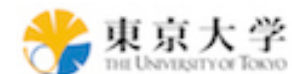


# ***Overview of my work in the field of resuscitation and Future Prospects***

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# 【Education】

March 24, 2016

**Ph.D.** in Surgery (Emergency Medicine)

Awarded from *the University of Tokyo* (JAPAN)

September 2016～

**Research Fellow**

Center for Resuscitation Science,  
Department of Emergency Medicine,  
Beth Israel Deaconess Medical Center,  
*Harvard Medical School* (USA)

# 【About my Dissertation】

The title of my dissertation work:

**“Risk factors and outcomes in out-of-hospital cardiac arrest: solutions for allocating medical resources”**

- comprised both “epidemiologic” and “clinical” studies
- focused on “medical futility” and “prognostication” for out-of-hospital cardiac arrest (OHCA).

# 【Background of my Dissertation work】

- In Japan, almost all OHCA patients are treated by EMS personnel and are transported to emergency hospitals according to the law, regardless of “age”, “physical status”, or “advanced directives”.
- After hospital arrival, they sometimes receive intensive, even excessive, and expensive advanced medical care.
- Nevertheless, the outcomes cannot be improved compared with those in other countries.

# 【Background of my Dissertation work】

- These ultimately futile procedures have become a major issue, because of the country's aging population and the resulting strain on medical resources.

In my dissertation work, I estimated unnecessary medical costs related to “in-hospital” resuscitation care, using national administrative inpatient claim data.



Clinical paper

Health care costs related to out-of-hospital cardiopulmonary arrest in Japan<sup>☆</sup>

Tatsuma Fukuda<sup>a</sup>, Hideo Yasunaga<sup>b,\*</sup>, Hiromasa Horiguchi<sup>b</sup>, Kazuhiko Ohe<sup>c</sup>,  
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Fukuda T, et al. ***Resuscitation*** 2013;84:964-9.

# 【Unnecessary medical costs】

Fukuda T, et al. *Resuscitation* 2013;84:964-9.

- **75.4%** of OHCA patients died **on the day of hospital arrival**  
with in-hospital medical costs of **\$ 1624 / patient.**
- **92.4%** of OHCA patients died **prior to hospital discharge**  
with in-hospital medical costs of **\$ 2220 / patient.**

Throughout Japan,  
the post hospital arrival medical costs alone were estimated at  
**\$ 153 million / year** for patients **who died on the day of arrival**, and  
**\$ 256 million / year** for patients **who die prior to discharge.**

# 【About Dissertation work】

To avoid such waste,  
I tried to identify risk factors which indicate resuscitation efforts would result in futile care, using another national OHCA registry data.

## 1. Predictors of good and poor prognosis in unwitnessed non-shockable OHCA.



Predictors of favorable and poor prognosis in unwitnessed out-of-hospital cardiac arrest with a non-shockable initial rhythm

Tatsuma Fukuda \*, Takehiro Matsubara, Kent Doi, Naoko Fukuda-Ohashi, Naoki Yahagi



Fukuda T, et al. *Int J Cardiol* 2014;176:910-5.

Predictors: “<65 years”, “conversion to VF/VT”, “prehospital ROSC”.

If unwitnessed non-shockable OHCA patient

- has all these factors, resuscitation efforts may be futile,
- doesn't have any of these factors, maximum efforts should be provided.

# 【About Dissertation work】

## 2. Importance of initial rhythm in determination of medical futility in non-shockable OHCA.

European Journal of Internal Medicine 30 (2016) 61–67

Contents lists available at ScienceDirect

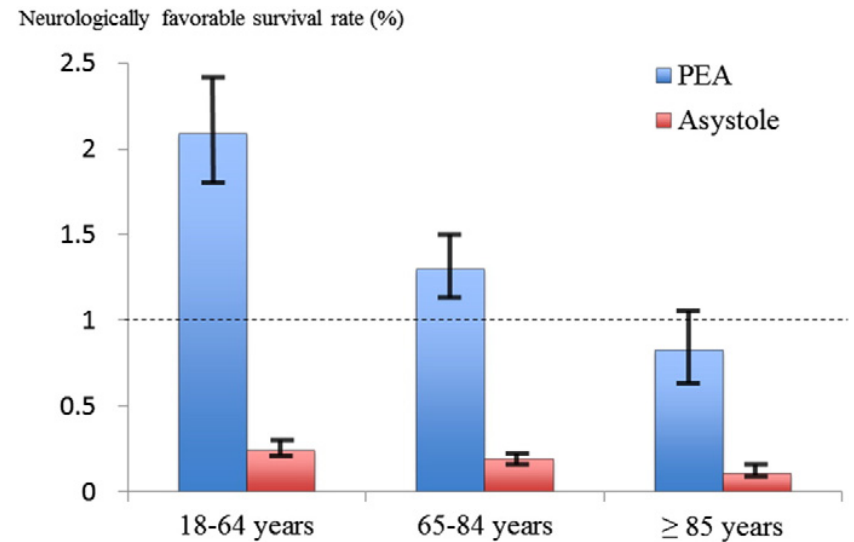

European Journal of Internal Medicine

journal homepage: [www.elsevier.com/locate/ejim](http://www.elsevier.com/locate/ejim)

Original Article

Association of initial rhythm with neurologically favorable survival in non-shockable out-of-hospital cardiac arrest without a bystander witness or bystander cardiopulmonary resuscitation☆☆☆

Tatsuma Fukuda\*, Naoko Ohashi-Fukuda, Takehiro Matsubara, Kent Doi, Yoichi Kitsuta, Susumu Nakajima, Naoki Yahagi



Fukuda T, et al. *Eur Intern Med* 2016;30:61-7.

From the perspective of quantitative medical futility, PEA and Asystole should not be considered to be identical to non-shockable rhythm, but rather should be clearly distinguished from each other.



# 【About Dissertation work】

I also conducted some clinical studies, by collecting data in my facility.

## 1. Validation of prehospital TOR (termination of resuscitation) rule in Tokyo.

American Journal of Emergency Medicine 32 (2014) 144-149



Contents lists available at ScienceDirect

American Journal of Emergency Medicine

journal homepage: [www.elsevier.com/locate/ajem](http://www.elsevier.com/locate/ajem)



Original Contribution

Applicability of the prehospital termination of resuscitation rule in an area dense with hospitals in Tokyo: a single-center, retrospective, observational study ☆☆☆★☆☆

Is the pre hospital TOR rule applicable in Tokyo?

Tatsuma Fukuda, MD\*, Naoko Ohashi, MD, Takehiro Matsubara, MD, PhD, Kent Doi, MD, PhD, Masataka Gunshin, MD, Takeshi Ishii, MD, Yoichi Kitsuta, MD, PhD, Susumu Nakajima, MD, PhD, Naoki Yahagi, MD, PhD

	No ROSC	ROSC	Death	Survival
Prehospital TOR rule positive	93	15	107	1
Prehospital TOR rule negative	51	30	72	9
The rate of the good outcomes (ROSC, survival, favorable neurologic outcome) despite the prehospital TOR rule positive	13.9 (9.3-19.2)		0.9 (0.2-3.7)	
Sensitivity, % (95%CI)	64.6 (60.6-68.0)		59.8 (58.1-60.2)	
Specificity, % (95%CI)	66.7 (54.0-77.6)		90.0 (60.5-98.2)	
PPV, % (95%CI)	86.1 (80.8-90.7)		99.1 (96.3-99.8)	
NPV, % (95%CI)	37.0 (30.0-43.1)		11.1 (7.5-12.1)	

Fukuda T, et al. ***Am J Emerg Med*** 2014;32:144-9.

This study suggested that the prehospital TOR rule could predict death with high accuracy, even in an area dense with hospitals in Tokyo.

The prehospital TOR rule may be helpful for identifying the OHCA patients for whom resuscitation efforts would be fruitless.

# 【About Dissertation work】

## 2. Cerebral oxygenation can predict futility of resuscitation care?

American Journal of Emergency Medicine 32 (2014) 747–751



Original Contribution

Application of cerebral oxygen saturation to prediction of the futility of resuscitation for out-of-hospital cardiopulmonary arrest patients: a single-center, prospective, observational study☆☆☆★



Can cerebral regional oxygen saturation predict the futility of CPR?

Tatsuma Fukuda, MD\*, Naoko Ohashi, MD, Masahiro Nishida, MD, Masataka Gunshin, MD, Kent Doi, MD, PhD, Takehiro Matsubara, MD, PhD, Susumu Nakajima, MD, PhD, Naoki Yahagi, MD, PhD

**Fukuda T, et al. *Am J Emerg Med* 2014;32:747-51.**

	Cutoff	AUC (95% CI)	P	Sensitivity (95% CI)	Specificity (95% CI)	PPV (95% CI)
Cerebral oxygen saturation						
Initial lower cerebral rSO <sub>2</sub>	26.0%	0.714 (0.535-0.844)	.0033	88.7% (82.8-93.4)	56.3% (36.9-71.9)	87.0% (81.3-91.7)
Initial higher cerebral rSO <sub>2</sub>	28.0%	0.650 (0.488-0.784)	.1788	73.6% (67.3-78.8)	62.5% (41.6-79.8)	86.7% (79.2-92.8)
Initial average cerebral rSO <sub>2</sub>	23.0%	0.677 (0.506-0.811)	.0235	71.7% (65.4-79.9)	62.5% (41.5-79.9)	86.4% (78.7-92.7)
Blood pH	6.886	0.620 (0.459-0.759)	.1687	66.0% (59.6-70.9)	68.8% (47.4-84.9)	87.5% (79.0-93.9)
Lactate	8.2 mmol/L	0.627 (0.436-0.786)	.1081	92.5% (87.5-96.5)	37.5% (21.0-51.1)	83.1% (78.6-86.7)

Initial lower cerebral rSO<sub>2</sub> (just after arrival at the hospital) is significantly associated with non-ROSC.

But, an initially lower cerebral rSO<sub>2</sub> alone does not result in a diagnosis performance that is sufficient for judging the futility of resuscitation.

# 【*Future Prospects*】

These studies identified certain factors correlated with poor prognosis, but we have yet to achieve a diagnostic accuracy that is sufficient for evaluating medical futility for all OHCA patients.

In the future study,  
I plan to establish an accurate prediction rule for futile resuscitation, by combining **physiologic factors** (e.g., cerebral rSO<sub>2</sub>, blood gas) and **non-physiologic factors** (e.g., witness, initial rhythm, age, downtime).

# 【Other epidemiologic studies】

Apart from my Dissertation work,  
I have undertaken some epidemiologic studies,  
to investigate the detailed characteristics of OHCA.

[1] Association of season (or ambient temperature)  
with outcomes of OHCA.

Fukuda T, et al. *J Crit Care* 2014;29:840-7.

[2] Association of the number of emergency physicians  
with outcomes of OHCA.

Fukuda T, et al. *J Emerg Med* 2015;48:e81-92.

[3] Epidemiology of stroke-related OHCA.

Fukuda T, et al. *Medicine (Baltimore)* 2016;95:e3107.

[4] Temporal trends in outcomes of OHCA.

Fukuda T, et al. *Medicine (Baltimore)* 2015;94:e2049.

# 【Practices improving patient outcomes】

In addition, I have also undertaken research that focused on prehospital resuscitation care to determine optimal CPR practices.

(1) Effect of **rescue breathing** in **respiratory** OHCA.

Fukuda T, et al. *Intern Emerg Med* 2016 In Press.

(2) Effect of **advanced airway management** in **respiratory** OHCA.

Fukuda T, et al. *Heart Lung Circ* 2015;24:241-9.

(3) Effect of **prehospital epinephrine** in **adult** OHCA.

Fukuda T, et al. *Eur J Clin Pharmacol* 2016;72:1255-64.

(4) Effect of **compression-only CPR** in **pediatric** OHCA.

Fukuda T, et al. *Circulation* 2016 In Press.

# 【About my greatest achievement】



Circulation

Manuscript Submission and Peer Review System

Title: Conventional versus compression-only versus no bystander cardiopulmonary resuscitation for pediatric out-of-hospital cardiac arrest

Manuscript number: CIRCULATIONAHA/2016/023831R3

Fukuda T, et al. *Circulation* 2016 In Press

## 【Backgrounds】

In children, great emphasis has been placed on rescue breathing, due to the background of predominantly respiratory OHCA (both physiologically and epidemiologically).

There are no RCTs comparing conventional vs. compression-only CPR in pediatric OHCA.

Only one large-scale observational study from Japan examined that.

(Lancet 2010;375:1347-54.)

# 【About my greatest achievement】

The findings of that study supported the idea that conventional CPR is better than compression-only CPR for pediatric non-cardiac OHCA.

In addition, that study also indicated that the neurological outcomes are comparable in both no CPR and compression-only CPR groups.

no CPR: 1.5%, compression-only CPR: 1.6%, conventional CPR: 7.2%

(Lancet 2010;375:1347-54.)

However, I had some concerns about these findings, because that study involved patients with OHCA **prior to 2010**.

# 【Compression-only CPR in pediatric OHCA】

April 2008:

AHA published a statement on the compression-only CPR technique.

October 2010:

In the 2010 international CPR guidelines update, compression-only CPR was given as a treatment option.

→

Compression-only CPR was not yet sufficiently widespread during that study period; compression-only CPR may have been performed by individuals who lacked adequate training for CPR.



# 【Compression-only CPR in pediatric OHCA】

We conducted a study on the effect of compression-only CPR, using national OHCA registry data between 2011 and 2012.



There were no significant differences in neurologically intact survival between conventional CPR group and compression-only CPR group, after adjusting for potential confounders:

Multivariable logistic regression modeling: OR 1.52 (95% CI 0.93-2.49)

Propensity score matching: OR 1.20 (95% CI 0.81-1.77)

Both conventional and compression-only CPR were associated with higher rates of neurologically intact survival, compared with no CPR.

Conventional vs no CPR: OR 5.01 (95% CI 2.98-8.57)

Compression-only vs no CPR: OR 3.29 (95% CI 1.93-5.71)

# 【Clinical implications】

- These data suggest that compression-only bystander CPR may be life-saving in children, as well as adults.
- These findings would encourage the dissemination of compression-only CPR in pediatric OHCA.
- This may lead to further improvement of the implementation rates of bystander CPR, which may result in further improvement of treatment outcomes for pediatric OHCA.

# 【*Future Prospects*】

It was uncertain why compression-only CPR is as effective as conventional CPR in pediatric OHCA.

There may be some reasons:

- The adverse effects of interrupting the chest compressions may be critical.
- Passive oxygenation during compression-only CPR may be sufficient.

In the future study,

I plan to measure cerebral rSO<sub>2</sub> during conventional and compression-only CPR, to verify the difference in cerebral perfusion (or oxygenation) between conventional and compression-only CPR.

Such study may scientifically enforce our findings that compression-only CPR is as effective as conventional CPR even in children.