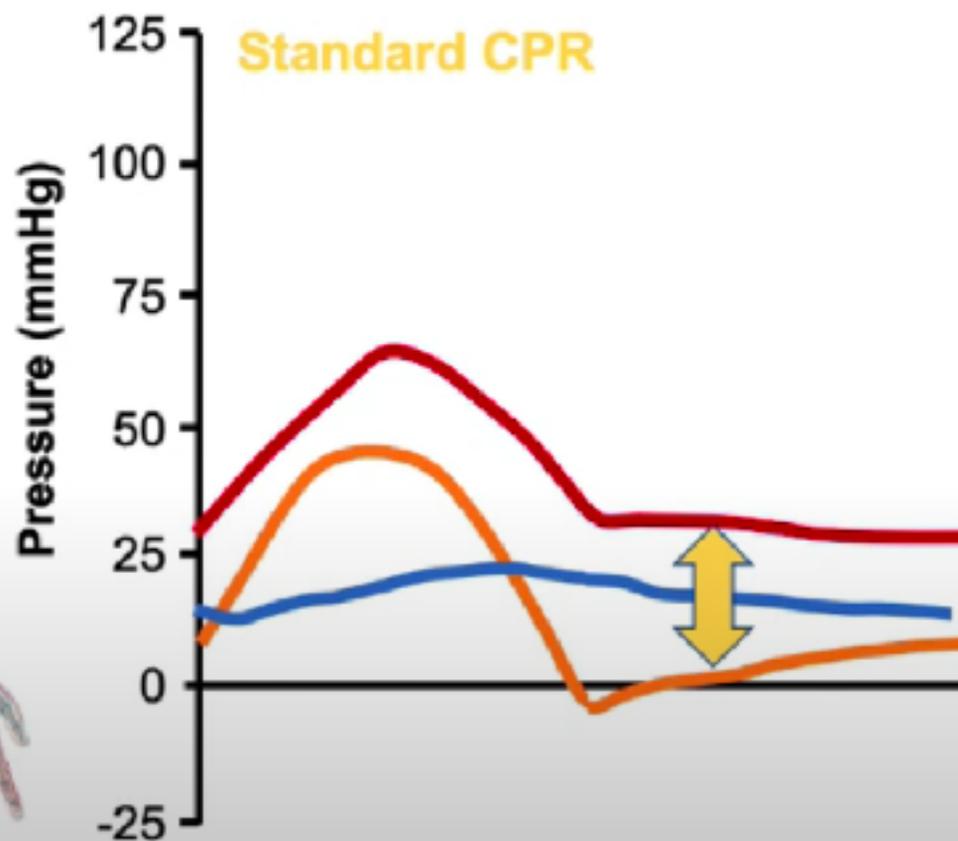
**Aortic Pressure**  
**Right Heart Pressure**  
**CVC Pressure**



$$\text{CoPP} = P_{\text{ao-D}} - P_{\text{RA-D}}$$



**Aortic Pressure**  
**Right Heart Pressure**  
**CVC Pressure**



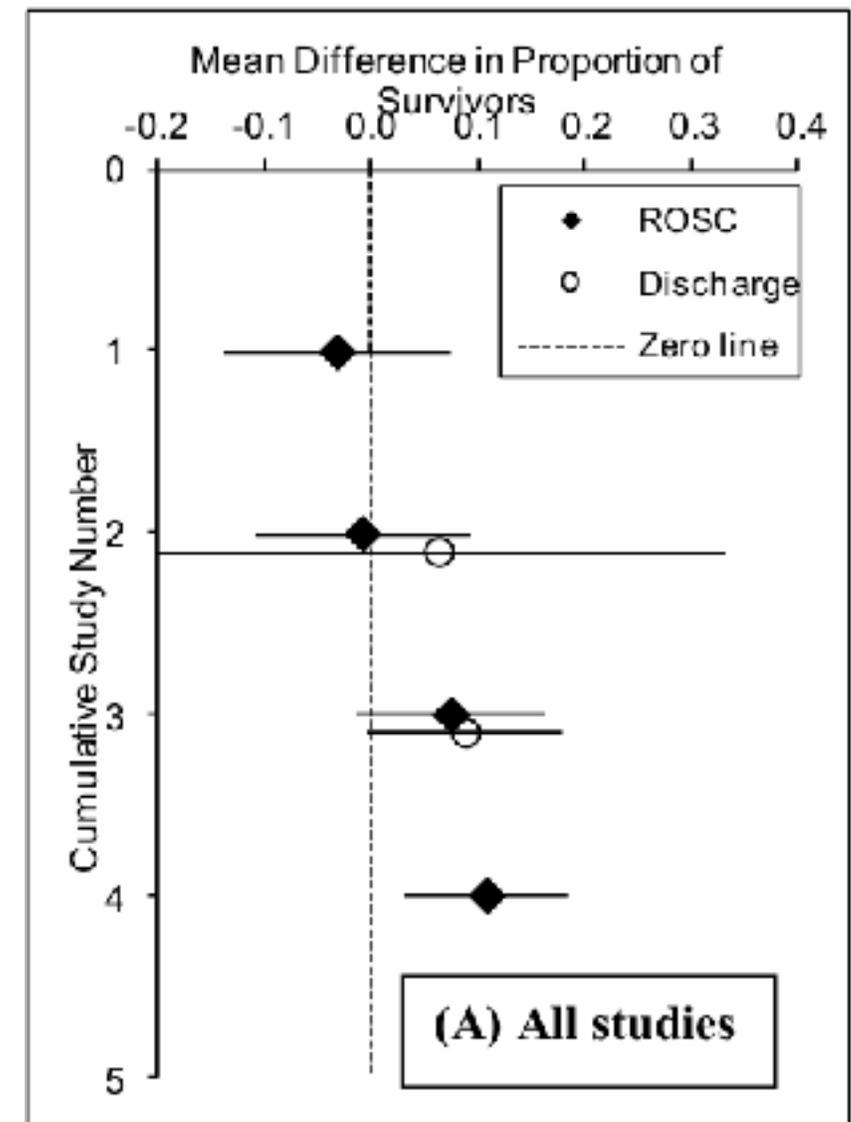
2003

## Interposed Abdominal Compression CPR: A Comprehensive Evidence Based Review

Charles F. Babbs

Purdue University, babbs@purdue.edu

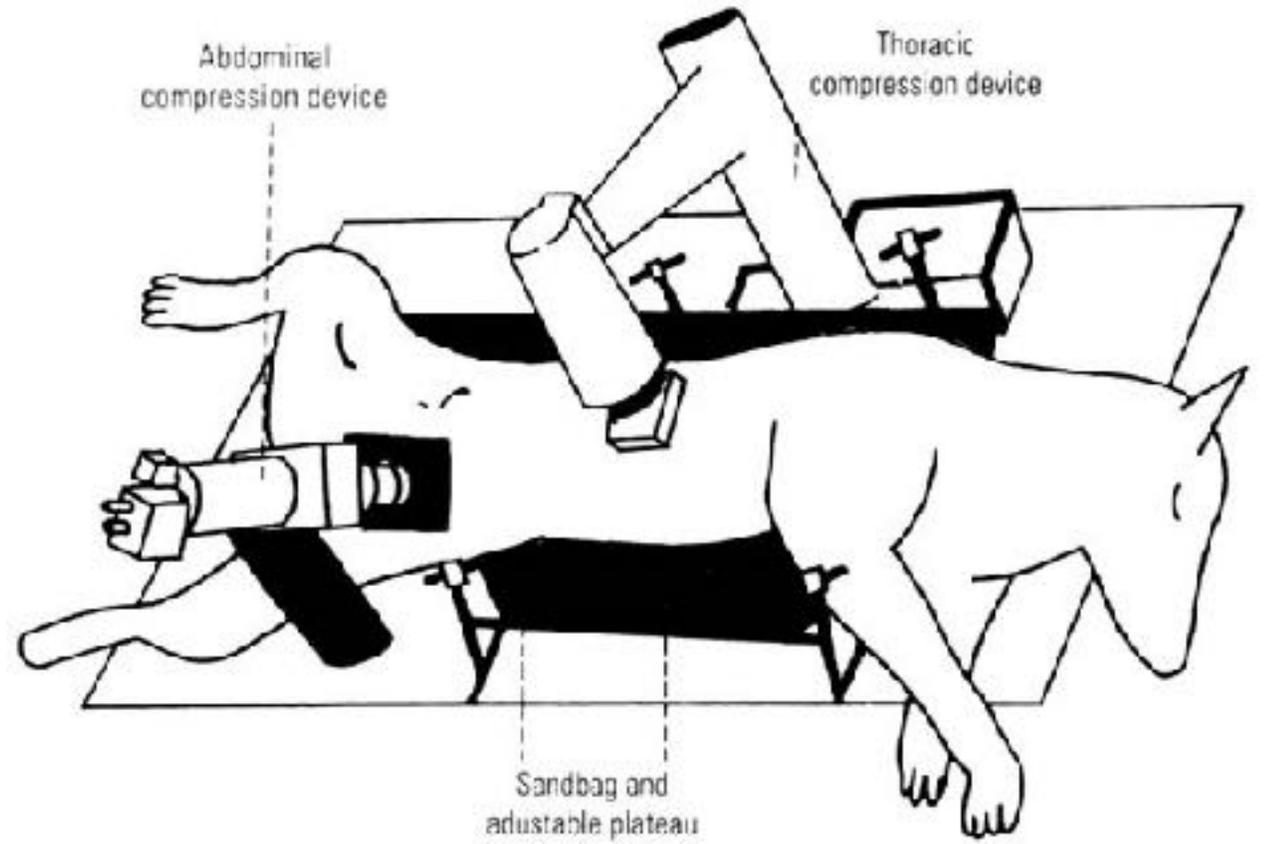
Outcome Measure	Studies	IAC-CPR	Standard CPR
Return of spontaneous circulation (ROSC) in or out-of-hospital	Mateer <sup>33</sup>	40/145 (28%)	45/146 (31%)
	Ward <sup>33</sup>	6/16 (38%)	3/17 (18%)
	Sack #1 <sup>1</sup>	29/48 (60%)	14/55 (25%)
	Sack#2 <sup>41</sup>	33/67 (49%)	21/76 (28%)
	All 4 studies	108/276 (39%)	83/294 (28%)
Return of spontaneous circulation (ROSC) after in-hospital resuscitation	Ward <sup>33</sup>	6/16 (38%)	3/17 (18%)
	Sack #1 <sup>1</sup>	29/48 (60%)	14/55 (25%)
	Sack#2 <sup>41</sup>	33/67 (49%)	21/76 (28%)
	All 3 studies	68/131 (52%)	38/148 (26%)
Survival to discharge, neurologically intact after in-hospital resuscitation	Ward <sup>33</sup>	1/16 (6%)	0/17 (0%)
	Sack #1 <sup>1</sup>	8/48 (17%)	3/55 (5%)
	Both studies	9/64 (14%)	3/72 (4%)



ROSC  $p < 0.05$

生存率は上昇傾向を示した

デモンストレーション



A pneumatic device performs abdominal compressions interposed between thoracic one.

# どのくらいの圧?



充填 約10mmHg



圧迫 100mmHgへ

# やる価値はあるの？

IACは血流と予後を改善できる

側腹部の圧迫は役に立たない

モニターにはBPカフと血圧計を用いる

練習と調整が必要

圧迫速度を落とさない

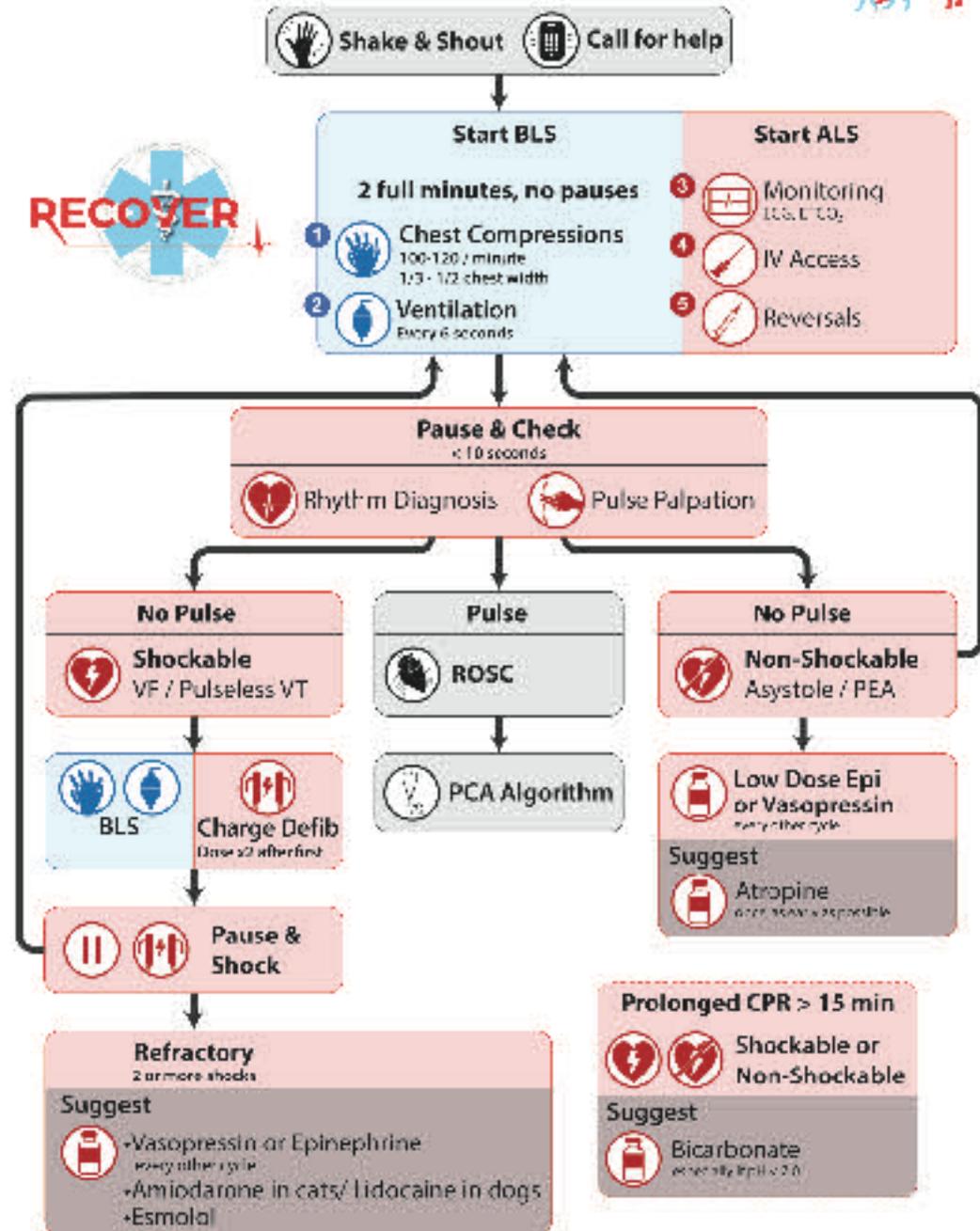


**Reassessment Campaign on  
Veterinary Resuscitation**

# ガイドラインのアップデート

- 認知補助アルゴリズムの設計
- 小動物向けの3つの圧迫技術
- 仰臥位での圧迫目標を浅めに (25%)
- 可能ならマスク + 酸素の使用を推奨
- ETCO<sub>2</sub> 目標値 ≥ 18 mmHg
- 脈あり + ETCO<sub>2</sub> ≥ 35 mmHg なら中断しても良い
- **高用量エピネフリンを使用しない**
- アトロピン? もし使用するなら、早め1回のみ
- 2回目の除細動は2倍のエネルギー量で
- 2回以上の除細動後もショック適応なら
  - 血管収縮薬 考慮
  - 抗不整脈薬 考慮
  - エスモロール 考慮

## CPR Algorithm for Dogs and Cats

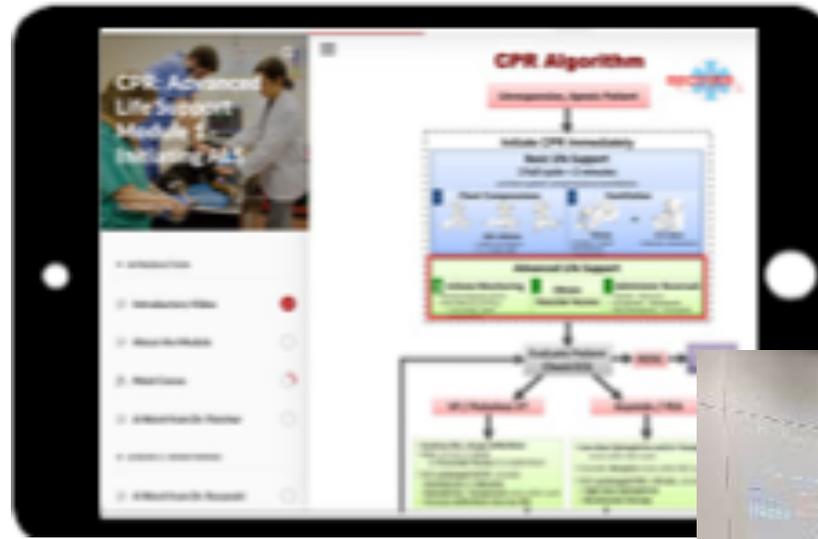


# CPR トレーニング

## 1. オンラインBLS & ALS

- ACVECC 認定
- VECCS 推奨
- 6時間のRACE 承認CE

## 2. 対面でのCPR救助者認定





RECOVER

Basic Life Support Skills Lab and Certification

Towarzystwo Polskie Towarzystwo Ratunkowe

Kenichiro Yagi, MS, RVT, VTS (ECC) (SAIM)

Email: [kenyagirvt@gmail.com](mailto:kenyagirvt@gmail.com)

# ご質問は？

