心臓外科学を歩んで

名古屋大学大学院　心臓外科

碓氷章彦

講義の内容

- 心臓外科学とは
- 新規技術の普及：The “S” curve theory
- 本邦の心臓外科手術数推移：The “S” curve theoryの検証
- 名大心臓外科教室の心臓外科学への貢献
- 私の歩んだ道

心臓外科学の発展プロセス

日本学術振興会　専門研究員　2017-2019

AS　自然歴　症候 / 生存率 ➡ 問題点の抽出

AVR　新規技術　早期成績 / 遠隔成績 / QOL ➡ 問題点の抽出

人工弁　改善　早期成績 / 遠隔成績 / QOL ➡ 問題点の抽出

belief　confidence　evidence

症例 ➡ 施設データ ➡ レジストリー ➡ ガイドライン

2002 JCVSD

2012 NCD

科研費

代表

- 1998～2001基盤研究(B)　小児用補助人工心臓のための超小型遠心ポンプの研究開発
- 2015～2018基盤研究(B)　幹細胞由来ペプチドを用いた革新的大動脈瘤治療法の開発
- 2019～2021基盤研究(B)　大動脈瘤に対する新規バイオ医薬の開発
- 2002～2004基盤研究(C)　神経栄養因子を用いた生理的脳保護法の開発
- 2007～2008基盤研究(C)　人工心肺を用いない心拍動下僧帽弁形成術式の開発
- 2009～2011基盤研究(C)　人工心肺を用いない大動脈弁狭窄症手術の開発
- 2011～2013基盤研究(C)　心室中隔穿孔に対するカテーテル治療の開発
- 1998～1999萌芽研究　数値流体力学を用いた心臓外科手術の三次元シミュレーション
- 2003～2004萌芽研究　リニアモーターを利用した補助心臓装置の開発
- 2020～2021萌芽研究　抗菌性ポリマーを利用した感染制御性人工血管の開発
- 2009年JSTシーズ発掘試験　人工心肺を用いない大動脈弁狭窄症手術法の開発

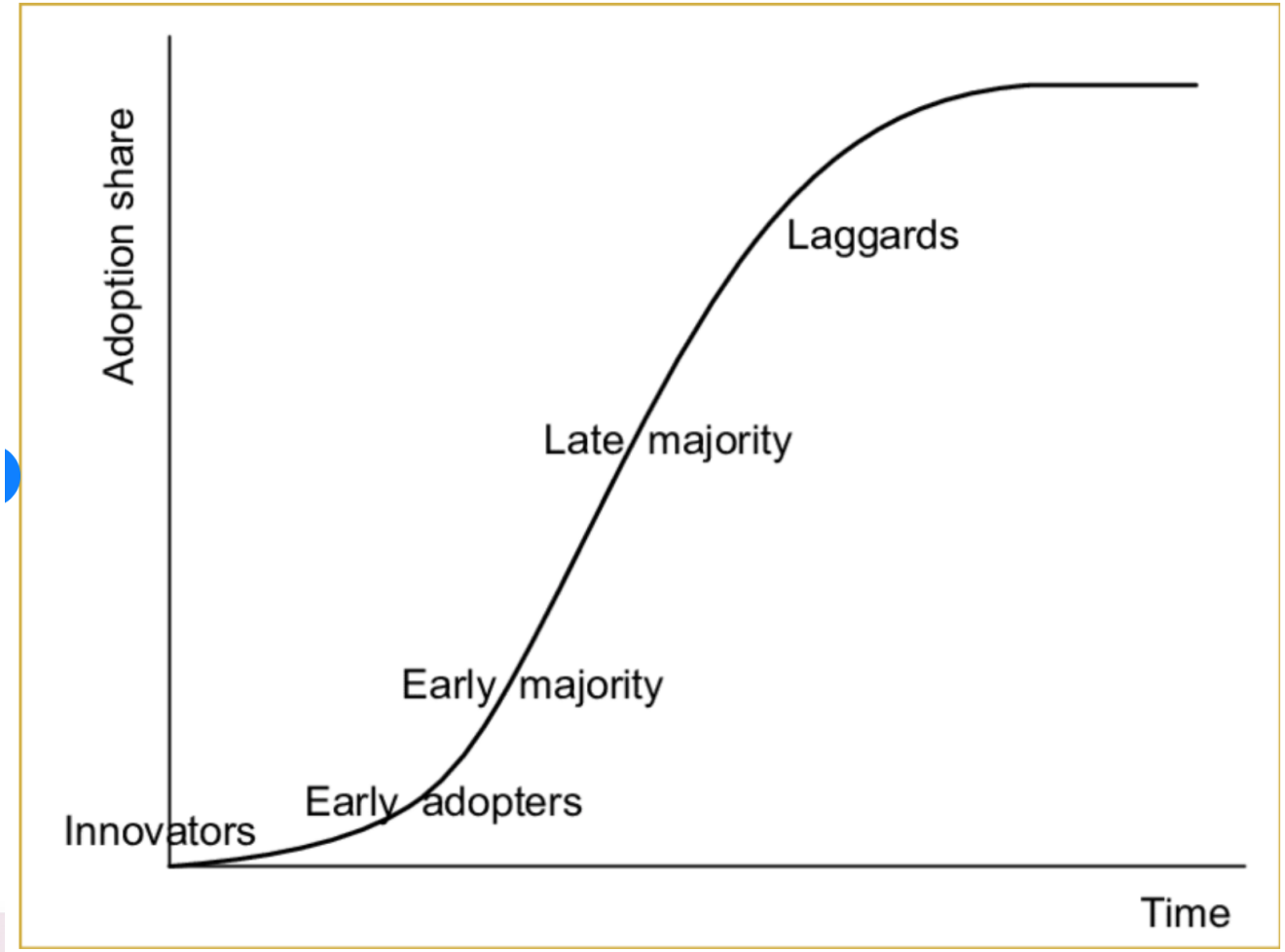
受賞

- 1991年　　日本心臓財団研究奨励
- 1993年　　鈴木謙三記念研究奨励
- 1996年　　堀情報財団研究奨励

The “S” curve theory

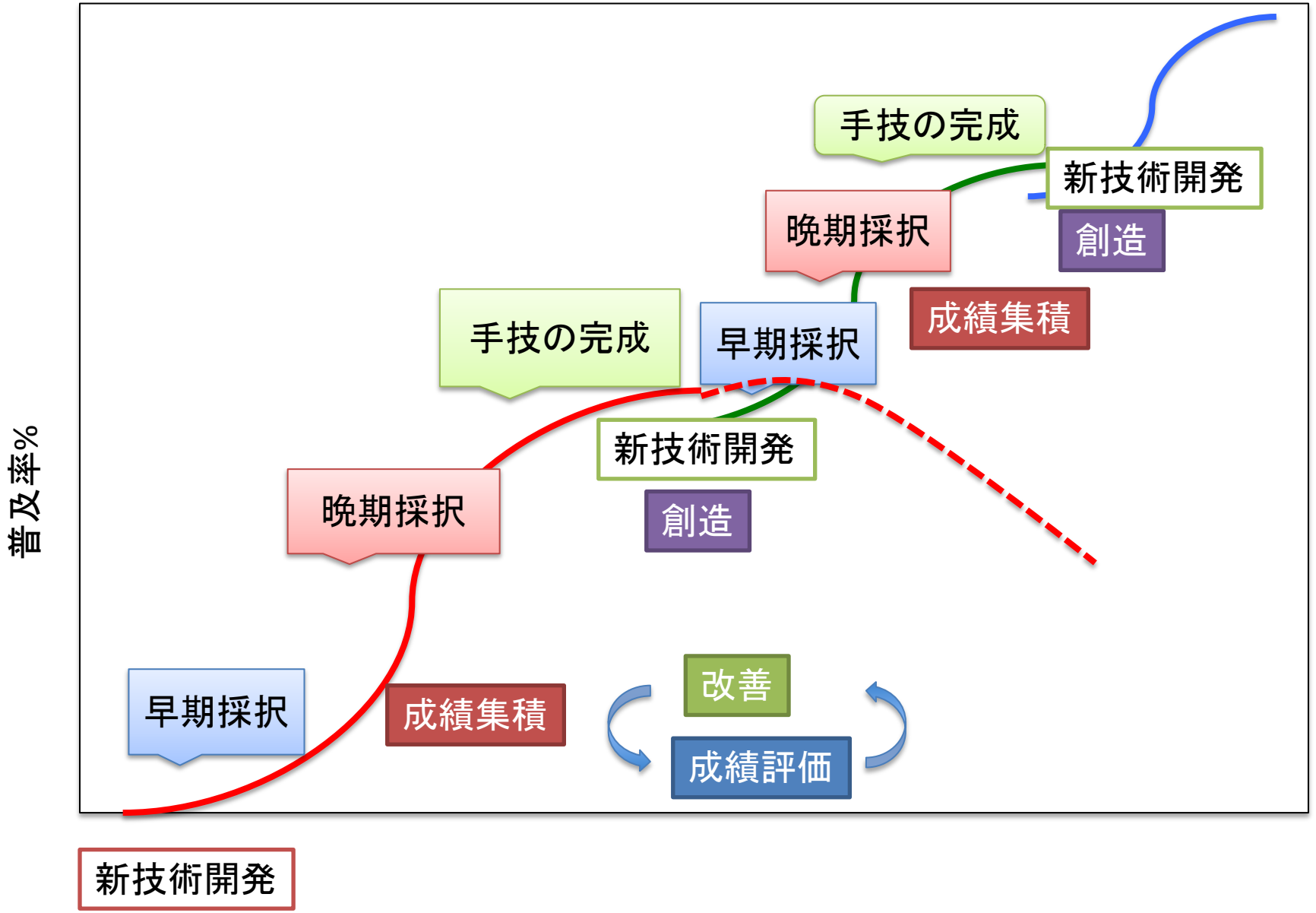
新商品　→ 普及率
新規技術　→ 手術数

Frank M Bass



Prof. James L Cox

外科における The “S” curve

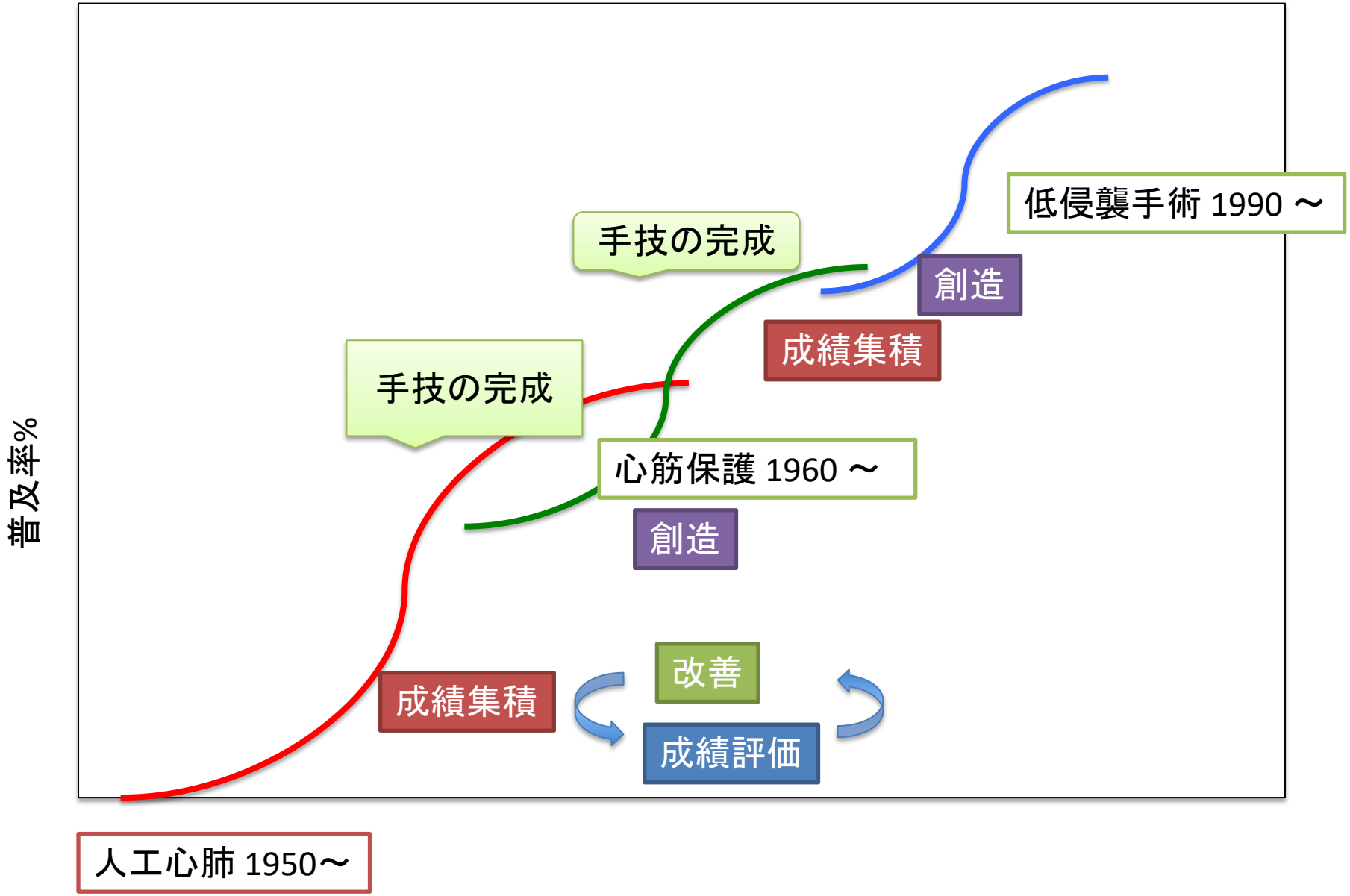


History of Cardiac Surgery

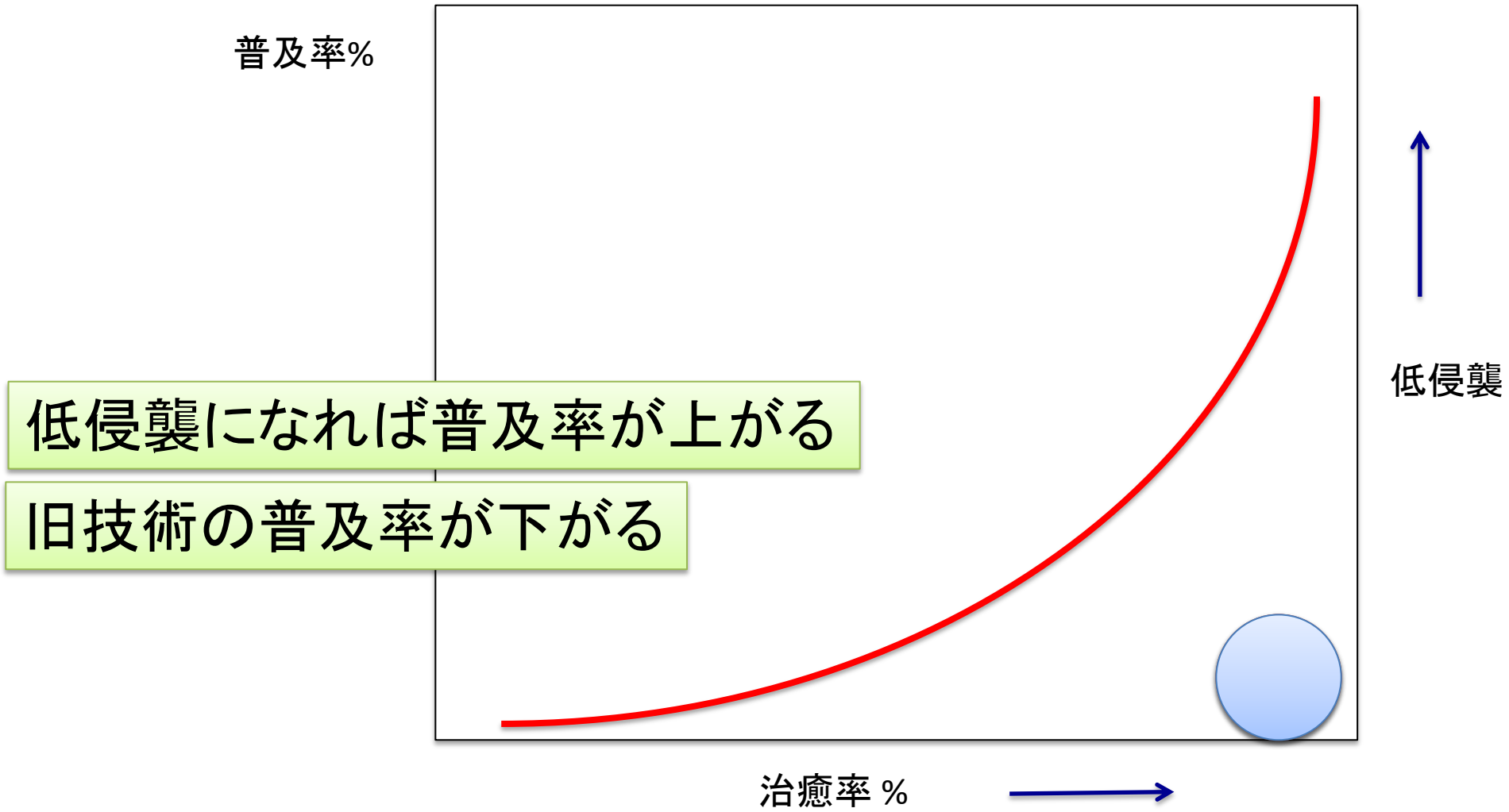
	By Whom	What
1953	John H. Gibbon, Jr.	CPB/ASD
1954	Walton Lillhei	Cross-circulation/VSD
1958	Mason Sones	CAG
1967	Rene Favaloro	CABG
1977	Andreas Gruentzig	PTCA

1883; Billroth; Gastrectomy

心臓外科の “S” curve



手術侵襲と普及率



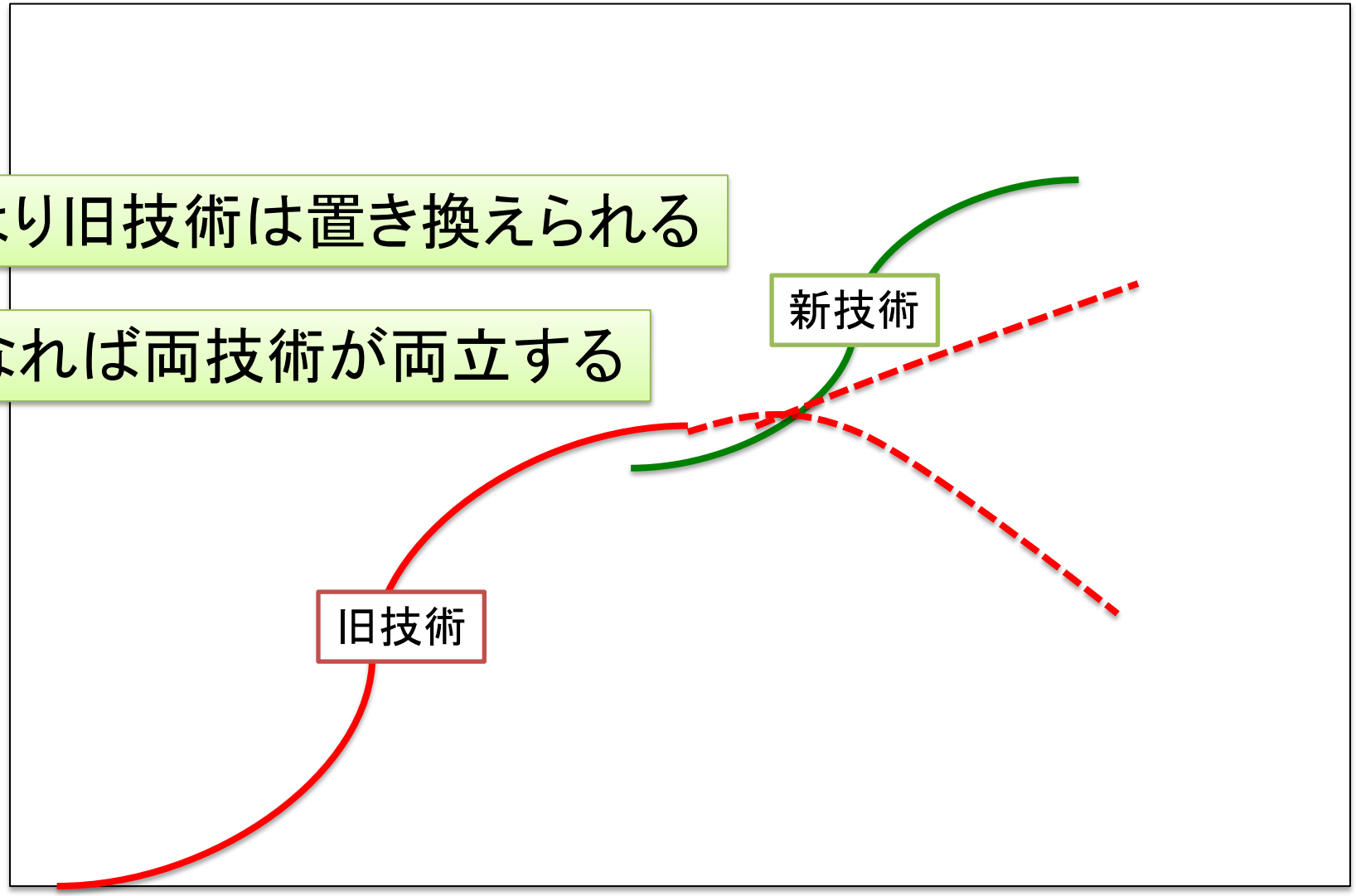
低侵襲になれば普及率が上がる

旧技術の普及率が下がる

The “S” curve

新技術により旧技術は置き換えられる

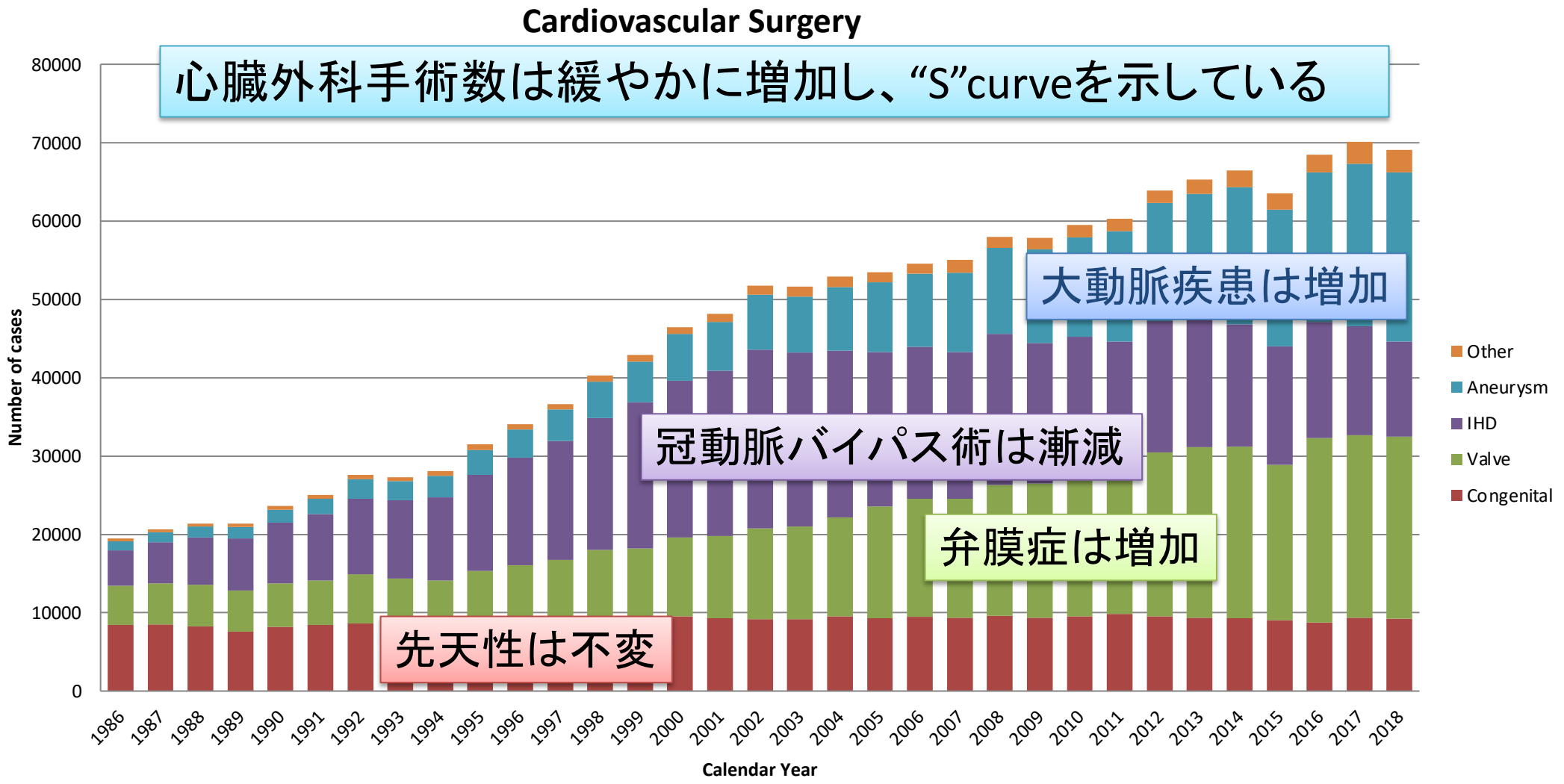
適応が異なれば両技術が両立する



本邦の心臓血管外科手術数の推移

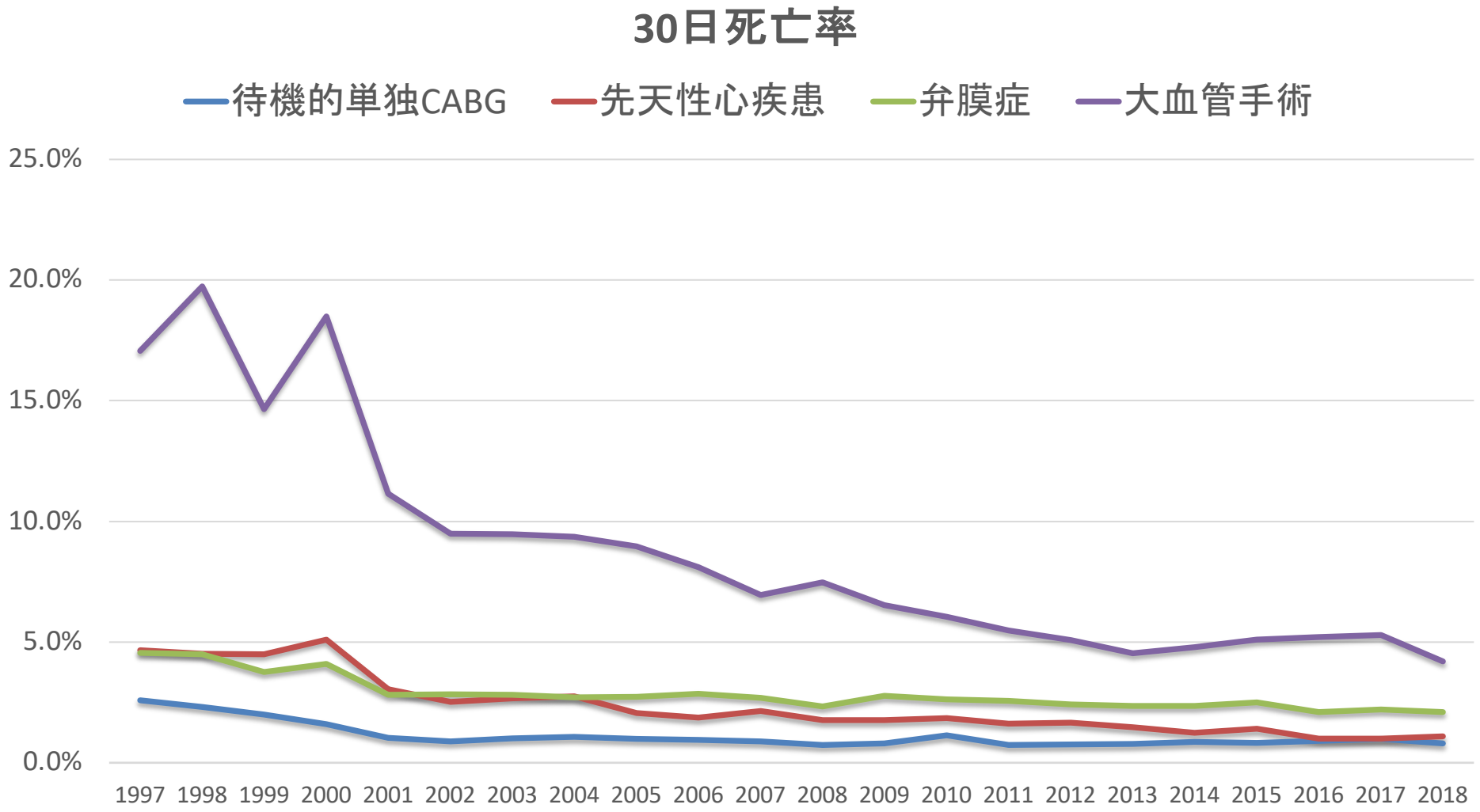
The “S” curveの検証

心臓外科手術の推移



参考資料： 2018 JATS Annual Report

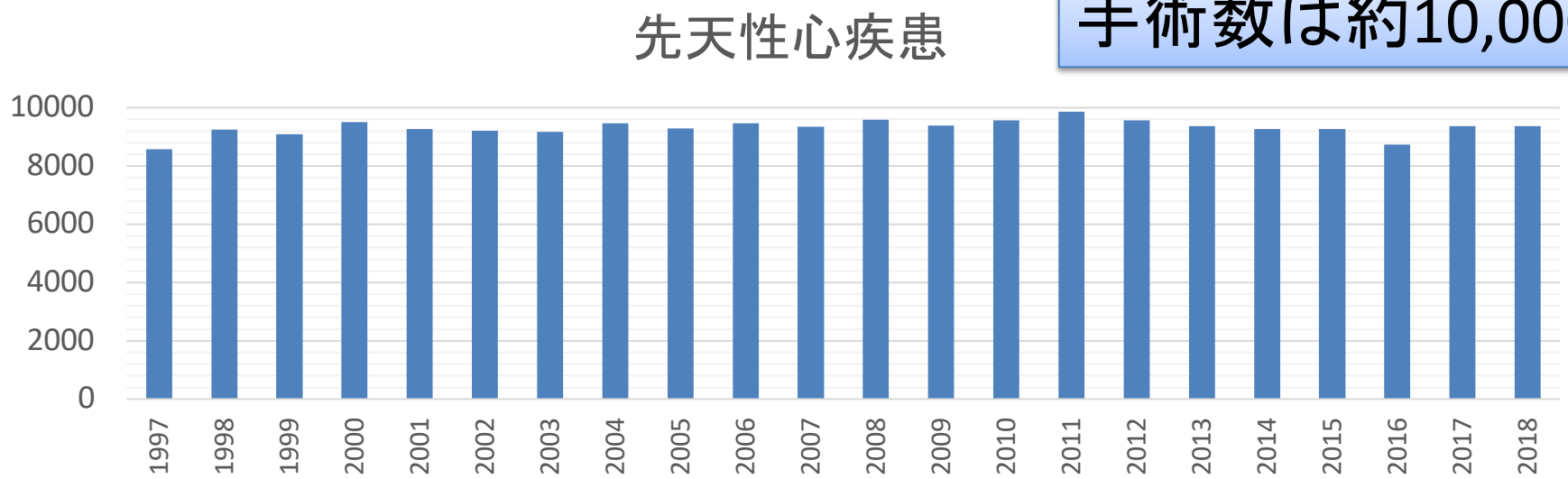
日本胸部外科学会学術集計

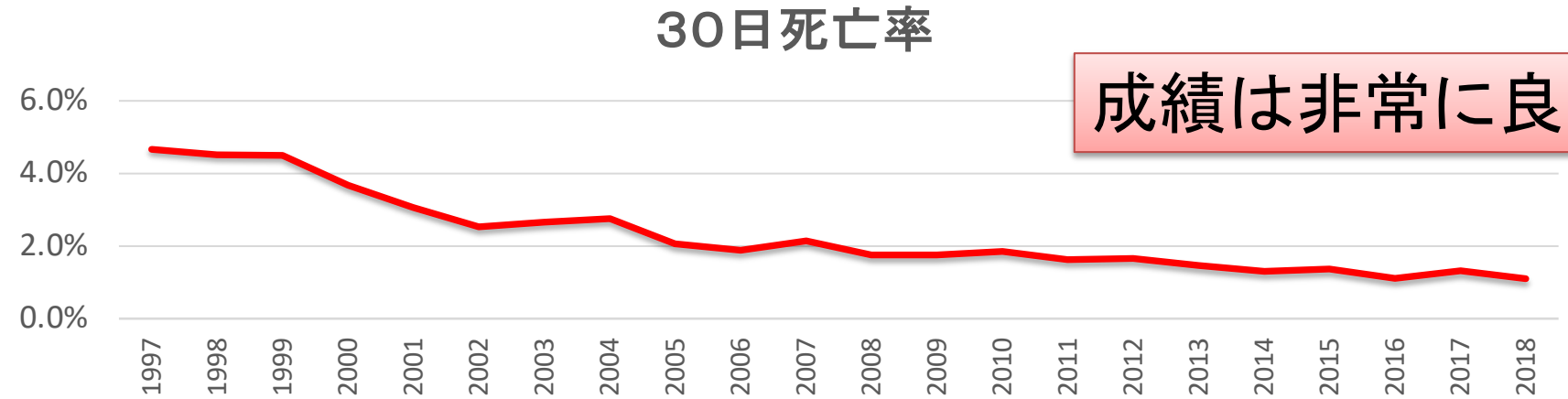


手術成績全般に良くなっている

先天性心疾患　手術数　成績

手術数は約10,000例で不変

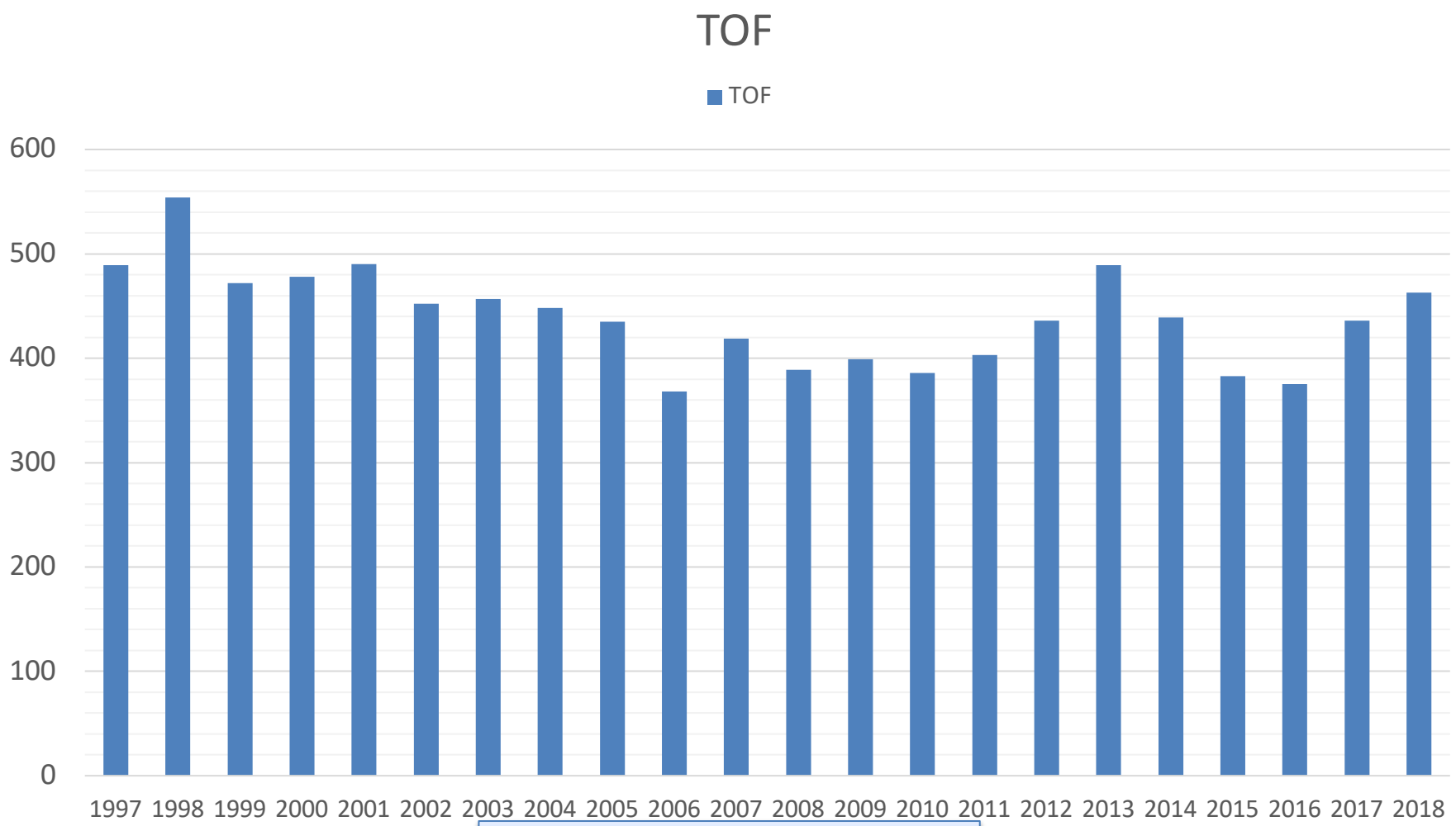




成績は非常に良くなった

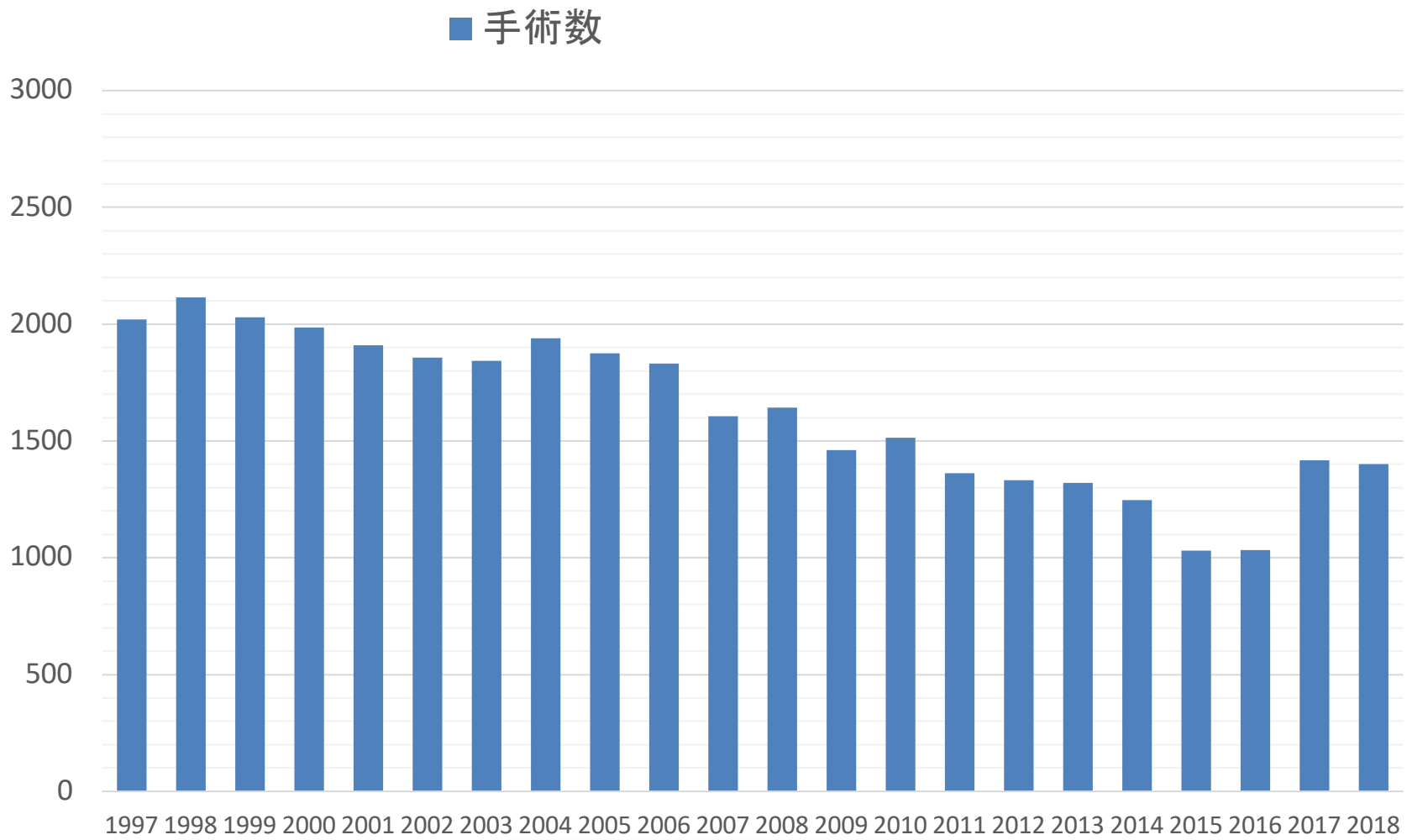
現在の手術法はほぼ完成の域に達している

ファロー四徴症　年次推移



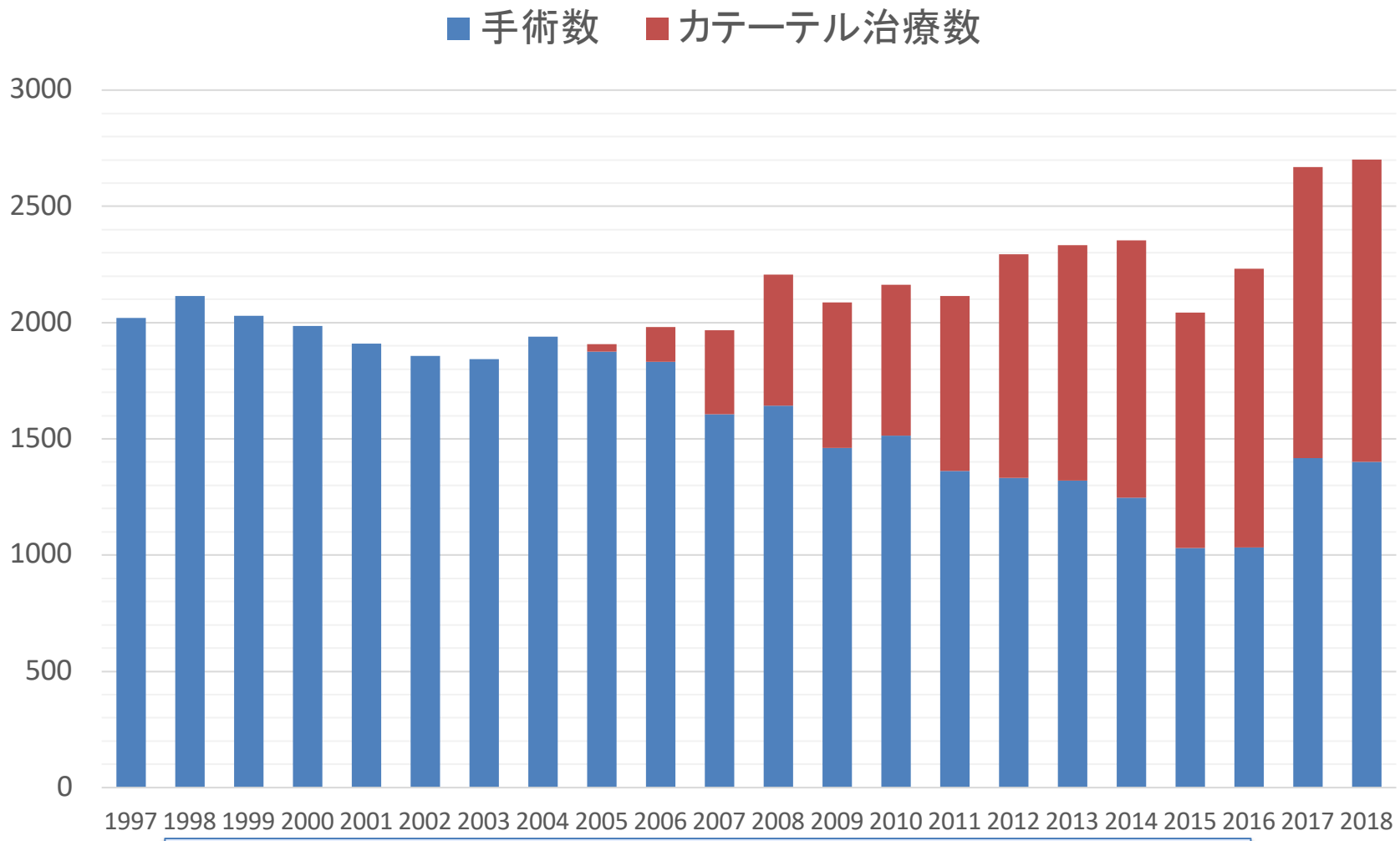
TOF手術数は不変

心房中隔欠損症　年次推移



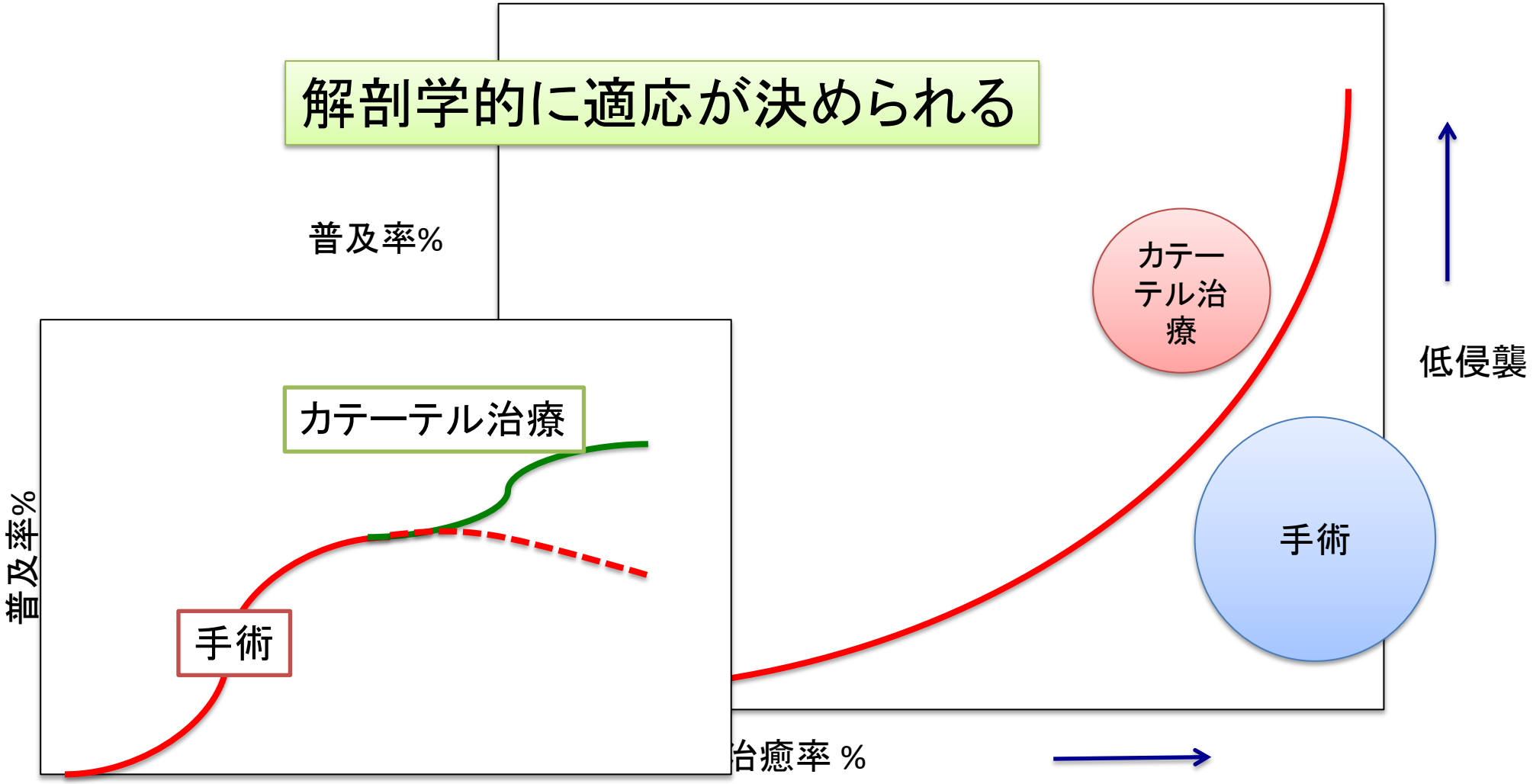
緩やかに減少？

心房中隔欠損症　年次推移



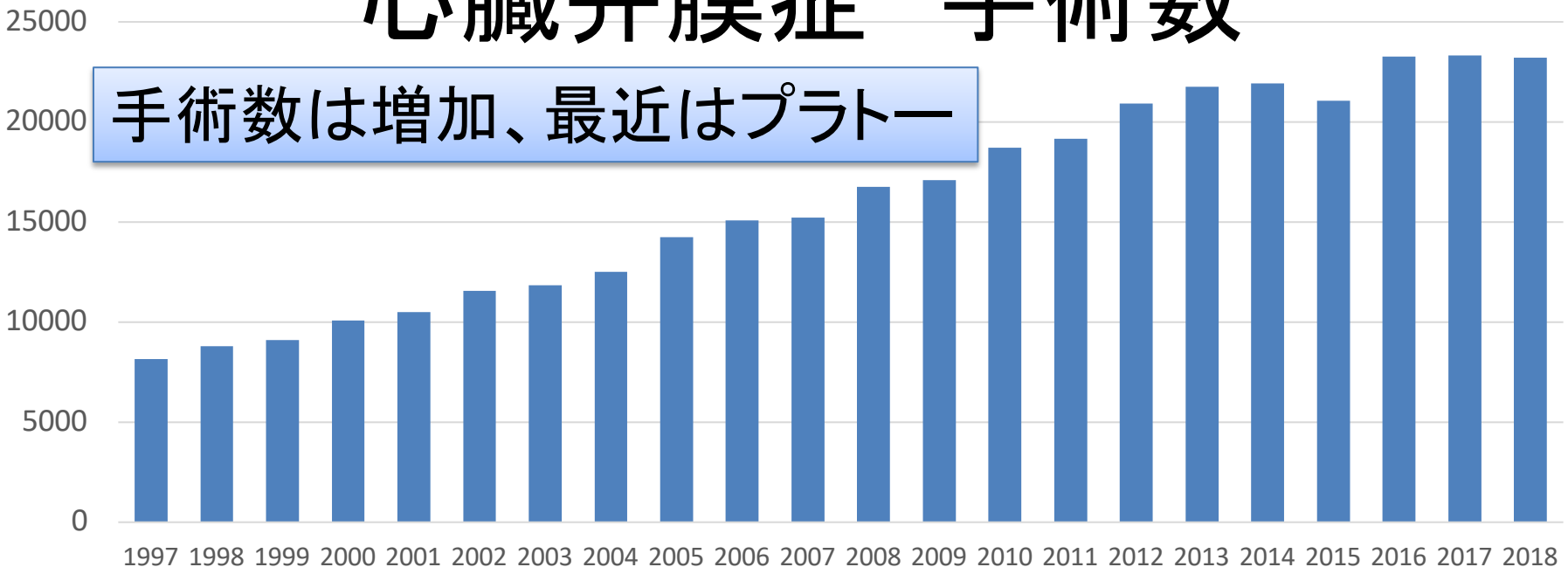
カテーテル治療によりASD治療数は漸増

手術侵襲と普及率
（心房中隔欠損）



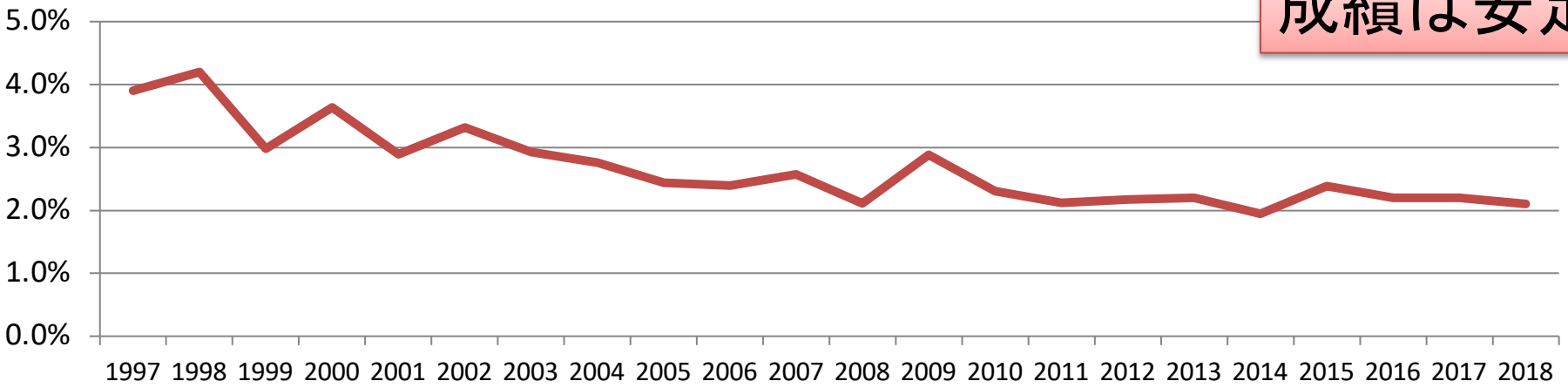
心臓弁膜症　手術数

手術数は増加、最近はプラトー

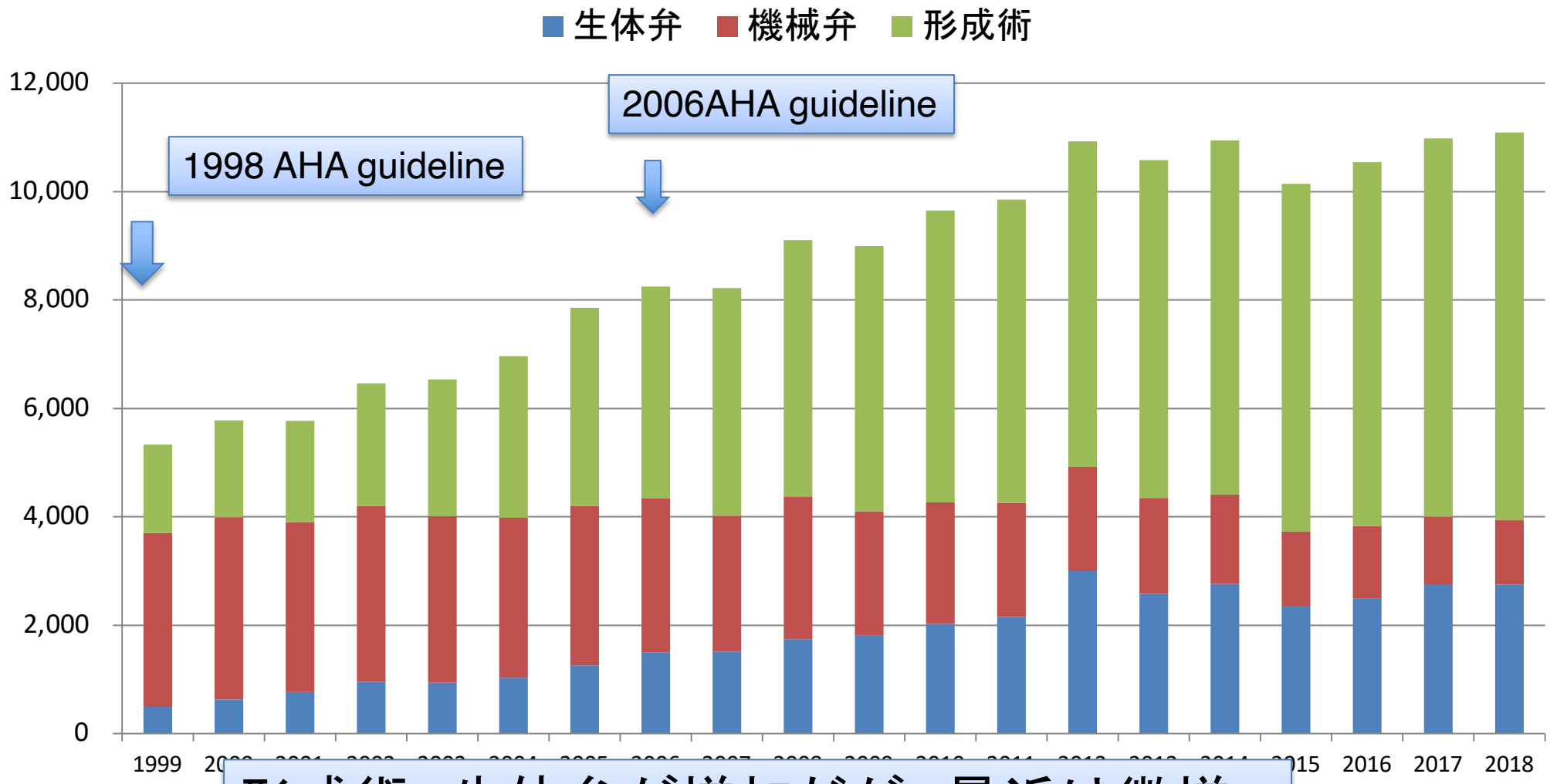


死亡率

成績は安定している

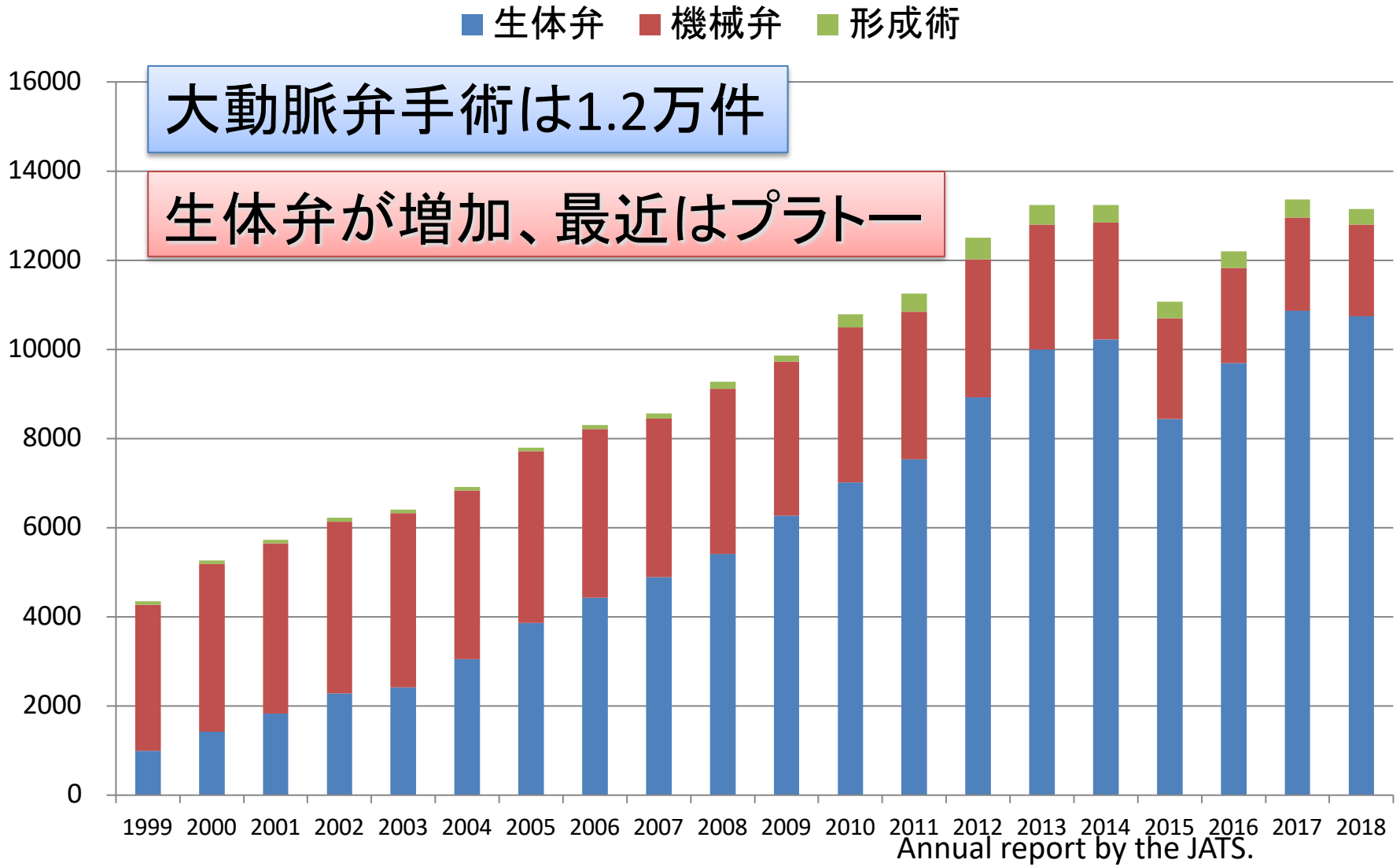


僧帽弁手術症例の推移



形成術、生体弁が増加だが、最近は微増

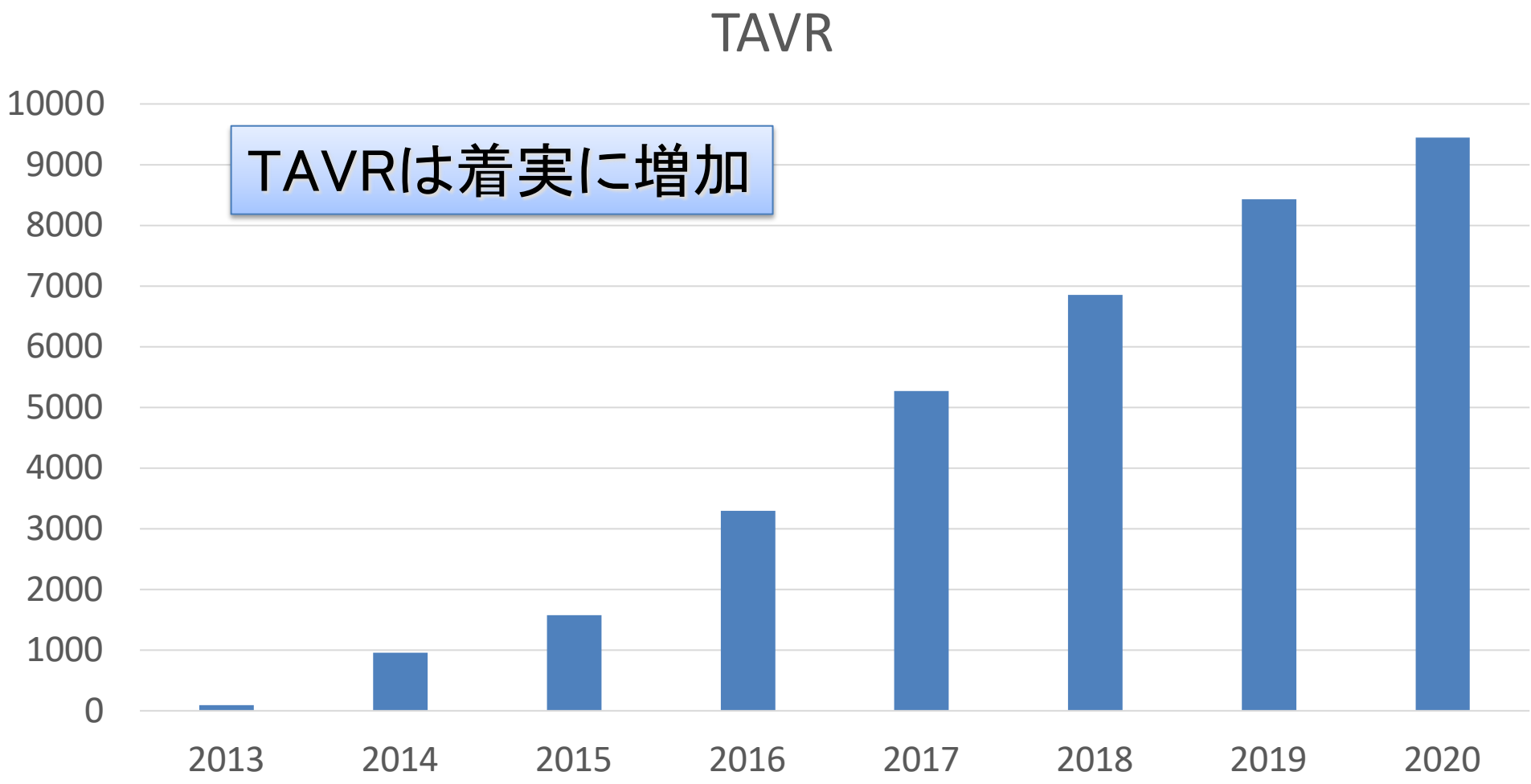
大動脈弁手術症例の推移



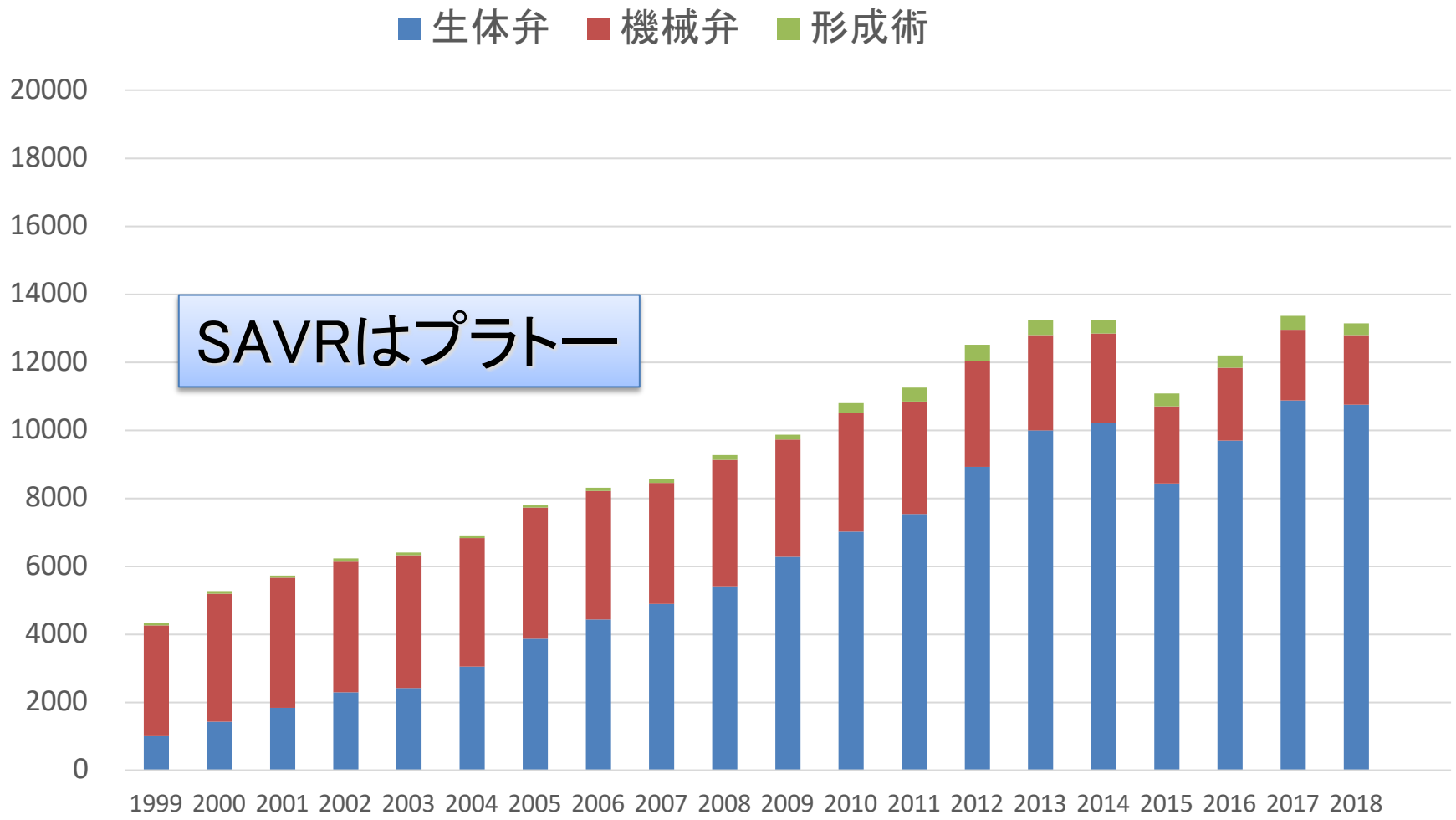
Annual report by the JATS.

Transcatheter Aortic valve replacement (TAVR)

TAVR 症例数の推移

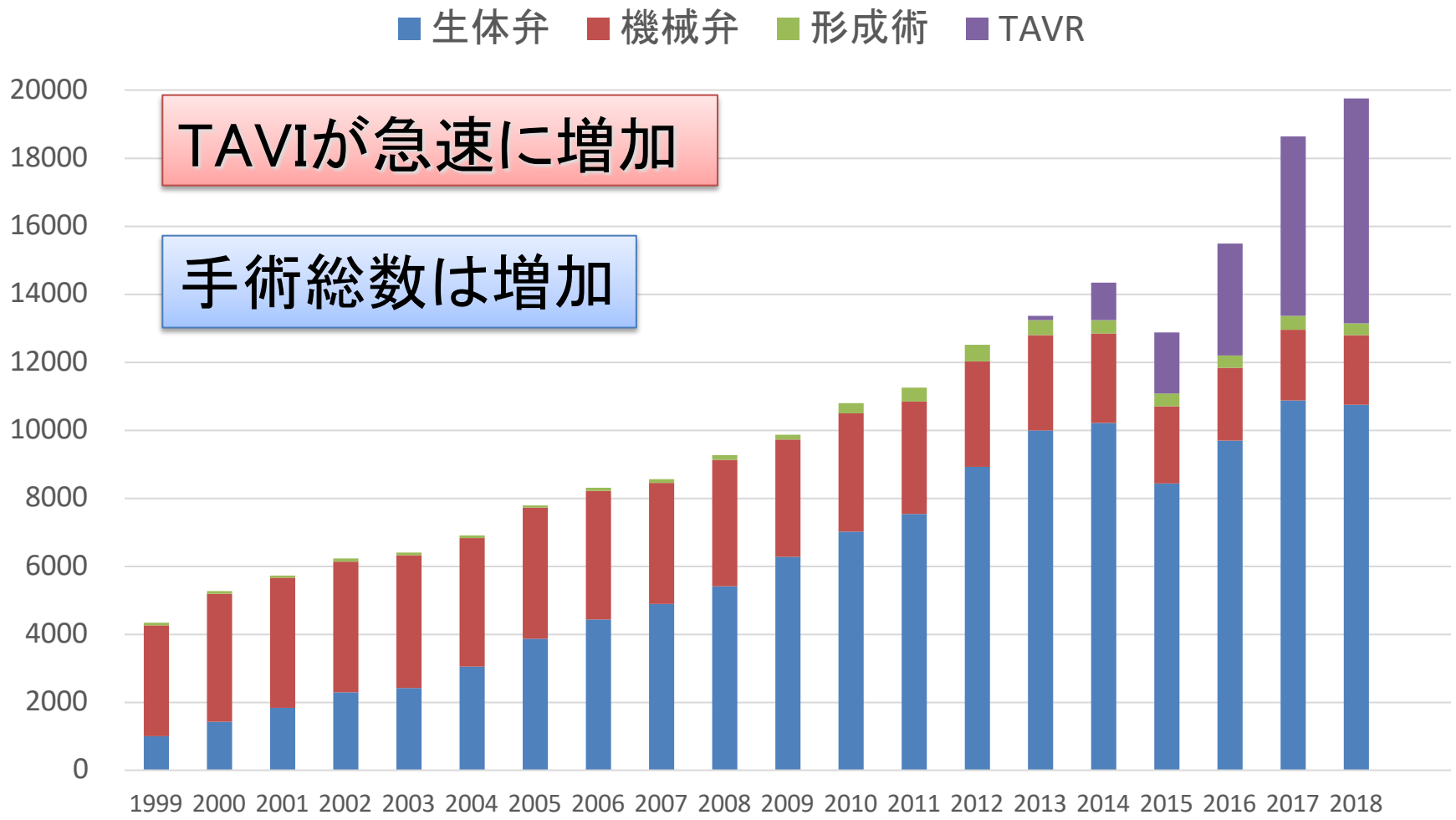

TAVR
TAVRは着実に増加
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
2013
2014
2015
2016
2017
2018
2019
2020

大動脈弁手術症例の推移



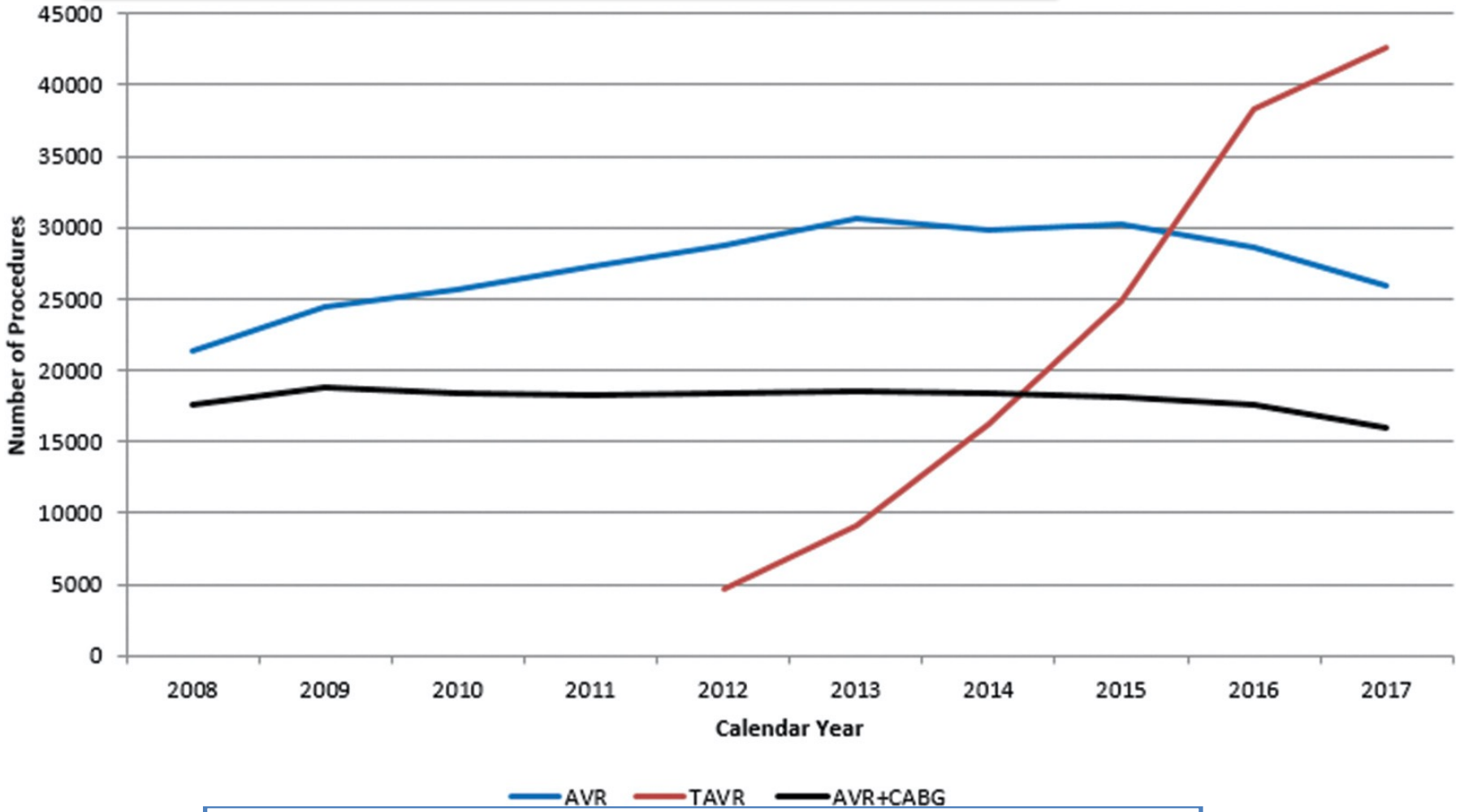
Annual report by the JATS.

大動脈弁手術症例の推移



Annual report by the JATS.

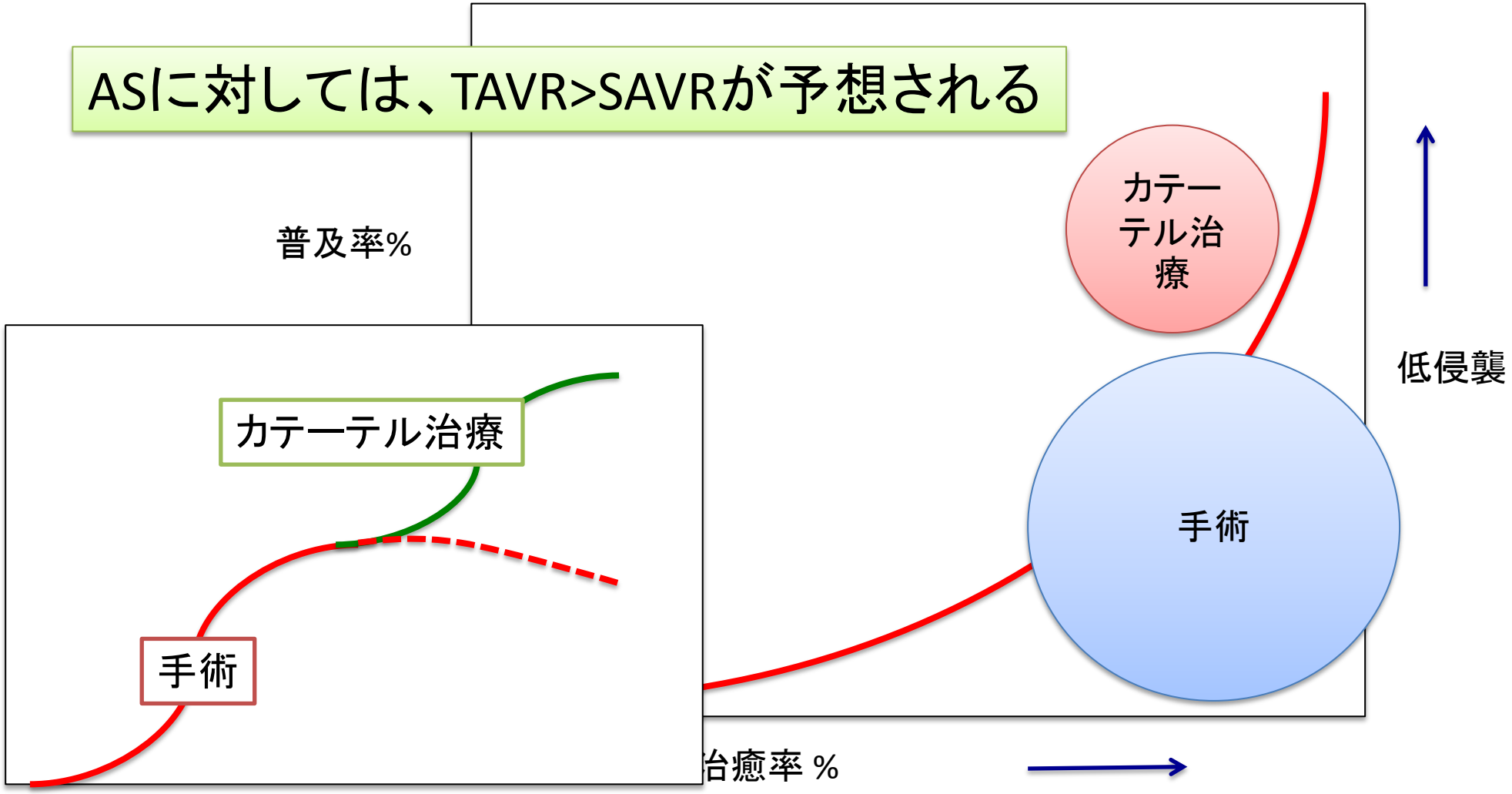
米国ではTAVRがSAVRを凌駕している



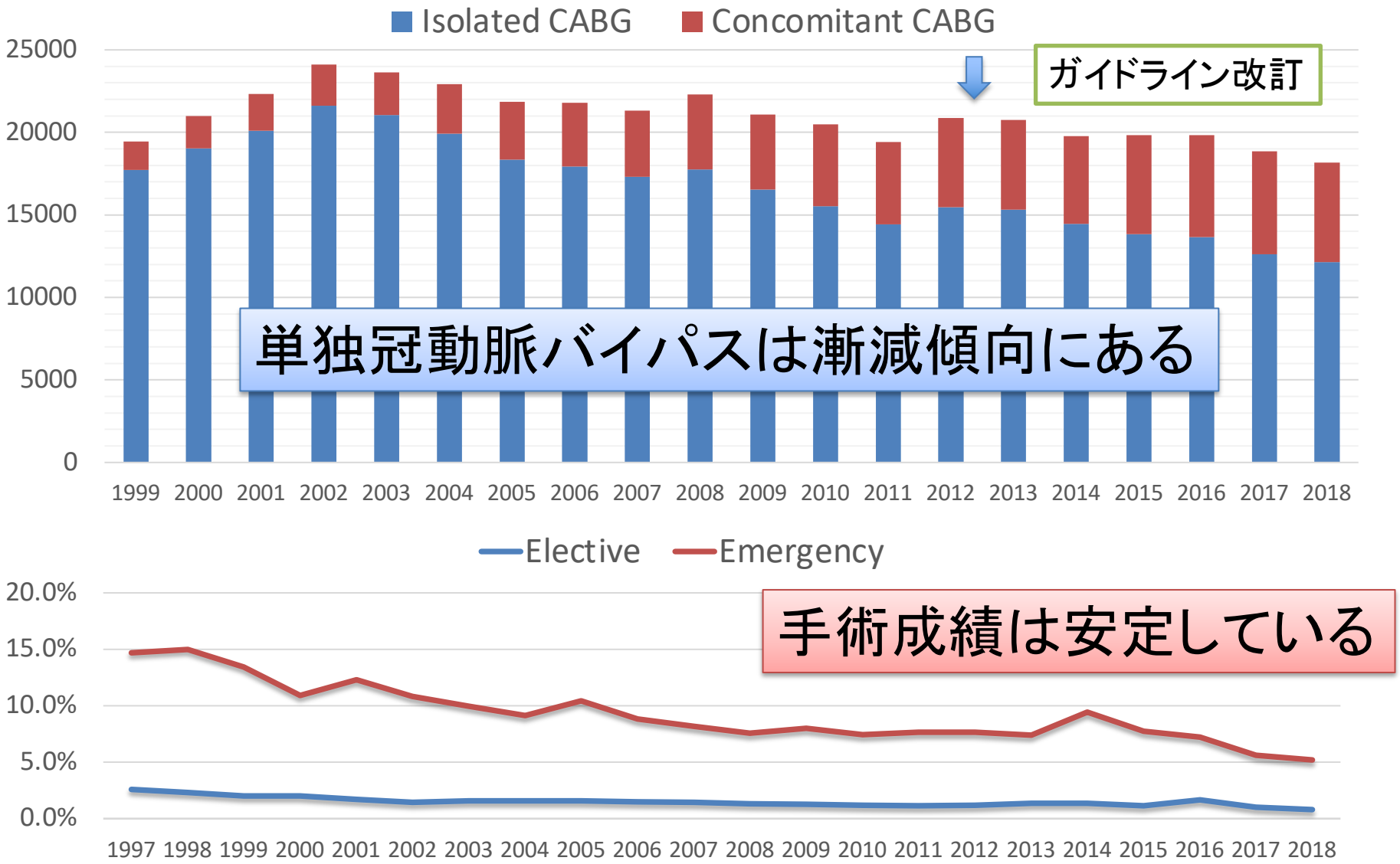
low risk candidateで非劣性が示され、
耐久性が保証されるとTAVRの位置づけが更に変わる可能性がある

手術侵襲と普及率
（大動脈弁狭窄症）

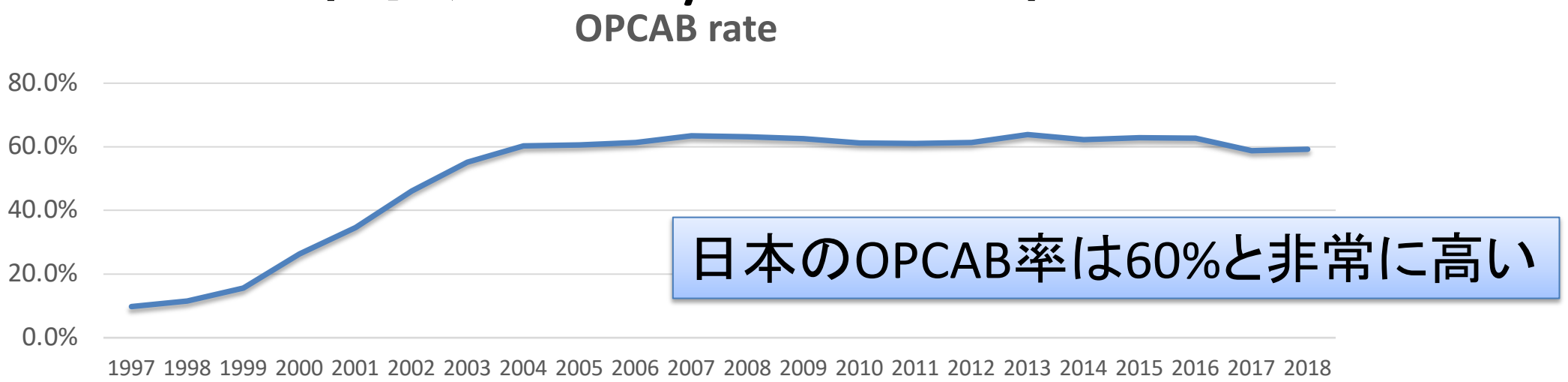
ASに対しては、TAVR>SAVRが予想される



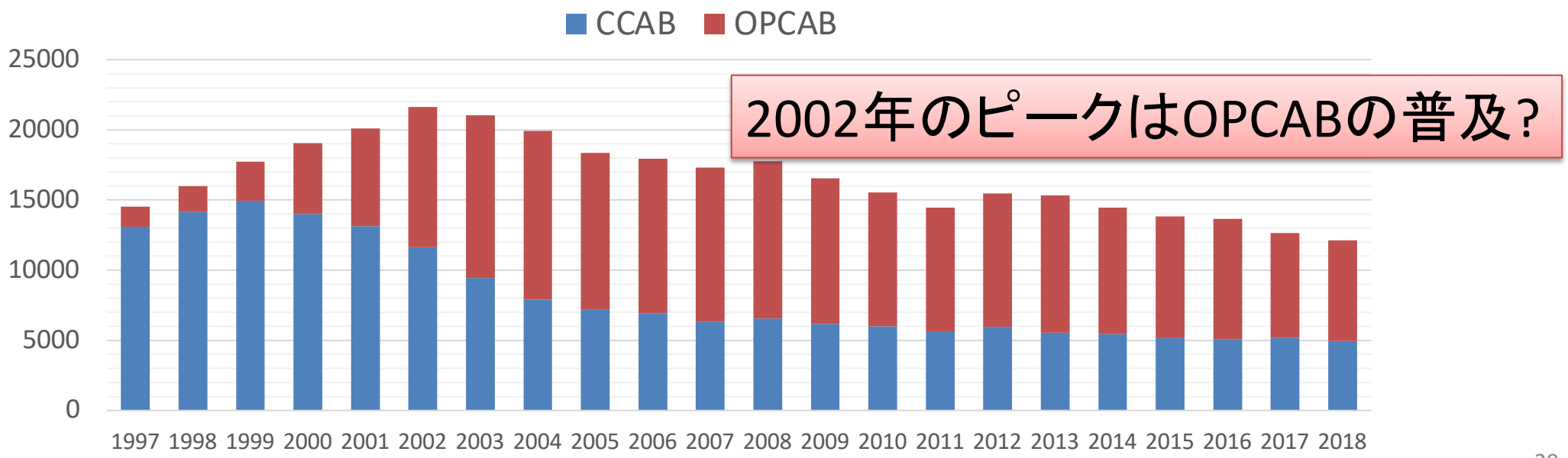
冠動脈バイパス手術数


Isolated CABG
Concomitant CABG
25000
20000
15000
10000
5000
0
ガイドライン改訂
単独冠動脈バイパスは漸減傾向にある
1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018
Elective
Emergency
20.0%
15.0%
10.0%
5.0%
0.0%
手術成績は安定している
1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018

単独CABG / OPCAB率



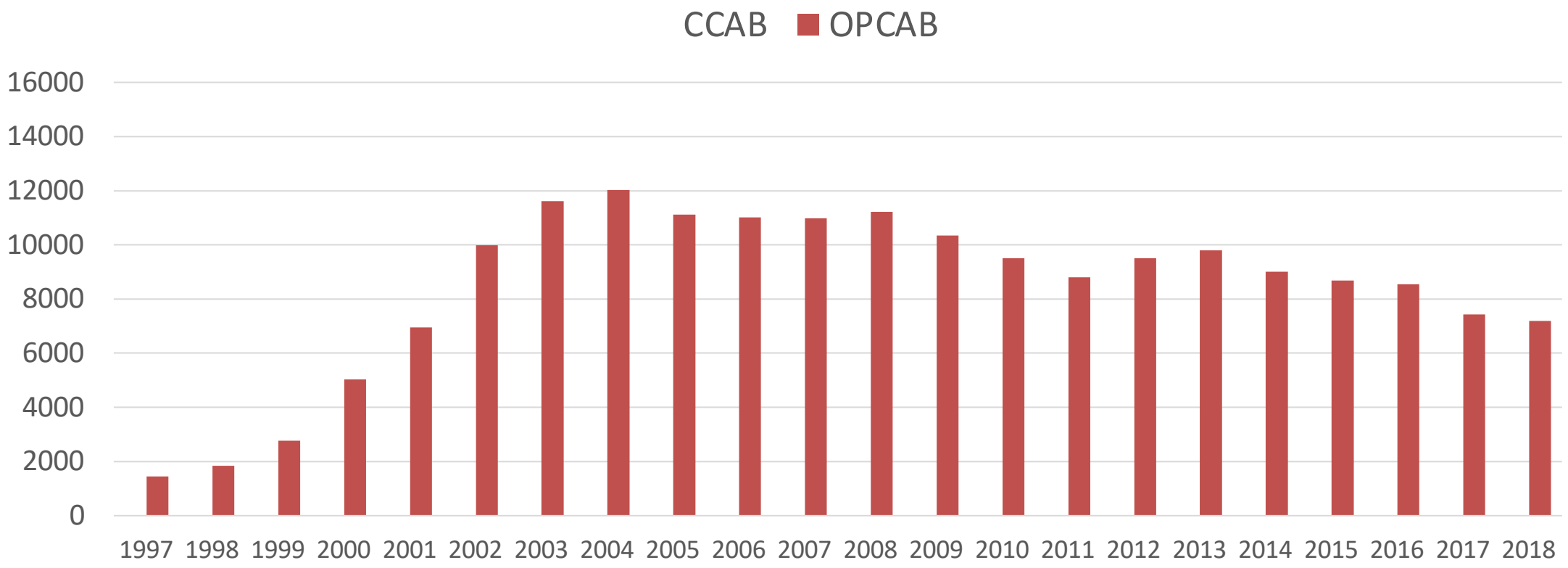
日本のOPCAB率は60%と非常に高い



2002年のピークはOPCABの普及?

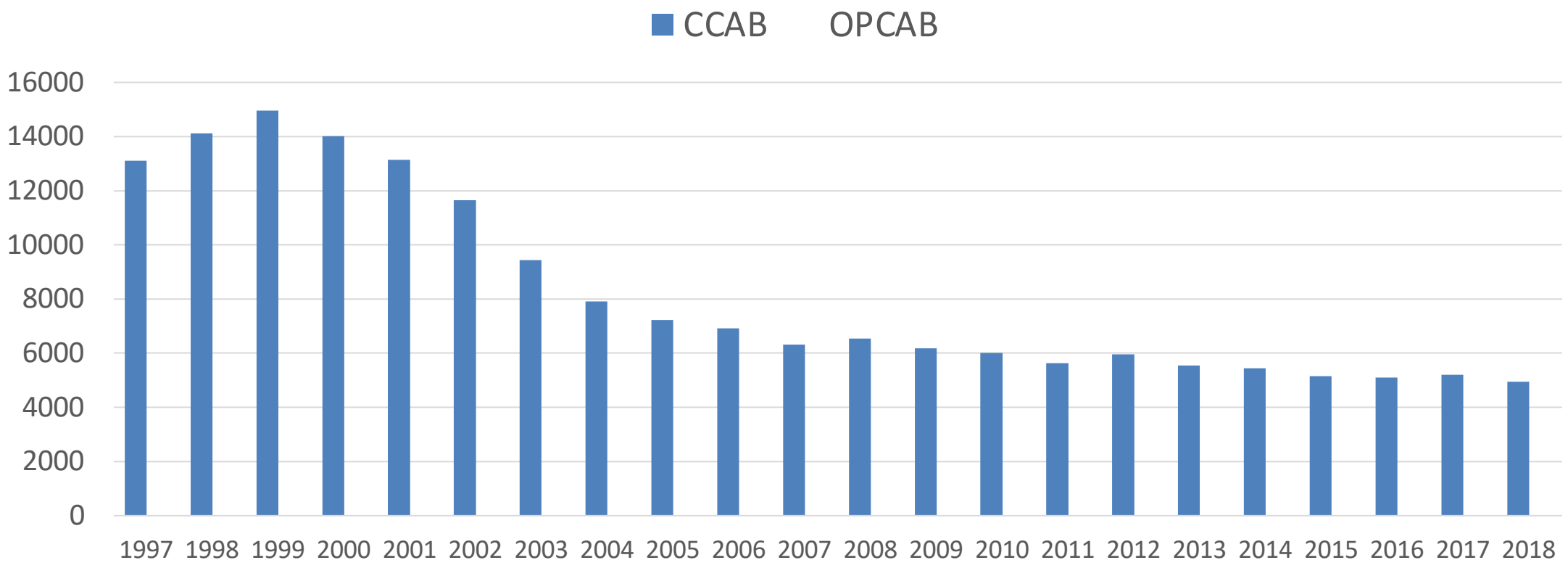
単独CABG / OPCAB率

OPCABはS字状に増加

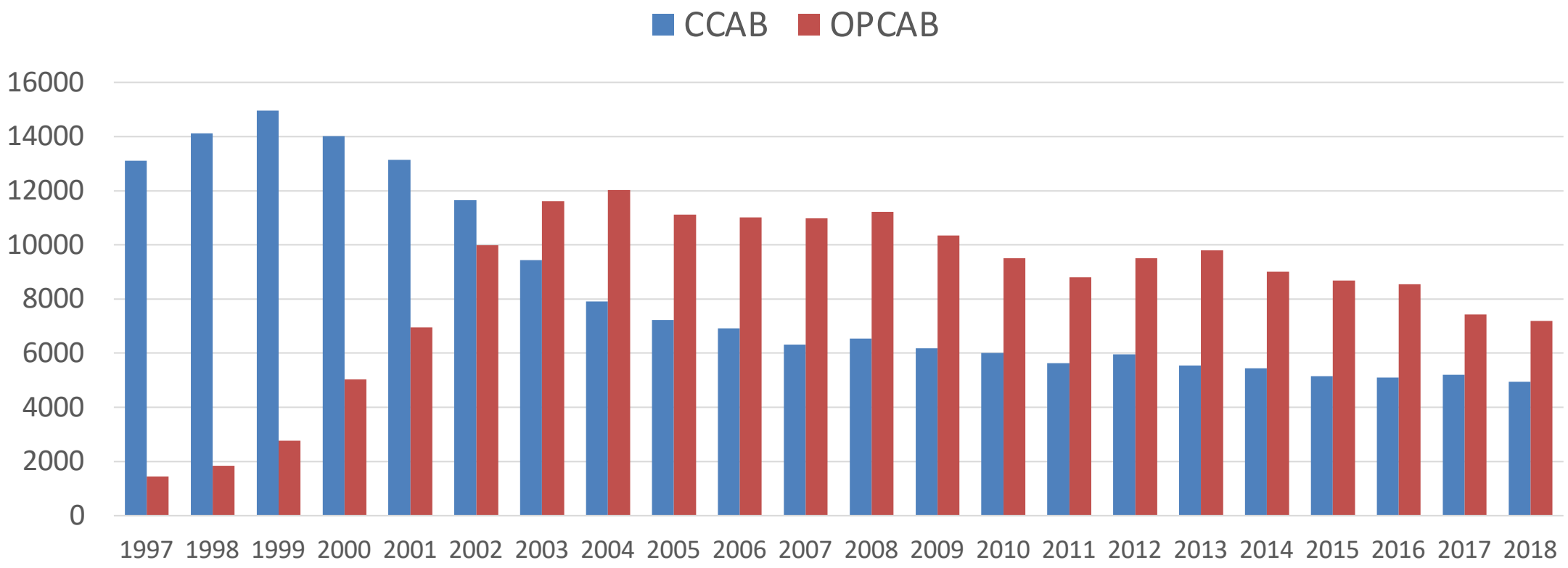


単独CABG / OPCAB率

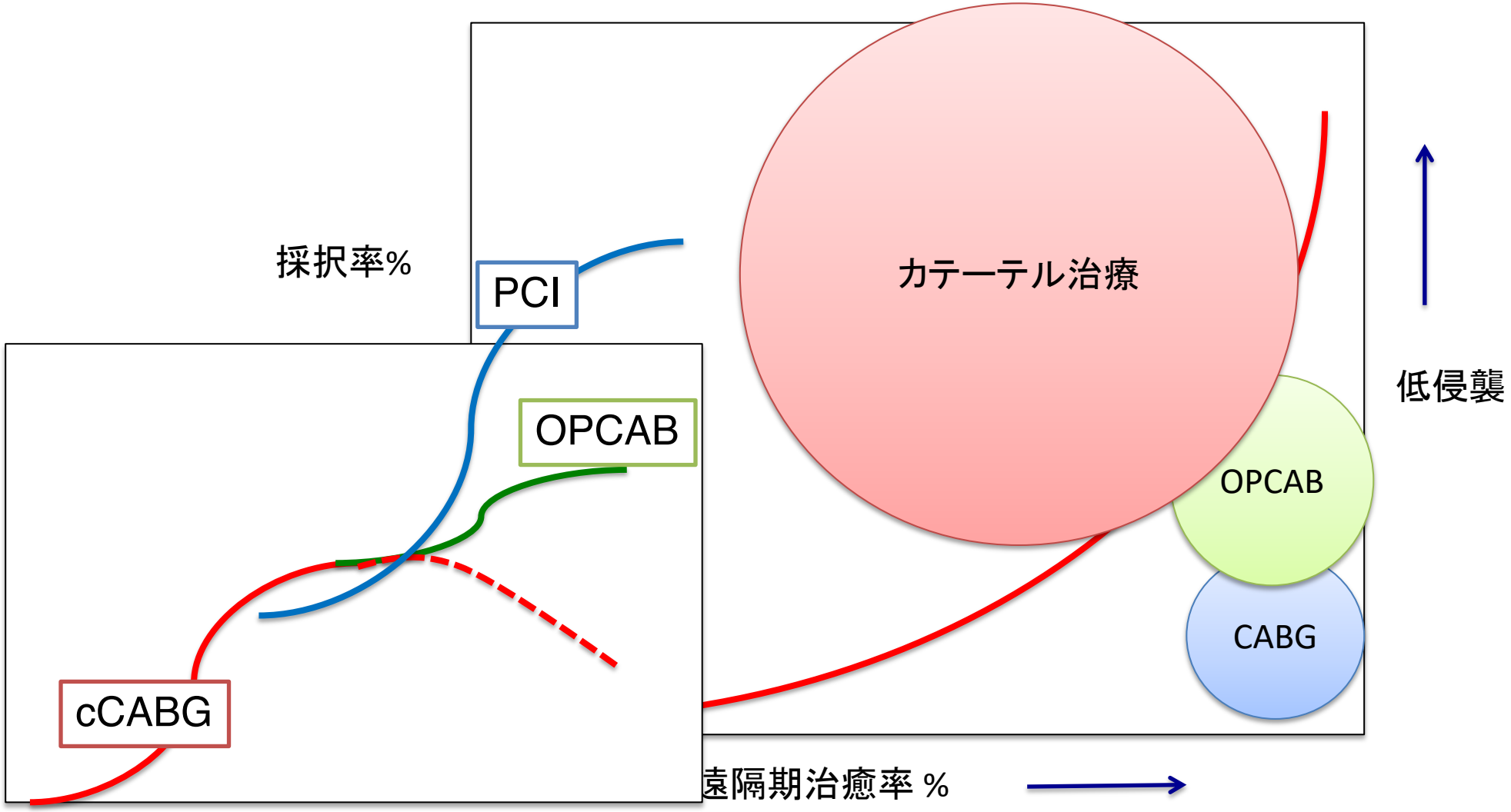
cCABGはS字状に減少



単独CABG / OPCAB率



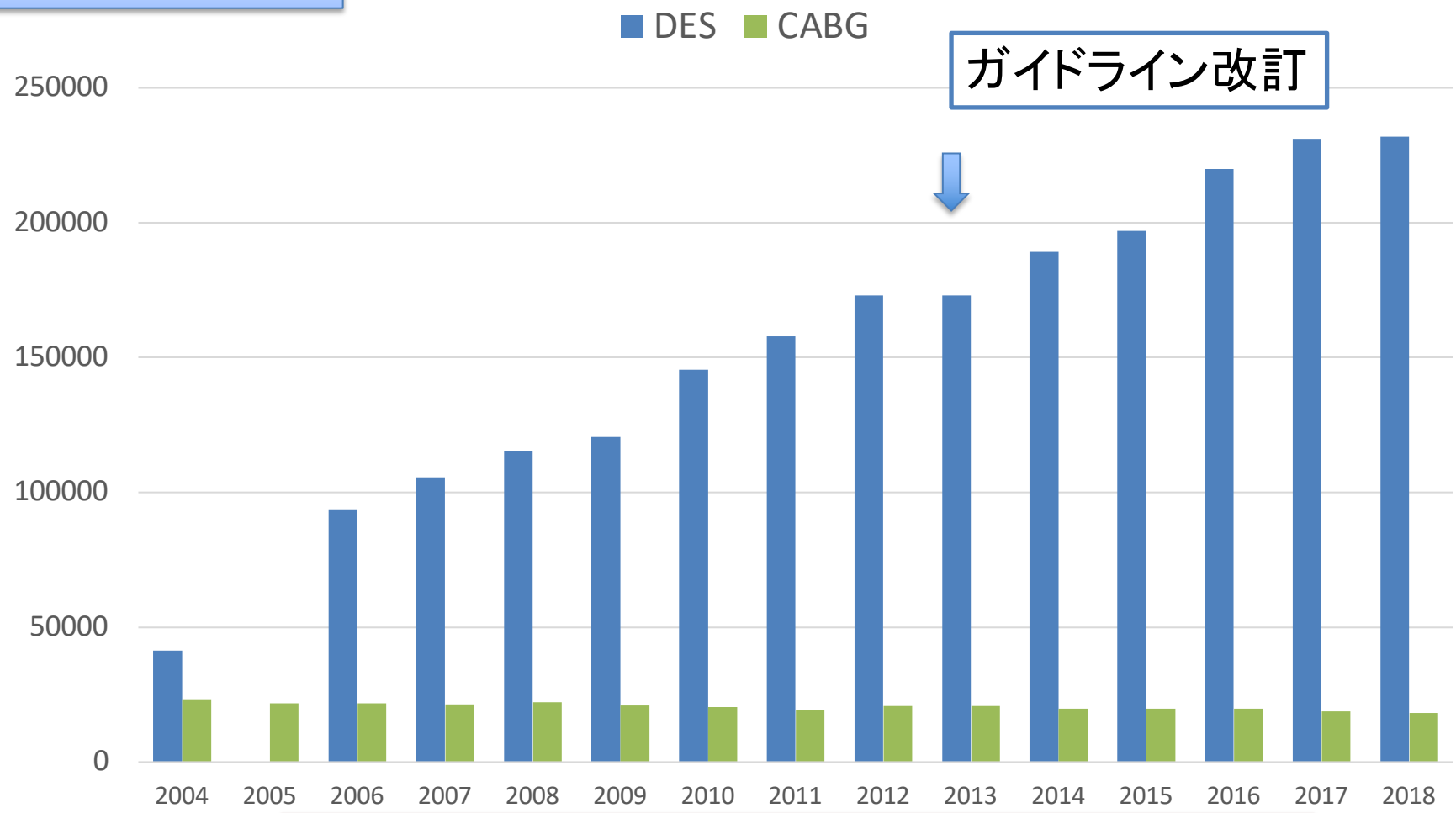
手術侵襲と普及率
（狭心症）



CABG vs. PCI

日循実態調査

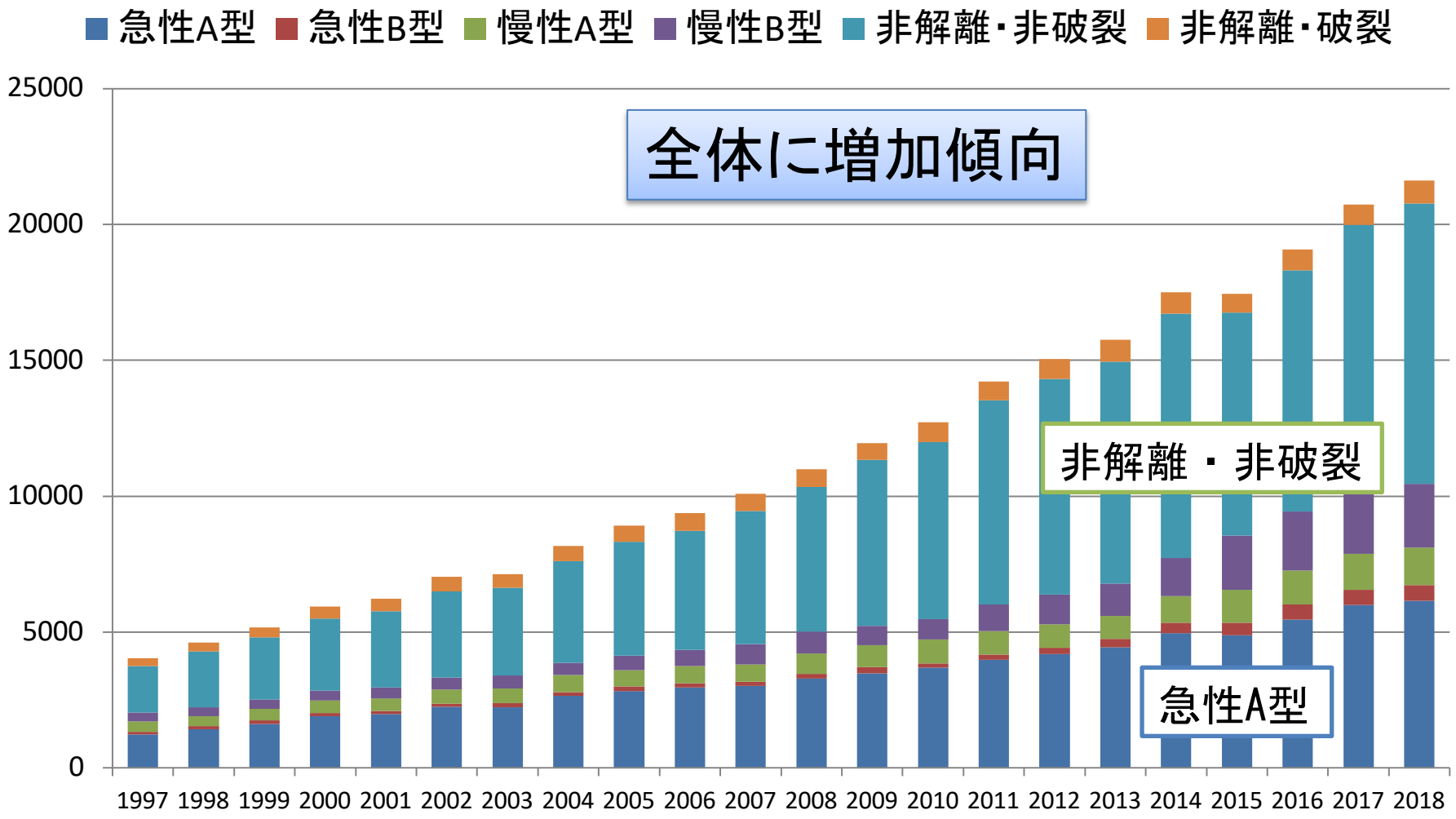
PCI : CABG = 10<



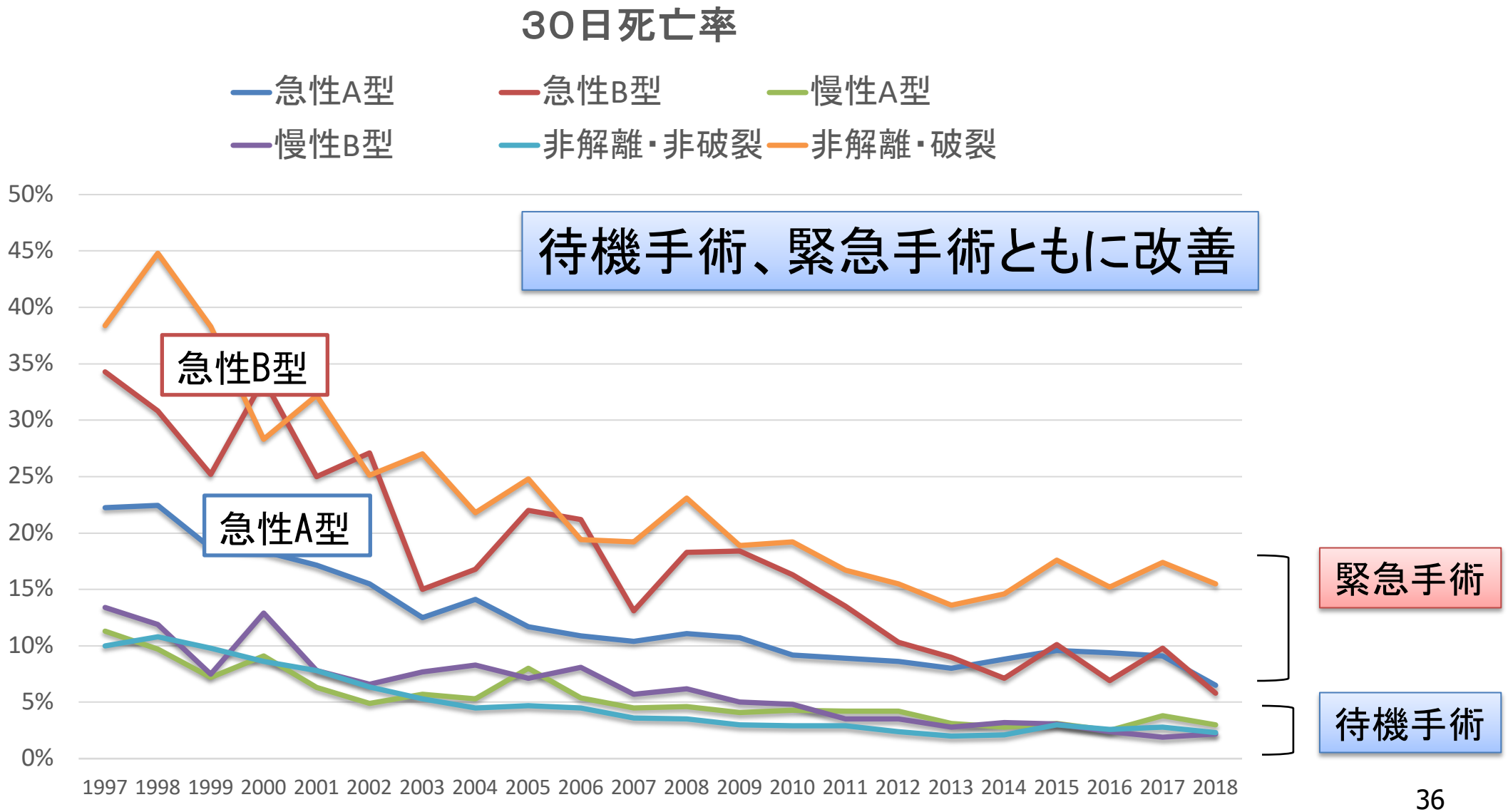
ハートチームで検討されているのか？

胸部大動脈手術数推移

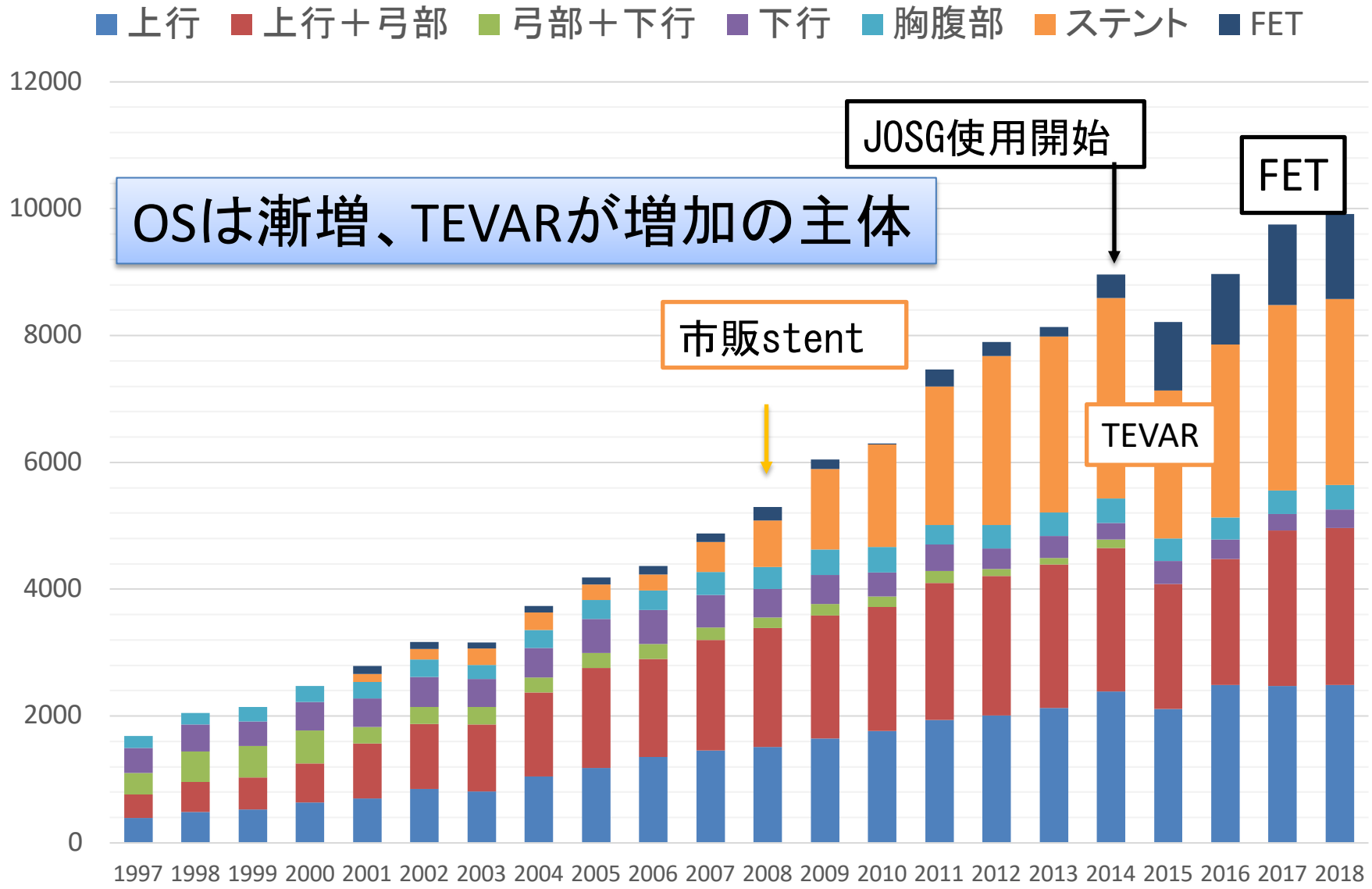
日本胸部外科学会学術集計



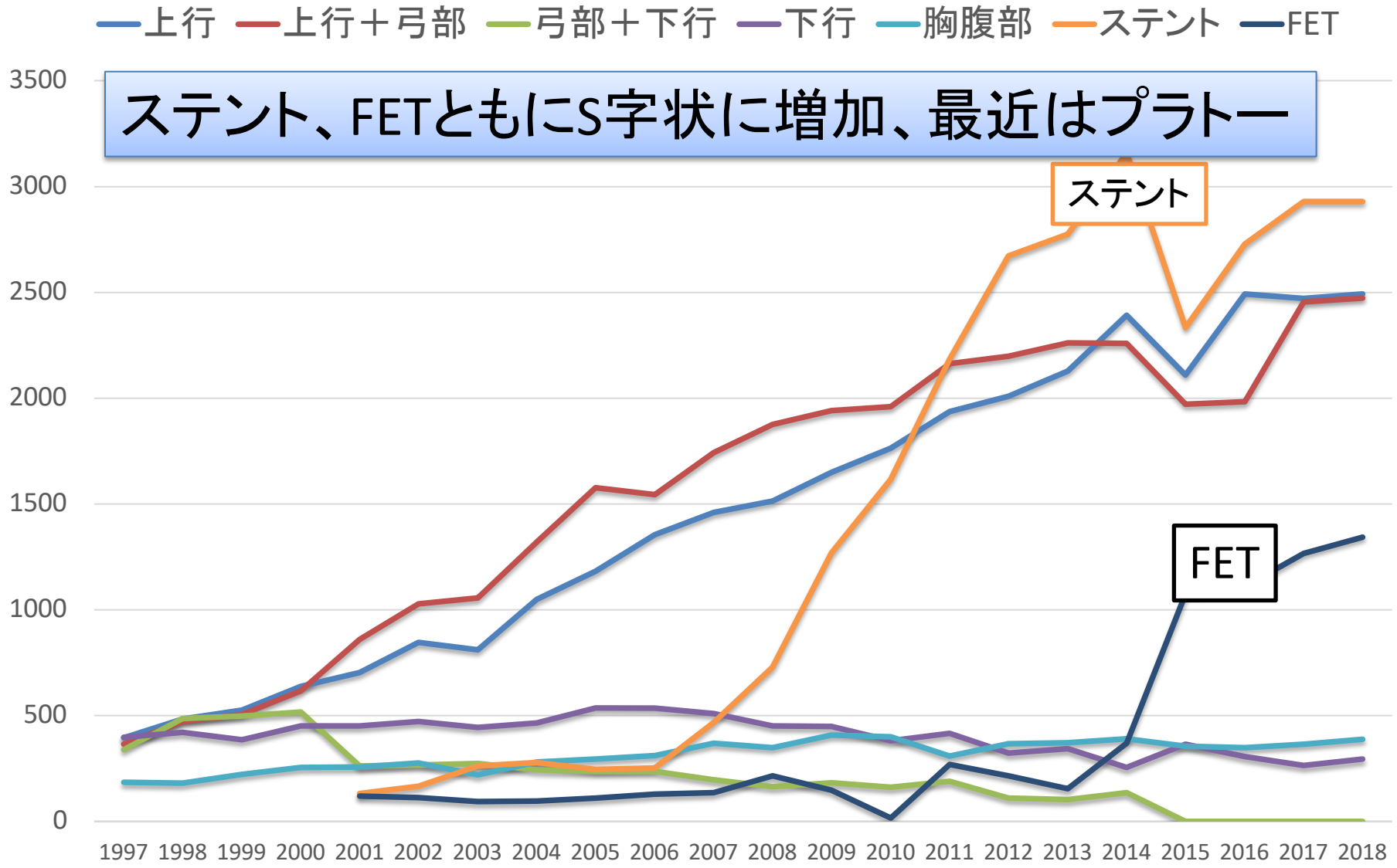
疾患による手術成績の推移



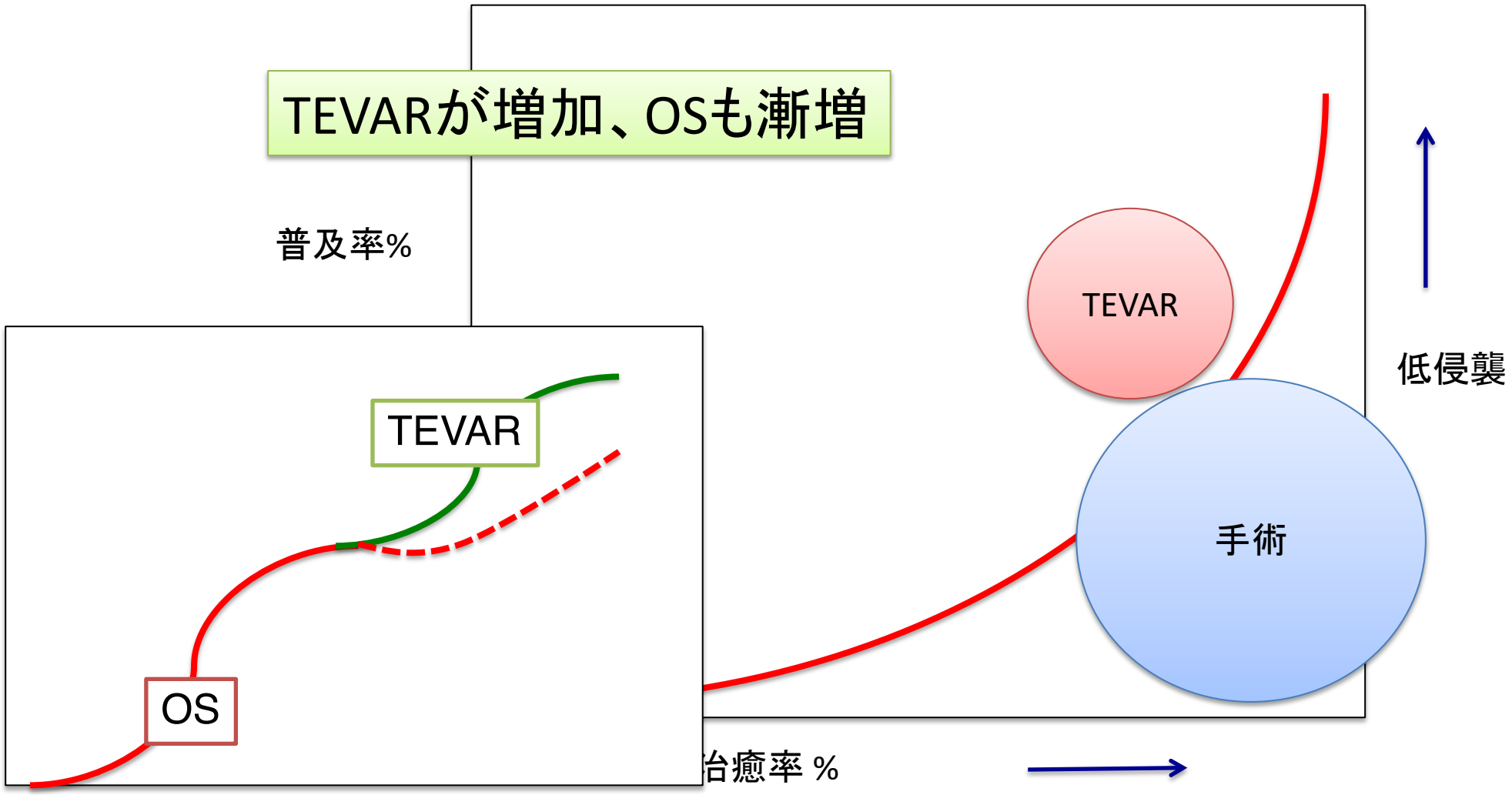
真性瘤非破裂


上行
上行＋弓部
弓部＋下行
下行
胸腹部
ステント
FET
12000
10000
8000
6000
4000
2000
0
1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018
OSは漸増、TEVARが増加の主体
JOSG使用開始
FET
市販stent
TEVAR

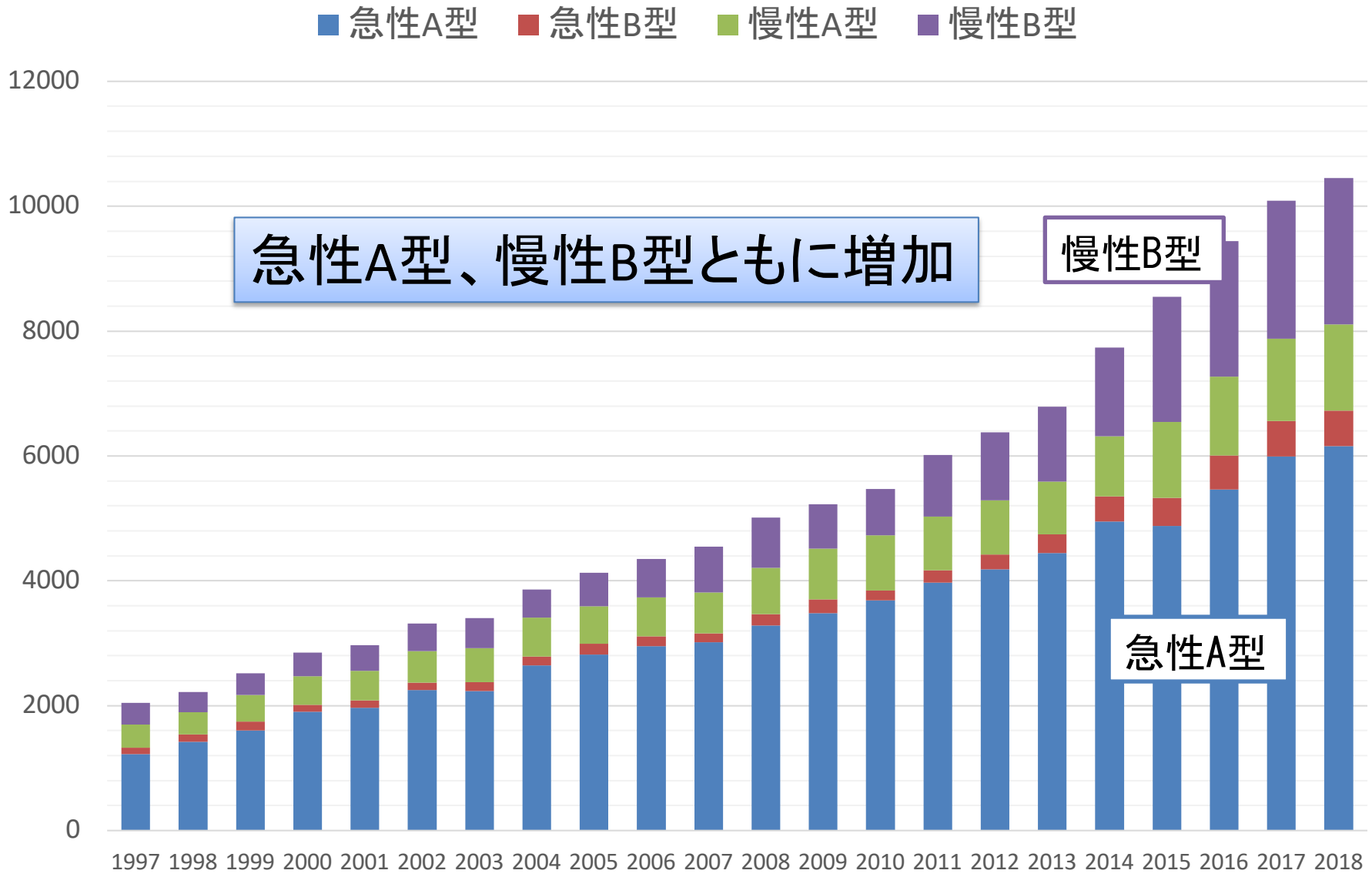
非解離非破裂


上行
上行＋弓部
弓部＋下行
下行
胸腹部
ステント
FET
ステント、FETともにS字状に増加、最近はプラトー
ステント
FET
3500
3000
2500
2000
1500
1000
500
0
1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018

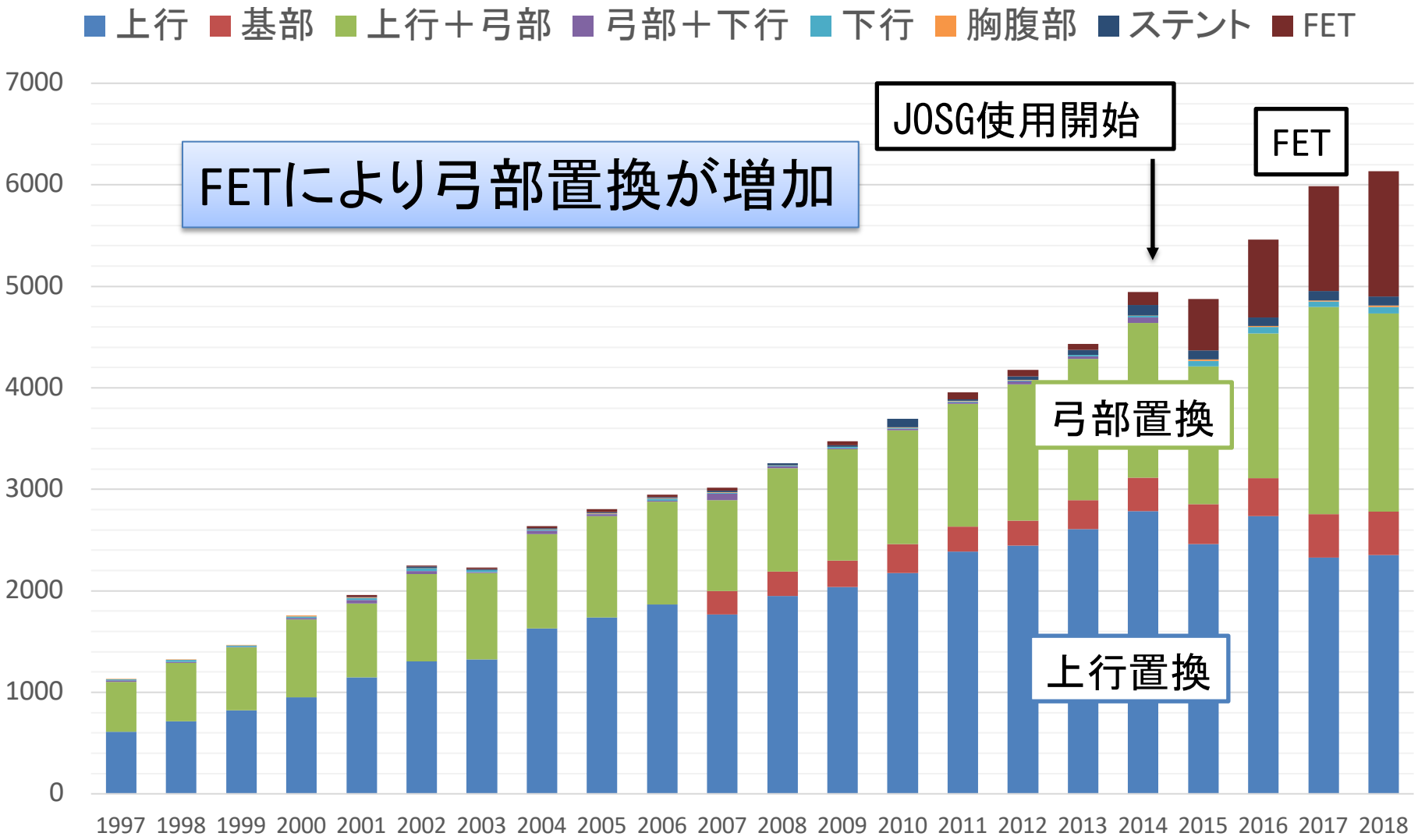
手術侵襲と普及率
（真性大動脈瘤）



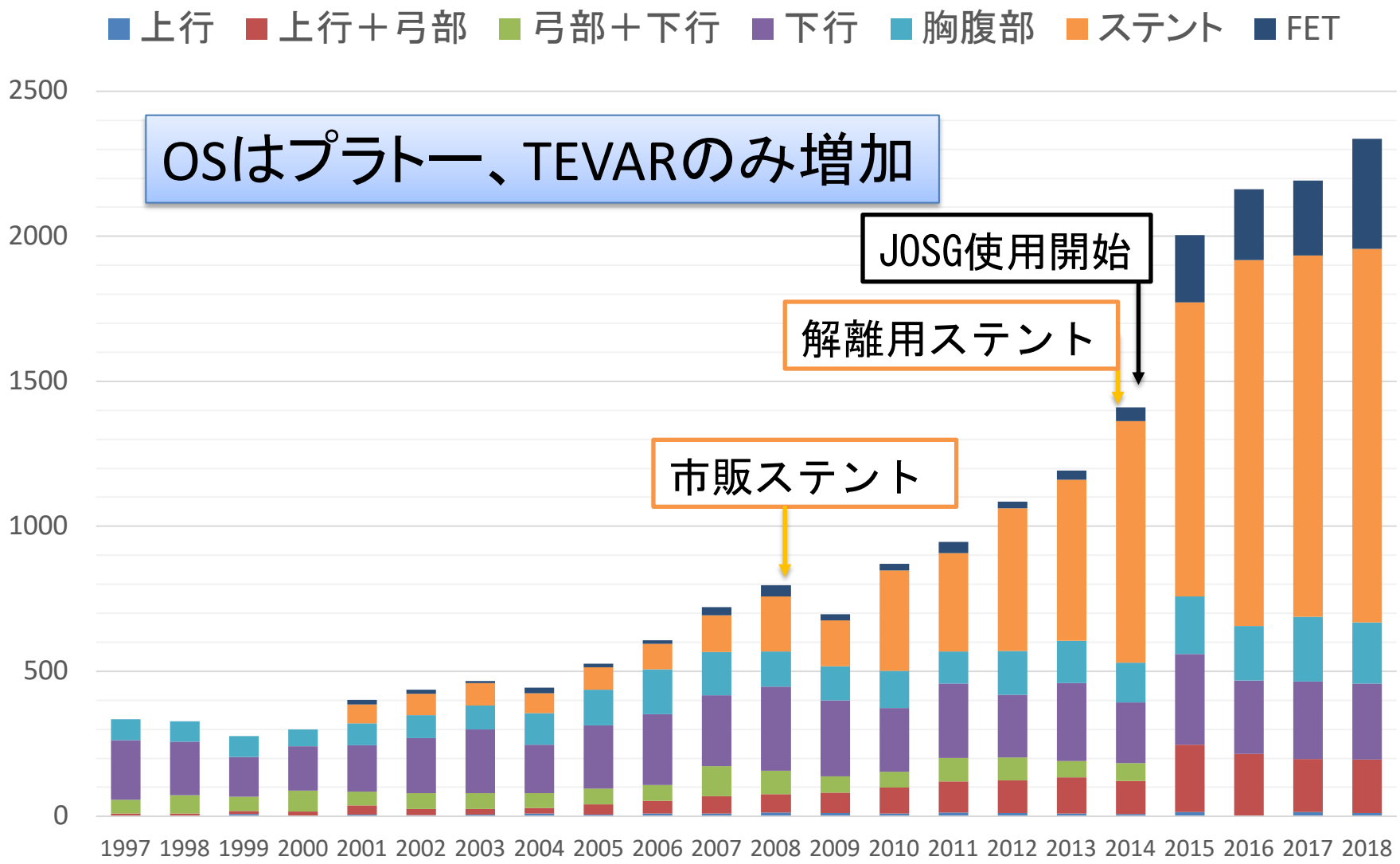
解離性大動脈瘤


急性A型
急性B型
慢性A型
慢性B型
12000
10000
8000
6000
4000
2000
0
急性A型、慢性B型ともに増加
慢性B型
急性A型
1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018

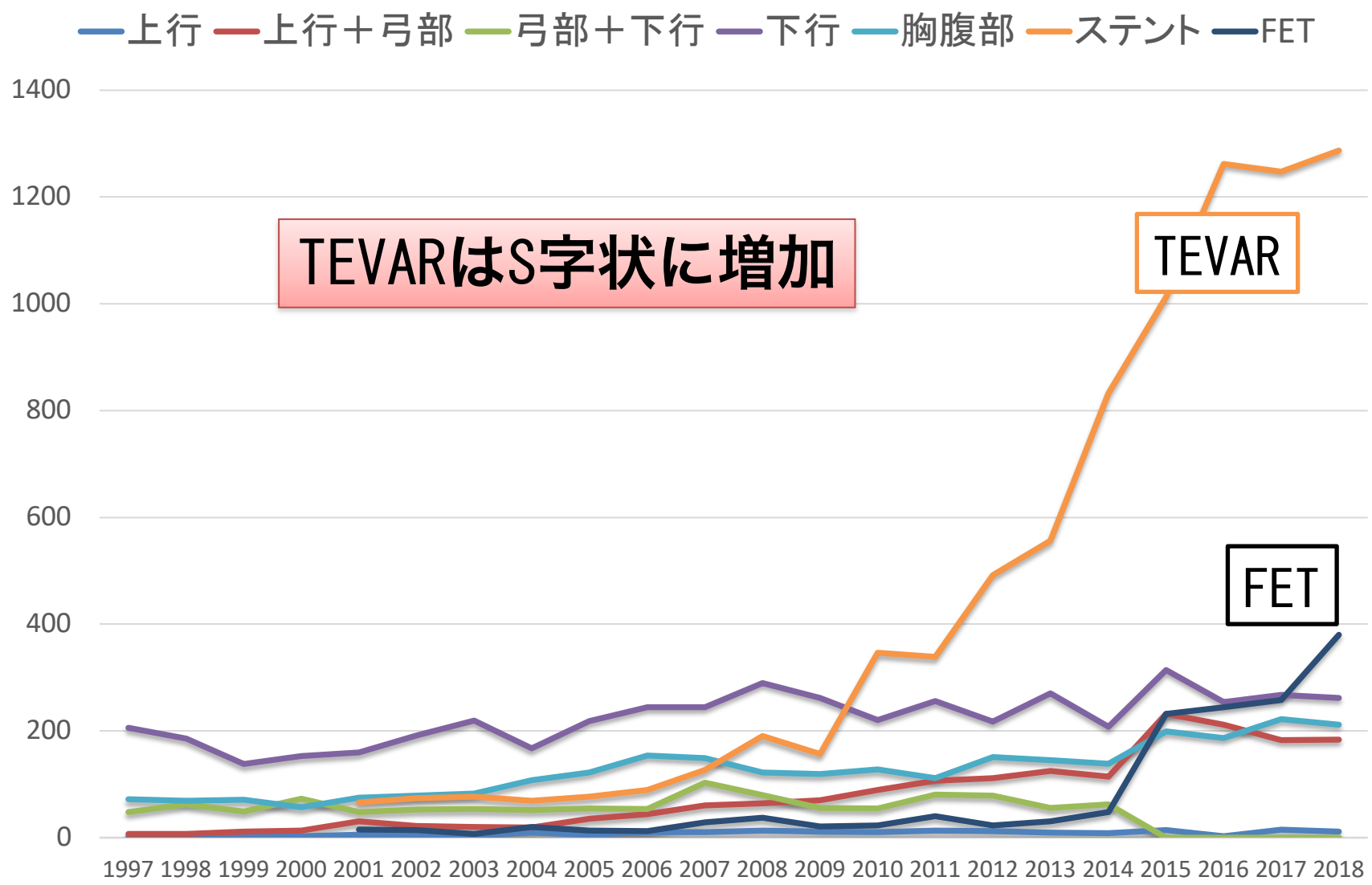
急性A型解離


上行
基部
上行＋弓部
弓部＋下行
下行
胸腹部
ステント
FET
7000
6000
5000
4000
3000
2000
1000
0
1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018
FETにより弓部置換が増加
JOSG使用開始
FET
弓部置換
上行置換

慢性B型解離


上行
上行＋弓部
弓部＋下行
下行
胸腹部
ステント
FET
2500
2000
1500
1000
500
0
OSはプラトー、TEVARのみ増加
JOSG使用開始
解離用ステント
市販ステント
1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018

慢性B型解離


上行
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TEVARはS字状に増加
TEVAR
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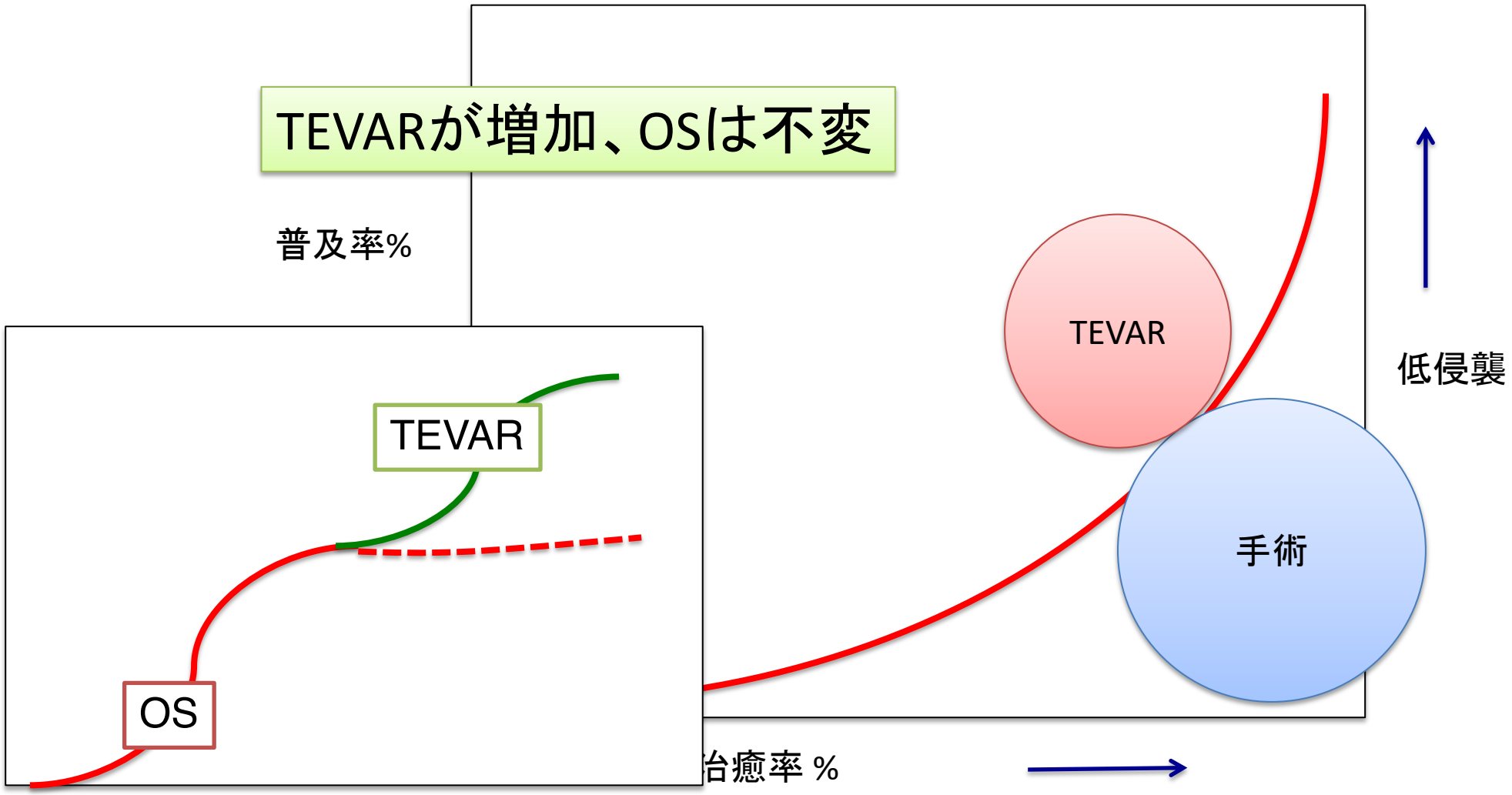
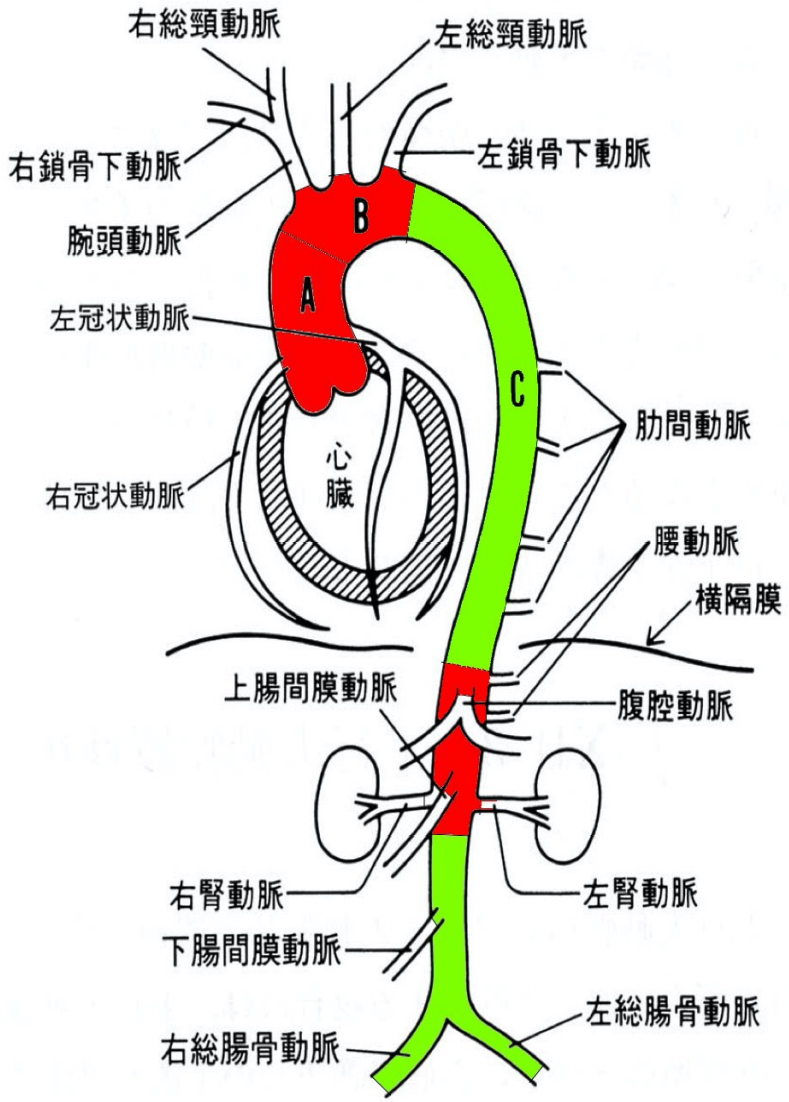
手術侵襲と普及率
（解離性大動脈瘤）

TEVARが増加、OSは不変



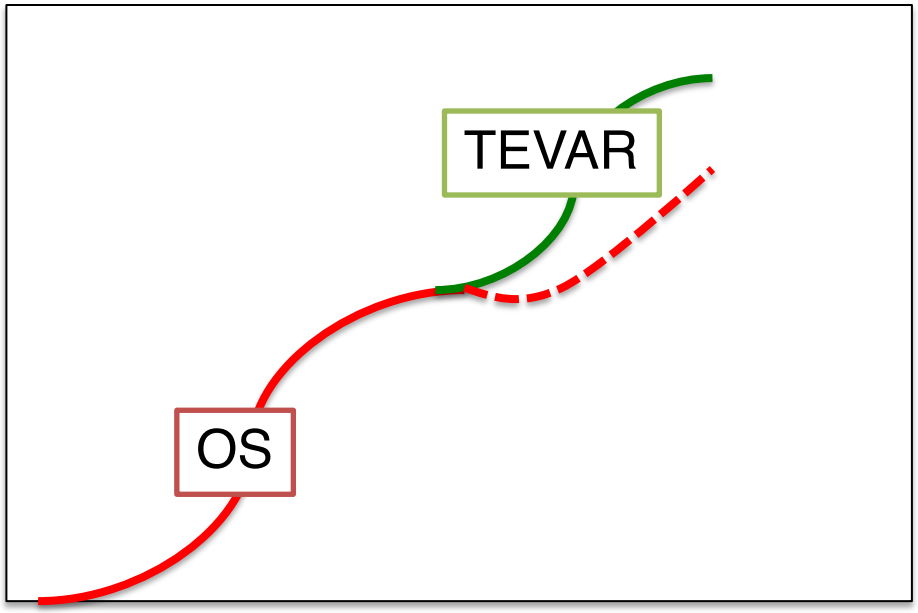
部位と治療方針



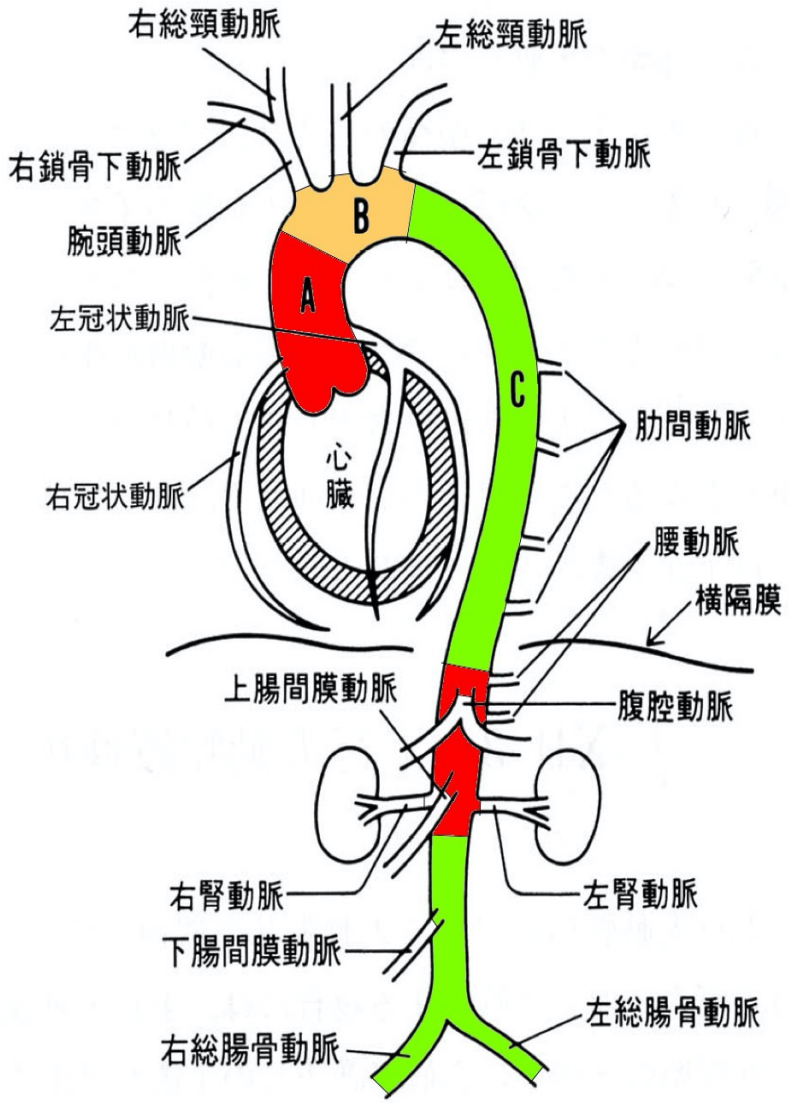
人工血管置換

ハイブリッド治療可能

ステント治療可能



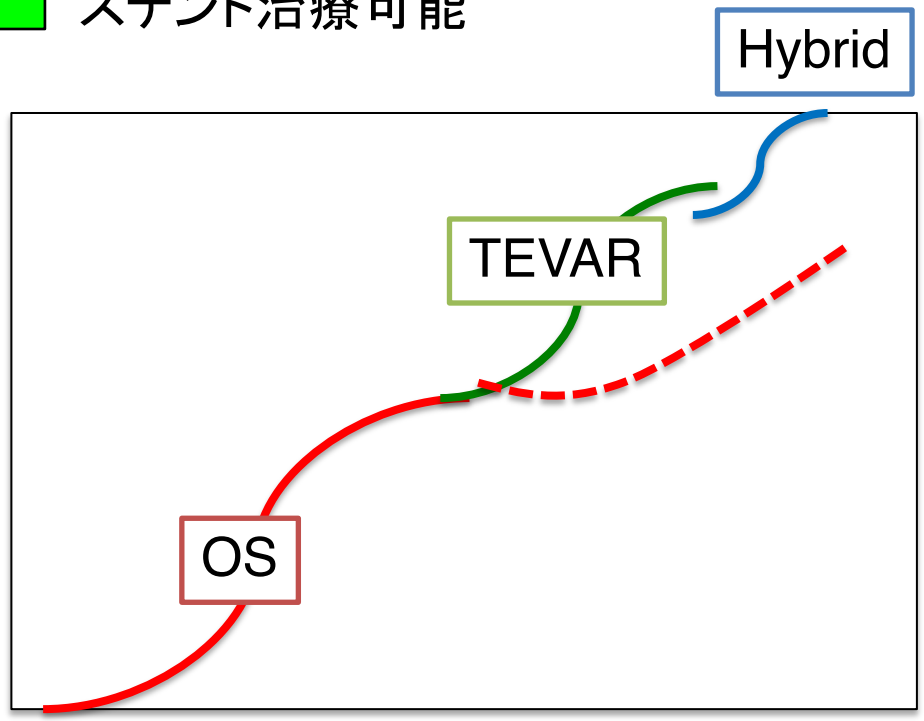
部位と治療方針



人工血管置換

ハイブリッド治療可能

ステント治療可能



心臓外科の技術革新のまとめ

- 心臓外科診療は低侵襲を目指して技術革新が進行している
- 大動脈弁狭窄症に対するカテーテル治療が普及し、高齢者の手術適応が拡大している
- オフポンプバイパスは手術侵襲を軽減するが、大きな適応拡大には繋がっていない
- 胸部大動脈手術では、ステント治療が普及し手術数が増加しているが、解剖学的制限により開胸手術も増加している

名大心臓外科教室の心臓外科学への貢献

1952年：日本で初めて人工心肺を開発（戸田博教授）

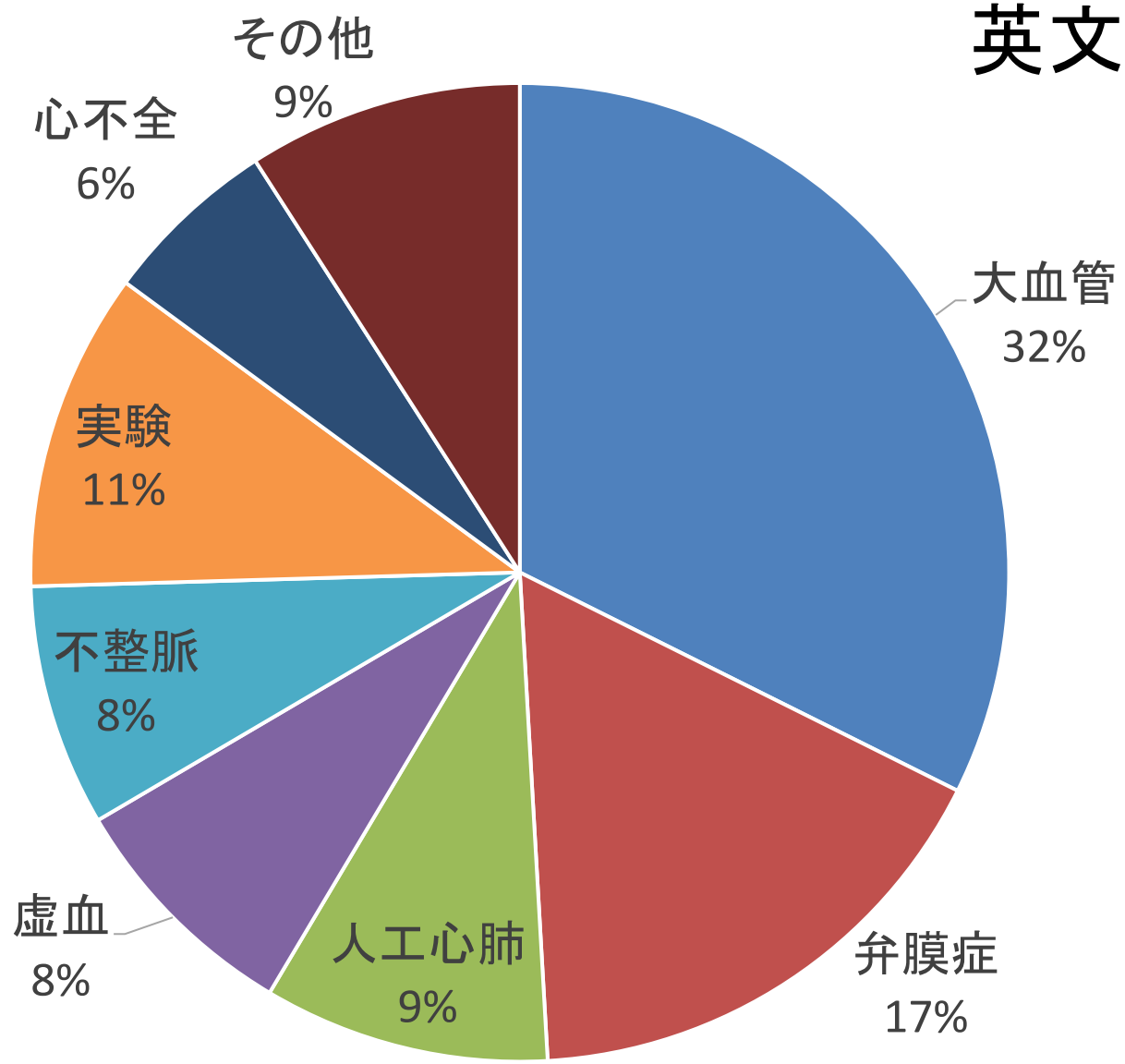
1960年：慢性解離性大動脈瘤に対する日本初の下行大動脈置換術（弥政洋太郎 教授）

名古屋大学心臓外科の歴史

	By Whom		名大	
			1918	血管造影法（斉藤真）
1953	John H. Gibbon, Jr.	ASD/人工心肺	1952	人工心肺（戸田博）
1954	榊原（東女医大）	PS/低体温	1957	低体温研究（橋本義雄）
1955	榊原（東女医大）	ASD/低体温	1957	ASD（低体温）福慶逸郎
1956	曲部（阪大）	TOF/人工心肺	1959	TOF（人工心肺）福慶逸郎
1958	Mason Sones	冠動脈造影	1960	人工血管置換（弥政洋太郎）
1967	Rene Favaloro	冠動脈バイパス	1966	膜型人工肺研究（加藤茂雄）
1972	瀬在幸安	冠動脈バイパス	1972	冠動脈バイパス（村瀬允也）
			1973	弥政教授就任
			1983	胸部外科新設（阿部教授）

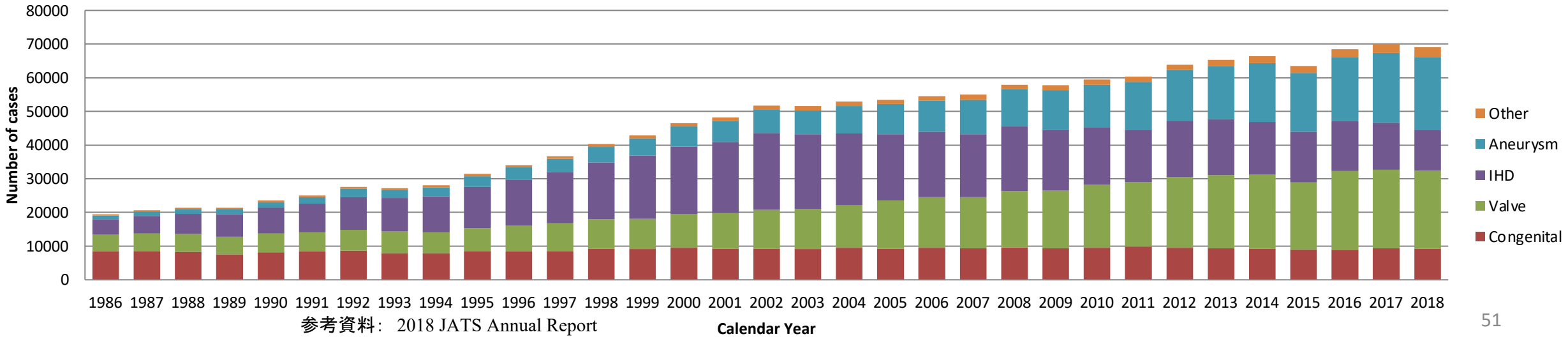
私の心臓外科学への貢献

英文論文　筆頭:49
共著:248



胸部大動脈領域への貢献

- 1990: 脳障害バイオマーカー; S100b
- 1992: 逆行性脳灌流法の確立
- 2002: Frozen Elephant Trunk
- 2006: Vascular tube法（肋間動脈再建）



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Creatine kinase BB isozyme in the blood during open heart surgery: comparison with creatine kinase MB and MM isozymes.

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逆行性脳灌流法の確立

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Retrograde Cerebral Perfusion Through a Superior Vena Caval Cannula Protects the Brain

Akihiko Usui, MD, Toshiro Hotta, MD, Mamabu Hiroura, Mitsuya Murase, MD, Masanobu Maeda, MD, Tomio Koyama, Minoru Tanaka, MD, Eiji Takeuchi, MD, Kenzo Yasuura, MD, Takashi Watanabe, MD, and Toshio Abe, MD

Department of Thoracic Surgery, Nagoya University School of Medicine, Nagoya, Japan, and Thoracic Surgery Division, Oogaki Municipal Hospital, Oogaki, Japan

Retrograde cerebral perfusion through a superior vena caval cannula is a new technique for protecting the brain during aortic arch operations. In mongrel dogs (n = 10; 13 to 15 kg) we have performed retrograde cerebral perfusion (300 mL/min) by infusing blood through a superior vena caval cannula with aortic and inferior vena caval drainage. We have measured the cerebral tissue blood flow, oxygen consumption, and carbon dioxide exudation during retrograde cerebral perfusion at normothermia (NT, 37°C) and hypothermia (HT, 20°C) and have compared these values with values obtained in dogs during cardiopulmonary bypass (1,200 mL/min). Cerebral tissue blood flow was measured by the hydrogen clearance method. During retrograde cerebral perfusion about 20% of the superior vena caval perfusate was returned through the aorta and the rest drained from the inferior vena cava. Cerebral vascular resistance during retrograde cerebral perfusion was lower than that during cardiopulmonary bypass (NT, 63.8 ± 52.5 versus 126.9 ± 58.4; HT, 28.4 ± 32.8 versus 69.5 ± 28.7 × 10^3 dynes · s · cm^{-5}). Retrograde cerebral perfusion provided half the cerebral tissue blood flow of cardiopulmonary bypass (NT, 14.7 ± 6.4 versus 34.3 ± 7.8; HT, 17.6 ± 5.6 versus 37.2 ± 10.6 mL/min). Retrograde cerebral perfusion also provided a third of the oxygen (NT, 4.4 ± 2.1 versus 12.3 ± 7.1; HT, 1.4 ± 0.8 versus 4.2 ± 1.3 mL/min) and discharged 20% of the carbon dioxide (NT, 0.24 ± 0.08 versus 1.19 ± 0.58; HT, 0.15 ± 0.06 versus 0.51 ± 0.17 mmol/min) when compared with cardiopulmonary bypass. Retrograde cerebral perfusion may reduce ischemic damage during interruption of cerebral blood flow.

(Ann Thorac Surg 1992;53:47–53)

Comparative experimental study between retrograde cerebral perfusion and circulatory arrest

To evaluate the efficacy of retrograde cerebral perfusion in protecting the brain, we comparatively studied retrograde cerebral perfusion and total circulatory arrest in 18 hypothermic (20° C) mongrel dogs (retrograde cerebral perfusion, n = 10; total circulatory arrest, $n = 8$). Retrograde cerebral perfusion was performed, maintaining an external jugular venous pressure of 25 mm Hg for 60 minutes. Retrograde cerebral perfusion provided half the cerebral blood flow and a third of the oxygen that was supplied during hypothermic cardiopulmonary bypass, which had a flow rate of 100 ml/min per kilogram. Oxygen consumption and carbon dioxide exudation did not increase on resuming cardiopulmonary bypass after retrograde cerebral perfusion, whereas they increased after total circulatory arrest (oxygen consumption 10.7 ± 5.3 versus 19.1 ± 8.6 ml/min, $p < 0.05$; carbon dioxide exudation, 0.92 ± 0.54 versus 1.64 ± 0.78 mmol/min, $p < 0.05$). Therefore, oxygen debt during retrograde cerebral perfusion was smaller than during total circulatory arrest. Retrograde cerebral perfusion also cooled the brain better than did total circulatory arrest (20.4° ± 1.5° C versus 22.7° ± 0.7° C, $p < 0.01$). Cerebral tissue oxygen tension decreased slightly (27.5 ± 7.7 versus 12.3 ± 3.0 mm Hg, $p < 0.01$), and cerebral tissue carbon dioxide tension increased slowly during retrograde cerebral perfusion (95 ± 34 versus 147 ± 44 mm Hg, $p < 0.05$). These changes were smaller than those seen in total circulatory arrest. Tissue concentrations of adenosine triphosphate in the brain remained relatively high during retrograde cerebral perfusion but decreased rapidly during total circulatory arrest (0.49 ± 0.16 versus 0.21 ± 0.05 mmol/gm, $p < 0.01$, just before resuming cardiopulmonary bypass). Retrograde cerebral perfusion cannot maintain aerobic metabolism but may reduce ischemic damage of the brain and may safely extend the cerebral circulation interruption time. (J THORAC CARDIOVASC SURG 1994;107:1228-36)

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Minoru Tanaka, MD,[a] Eiji Takeuchi, MD,[a] and Toshio Abe, MD,[a] *Nagoya and Gifu, Japan*

Determination of optimum retrograde cerebral perfusion conditions

Retrograde cerebral perfusion through a superior vena caval cannula is a new technique used to protect the brain during operations on the aortic arch. We measured cerebral tissue blood flow, oxygen consumption, and cerebrospinal fluid pressure under various perfusion conditions in hypothermic (20° C) mongrel dogs (n = 18, 12.8 ± 0.6 kg) to determine the optimum conditions for retrograde cerebral perfusion. Retrograde cerebral perfusion was performed by infusion via the superior vena caval cannula and drainage via the ascending aortic cannula while the inferior vena cava and azygos vein were clamped. Retrograde cerebral perfusion was performed as the external jugular venous pressure was changed from 15 to 35 mm Hg in increments of 5 mm Hg. Cerebral tissue blood flow was measured by the hydrogen clearance method. Hypothermic retrograde cerebral perfusion with an external jugular venous pressure of 25 mm Hg provided about half the cerebral tissue blood flow of hypothermic (20° C) cardiopulmonary bypass with a flow rate of 1000 ml/min (13.7 ± 7.9 versus 32.7 ± 8.5 ml/min per 100 gm). It decreased significantly as the external jugular venous pressure was decreased from 25 to 15 mm Hg but did not increase significantly as the external jugular venous pressure was increased from 25 to 35 mm Hg. Whole-body oxygen consumption during hypothermic retrograde cerebral perfusion with an external jugular venous pressure of 25 mm Hg was one quarter of that during hypothermic cardiopulmonary bypass (3.4 ± 0.7 versus 12.7 ± 5.6 ml/min) and varied in proportion to external jugular venous pressure. The cerebrospinal fluid pressure was a little lower than the external jugular venous pressure (19.2 ± 4.5 mm Hg versus 24.8 ± 2.4 mm Hg) but also varied with the external jugular venous pressure. The cerebrospinal fluid pressure remained lower than 25 mm Hg so long as the external jugular venous pressure remained lower than 25 mm Hg. High external jugular venous pressure was associated with high intracranial pressure, which restricts cerebral tissue blood flow and may cause brain edema. We believe that a venous pressure of 25 mm Hg is the optimum condition for retrograde cerebral perfusion. (J THORAC CARDIOVASC SURG 1994;107:300-8)

Akihiko Usui, MD,[a] Keiji Oohara, MD,[a] Tong-lin Liu, MD,[a] Mitsuya Murase, MD,[b]
Minoru Tanaka, MD,[a] Eiji Takeuchi, MD,[a] and Toshio Abe, MD,[a] *Nagoya and Gifu, Japan*

BODY TEMPERATURE INFLUENCES REGIONAL TISSUE BLOOD FLOW DURING RETROGRADE CEREBRAL PERFUSION

Akihiko Usui, MD[a]
Keiji Oohara, MD[a]
Fumihiko Murakami, MD[b]
Hideki Ooshima, MD[b]
Mitsuo Kawamura, MD[b]
Mitsuya Murase, MD[a]

Objective: This study compared the cerebral microcirculation during retrograde cerebral perfusion with that during antegrade cardiopulmonary bypass under normothermic and hypothermic conditions. *Methods:* Brain tissue blood flow was measured with the hydrogen-clearance and colored microsphere (15 and 50 μm) methods during antegrade cardiopulmonary bypass and retrograde cerebral perfusion. Measurements were performed during normothermia (37° C), moderate hypothermia (28° C) and deep hypothermia (20° C) in groups of mongrel dogs ($n = 8$). *Results:* During antegrade cardiopulmonary bypass, the microsphere method showed a significant decrease in cerebral blood flow as body temperature decreased (40.1 ± 20.8 ml/min/100 gm at 37° C, 16.2 ± 18.0 ml/min/100 gm at 20° C with 50 μm microspheres) At 20° C, the cerebral blood flow measured with the 15 μm microspheres was significantly lower than that assessed with the hydrogen-clearance method (11.3 ± 7.0 vs 24.8 ± 7.0 ml/min/100 gm). During retrograde cerebral perfusion, the microsphere method also showed a significant decrease in cerebral blood flow with cooling. At 37° C, the cerebral blood flow measured with the 15 μm microspheres (0.8 ± 0.7 ml/min/100 gm) was significantly lower than that assessed with the hydrogen-clearance method (10.1 ± 3.5 ml/min/100 gm). At both 28° and 20° C, the hydrogen-clearance method showed significantly higher cerebral blood flow (10.1 ± 5.8 and 8.2 ± 3.7 ml/min/100 gm) than did the 50 μm microspheres (1.8 ± 0.6 and 1.0 ± 0.8 ml/min/100 gm) and 15 μm microspheres (0.23 ± 0.14 and 0.18 ± 0.15 ml/min/100 gm). *Conclusion:* (1) Cerebral blood flow that shunts to capillaries is increased during antegrade cardiopulmonary bypass under deep hypothermia. (2) During retrograde perfusion, the majority of the blood flow shunts away from brain capillaries, even under normothermic conditions, and blood flow through large venoarterial shunts increases as body temperature decreases. Although the cerebral microcirculation during retrograde perfusion is decreased, retrograde perfusion provides some degree of oxygenation to the body. (J Thorac Cardiovasc Surg 1997;114: 440-7)

REGIONAL CEREBRAL TISSUE BLOOD FLOW MEASURED BY THE COLORED MICROSPHERE METHOD DURING RETROGRADE CEREBRAL PERFUSION

Keiji Oohara, MD,[a] Akihiko Usui, MD,[a] Mitsuya Murase, MD,[b] Minoru Tanaka, MD,[a] and Toshio Abe, MD,[a] *Nagoya and Gifu, Japan*

Brain tissue blood flow was measured precisely by the colored microsphere method during retrograde cerebral perfusion in 10 normothermic mongrel dogs. The average tissue blood flow rates to the cerebral cortex, cerebral medulla, brain stem, cerebellum, and spinal cord during retrograde cerebral perfusion at 25 mm Hg of external jugular venous pressure were 10.5 ± 10.3, 4.2 ± 4.6, 11.1 ± 9.8, 12.3 ± 8.6, and 9.1 ± 5.8 ml/min per 100 gm, respectively. The brain was perfused wholly by retrograde cerebral perfusion without lateralization. Total cerebral blood flow was calculated as the sum total rates of blood flow to each area. Total cerebral blood flow during retrograde cerebral perfusion at 25 mm Hg was 7.8 ± 4.4 ml/min, which represented 3.5% ± 1.9% of whole body blood flow and one third of the total cerebral blood flow (28.0 ± 4.2 ml/min) during cardiopulmonary bypass at a flow rate of 1000 ml/min. Oxygen consumption and carbon dioxide elimination by the total cerebrum during retrograde cerebral perfusion at 25 mm Hg were 0.54 ± 0.23 ml/min and 34 ± 15 μmol/min, respectively, or 8.6% ± 3.6% and 7.0% ± 3.1% of the corresponding whole body value and represented about one third of that measured during cardiopulmonary bypass (1.21 ± 0.39 ml/min and 96 ± 15 μmol/min). Total cerebral blood flow, total cerebral oxygen consumption, and carbon dioxide elimination increased as the external jugular venous pressure increased from 15 to 25 mm Hg; however, no further increase occurred once the external jugular venous pressure exceeded 25 mm Hg. (J THORAC CARDIOVASC SURG 1995;109:772-9)

Comparative clinical study between retrograde cerebral perfusion and selective cerebral perfusion in surgery for acute type A aortic dissection

Akihiko Usui*, Kenzo Yasuura, Takashi Watanabe, Takashi Maseki

European Journal of Cardio-thoracic Surgery 15 (1999) 571–578

Abstract

Objective: Selection of a brain protection method is a primary concern for aortic arch surgery. We performed a retrospective study to compare the respective advantages and disadvantages of retrograde cerebral perfusion (RCP) and selective cerebral perfusion (SCP) in patients who underwent surgery for acute type A aortic dissection. **Methods:** The study reviewed 166 patients who underwent surgery at Nagoya University or its eight branch hospitals between January 1990 and August 1996. There were 91 patients who received SCP and 75 patients who underwent RCP. Results for these two groups were compared. **Results:** There were no significant differences in age, gender, Marfan syndrome rate, DeBakey classification, or emergency operation rate. Rates of various preoperative complications were similar except for aortic valve regurgitation. Arch replacement was performed more often in SCP than in RCP patients (49% vs. 27%, $P = 0.0028$). There were no significant differences between groups in cardiac ischemic time or visceral organ ischemic time. However, RCP group showed shorter cardio-pulmonary bypass time (297 ± 99 vs. 269 ± 112 min, $P = 0.013$) and lower the lowest core temperature (21.6 ± 3.1°C vs. 18.7 ± 2.1°C, $P = 0.0001$). SCP duration was longer than RCP duration (103 ± 56 vs. 54 ± 24 min, $P < 0.0001$). Despite these differences, RCP patients were not significantly different from SCP patients with regard to any postoperative complication, neurological dysfunction (16 vs. 19%), or operative mortality (all deaths within the hospitalization; 24 vs. 21%). Regarding neurologic dysfunction, there were six cases of coma, six of motor paralysis, two of paraplegia and one of visual loss among SCP patients, and eight cases of coma, three of motor paralysis, and three of convulsion in the RCP group. The incidence of motor paralysis was higher in the SCP group, while the incidence of coma was higher in the RCP group. **Conclusions:** RCP can be performed without clamping or cannulation of the cervical arteries, which is an advantage in reducing the chances of arterial injury or cerebral embolization. RCP is comparable to SCP in terms of clinical outcome.

Early Clinical Results of Retrograde Cerebral Perfusion for Aortic Arch Operations in Japan

Akihiko Usui, MD, Toshio Abe, MD, and Mitsuya Murase, MD

Background. In Japan, retrograde cerebral perfusion (RCP) has been used for protection of the brain since 1986. The techniques vary by institution, and thus the optimum perfusion conditions have not yet been established.

Methods. A survey of 49 institutions was performed to investigate the early results of RCP in Japan. There were 228 patients collected, 46 (20.2%) of whom sustained brain complications. Twenty-seven patients had permanent and 19, temporary neurologic dysfunction. There were 31 early deaths (13.6%) and an additional 14 hospital deaths (6.1%). Significant predictors of brain complications and mortality were evaluated by univariate analysis and multivariate analysis using stepwise logistic regression.

Results. By multivariate analysis, preoperative cardiac arrest (odds ratio 8.901, $p = 0.0004$) and RCP duration longer than 60 minutes (odds ratio 3.234, $p = 0.0352$) were significant predictors of permanent neurologic dysfunction. Preoperative hemodynamic compromise (odds ratio 6.150, $p = 0.0070$), presence of preoperative neurologic symptoms (odds ratio 7.155, $p = 0.0283$), and left thoracotomy (odds ratio 2.37, $p = 0.0335$) were significant predictors of early death. Duration of RCP was the single RCP–related factor predictive of a brain complication (odds ratio 1.025 per minute, $p < 0.0001$). The incidence of permanent neurologic dysfunction was less than 10% when the RCP time was shorter than 60 minutes but increased abruptly when the RCP time exceeded 100 minutes, and it remained approximately 15% between 60 and 99 minutes.

Conclusions. Less than 60 minutes of RCP can be tolerated with minimal risk of brain complication. Retrograde cerebral perfusion is one method of cerebral protection during circulatory arrest. This method is not the complete answer for brain protection, but, given specific guidelines, it may help prolong the safe time of circulatory arrest.

(Ann Thorac Surg 1996;62:94–104)

Risk-adjusted and case-matched comparative study between antegrade and retrograde cerebral perfusion during aortic arch surgery: based on the Japan Adult Cardiovascular Surgery Database

Akihiko Usui, MD, PhD · Hiroaki Miyata, PhD
Yuichi Ueda, MD · Noboru Motomura, MD, PhD
Shinichi Takamoto, MD

Gen Thorac Cardiovasc Surg (2012) 60:132–139

Conclusion. Both RCP and ACP provide comparable clinical outcomes regarding both the mortality and stroke rates. RCP resulted in a higher incidence only in patients demonstrating transient neurological dysfunction and the need for dialysis.

Frozen Elephant Trunk (FET)

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Usui A, et al. Artificial Organ 2002;26:1044-49.
Usui A et al. Ann Thorac Surg 2002;74:S1821-24 .
Cerebrospinal dysfunction after endovascular stent-grafting via median-sternotomy (frozen elephant trunk procedure).
Usui A, Ueda Y. Ann Thorac Surg. 2009;88:349

Implantation of an endovascular covered stent-graft for distal aortic arch aneurysm via midsternotomy under pigtail catheter guidance

Akihiko Usui[a,*], Kazuki Tajima[b], Naomichi Nishikimi[c], Tsuneo Ishiguchi[d]

European Journal of Cardio-thoracic Surgery 16 (1999) 356–358

Abstract

We implanted an endovascular covered stent-graft for distal aortic arch aneurysm involving the left subclavian artery in 12 cases. A stent-graft was delivered just below the aneurysm via aortotomy with direct vision using a 12 F delivery sheath under guidance of a pigtail catheter placed via the groin artery. The proximal anastomosis of the stent-graft was performed with inclusion technique, and the aortotomy was then closed with it. This technique reduces operative damage by eliminating distal anastomosis and should reduce operative mortality and morbidity.

Cerebrospinal Dysfunction After Endovascular Stent-Grafting via a Median Sternotomy: The Frozen Elephant Trunk Procedure

Akihiko Usui, MD, PhD, Kazuro Fujimoto, MD, Tsuneo Ishiguchi, MD, Masaharu Yoshikawa, MD, Toshiaki Akita, MD, PhD, and Yuichi Ueda, MD

Background. Endovascular stent grafting through a median sternotomy for a distal arch aneurysm (the frozen elephant trunk procedure) is an alternative to synthetic graft replacement. But spinal cord dysfunction can easily occur as a complication after surgery. Although its cause is uncertain, some attempts at prevention have been instituted. We address the mechanism of spinal cord dysfunction and evaluate the efficacy of our preventive measures.

Methods. There were 22 men and 2 women with an average age of 71 (59 to 83) years. There were 22 true aneurysms (13 fusiform, nine saccular), one chronic dissection, and one penetrating aortic ulcer. The following strategies for prevention of spinal cord dysfunction were utilized: low flow perfusion through both axillary arteries (n = 10); pigtail catheter guidance (n = 19); use of a shorter graft with anchoring sutures (n = 12); flooding of the operative field with carbon dioxide (n = 7); aortic unclamping (n = 7), and use of ultra-thin woven Dacron grafts (n = 15).

Results. There was no operative mortality, but cerebrospinal dysfunction complicated four cases (17%): one paraplegia, one stroke along the basilar artery, and two cases of temporary spinal cord dysfunction (paresthesia of the right leg and urinary disturbance). Cerebrospinal dysfunction tended to occur in fusiform aneurysms (31%, $p = 0.044$). Except when low flow antegrade perfusion through both the axillary arteries was utilized, which resulted in no cases of paraplegia or paraparesis ($p = 0.064$), the methods used for prevention of cerebrospinal dysfunction appeared to have little efficacy.

Conclusions. Cerebrospinal dysfunction is a serious complication of the frozen elephant trunk procedure. Its cause has not been clarified, but it tends to occur in fusiform-type aneurysms. Antegrade perfusion through both axillary arteries while the aorta is open may be helpful in its prevention.

(Ann Thorac Surg 2002;74:S1821–4)

Hybrid versus open repair of aortic arch aneurysms: comparison of postoperative and mid-term outcomes with a propensity score-matching analysis

European Journal of Cardio-Thoracic Surgery 49 (2016) 149–156

Yoshiyuki Tokuda[a,*], Hideki Oshima[a], Yuji Narita[a], Tomonobu Abe[a], Yoshimori Araki[a], Masato Mutsuga[a], Kazuro Fujimoto[a], Sachie Terazawa[a], Kei Yagami[a], Hideki Ito[a], Kiyoto Yamamoto[b], Kimihiro Komori[b] and Akihiko Usui[a]

Abstract

OBJECTIVES: Operative strategies for repairing aortic arch aneurysms should be re-evaluated following recent technical advances.

METHODS: Of 364 patients who underwent aortic arch repair between 2002 and 2014, 58 were high-risk subjects who received isolated hybrid arch repair (HAR) via median sternotomy (type I $n = 32$, type II $n = 1$ and type III $n = 25$). During this period, excluding patients with type A dissection or extensive aneurysms, 124 patients received isolated open arch repair via median sternotomy. The patients in the HAR and open arch repair groups were compared. A propensity score-matching analysis was applied to adjust for baseline risk factors.

RESULTS: The patients in the HAR group were older (77 years ± 6 vs 69 ± 9, $P < 0.0001$), exhibited a greater rate of malignancy (21 vs 4.8%, $P = 0.0022$) and had higher logistic EuroSCORE values (31 ± 18 vs 20 ± 15, $P < 0.0001$) than those in the open arch repair group. Following propensity score matching creating 38 matched pairs, the differences in preoperative risk diminished. Operative complications, including the mortality rate (2.6 vs 0%), were similar between the groups. Apart from the lower rates of cardiopulmonary bypass (CPB) and circulatory arrest, there was no apparent superiority of HAR with respect to patient recovery. The mean follow-up duration was 52.5 months, during which the rate of freedom from aortic events in the HAR and open arch repair groups was 79 and 99% at 24 months, respectively ($P < 0.0001$).

CONCLUSIONS: HAR achieves equivalent short-term results to standard open arch repair, with a decreased need for CPB. However, considering the inferior mid-term outcomes of this procedure, its indications should be limited to high-risk patients.

Vascular tube 法

胸腹部大動脈手術時の肋間動脈再建
脊髄保護法

A vascular tube for intercostal artery reimplantation

European Journal of Cardio-thoracic Surgery 29 (2006) 413—415

Masashi Toyama*, Akihiko Usui, Toshiaki Akita, Yuichi Ueda

Abstract

Paraplegia and paraparesis are major concerns in descending and thoracoabdominal aortic repair. A shorter period of spinal cord ischemia is preferred for protection. We have developed a new technique in which plural intercostal arteries are reattached in a short time. The lower descending aorta is tailored using automatic sutures, and a vascular tube is made with diameter about 2.0 cm. Blood supply of intercostal arteries including the Adamkiewicz artery is resumed by perfusing the vascular tube in not more than 20 min. This technique has been applied in four patients, and there was neither paraplegia nor paraparesis.

Interactive CardioVascular and Thoracic Surgery 11 (2010) 15–19

www.icvts.org

Institutional report - Vascular thoracic

Spinal cord protection during a thoracoabdominal aortic repair for a chronic type B aortic dissection using the aortic tailoring strategy☆

Masato Mutsuga*, Yuji Narita, Yoshimori Araki, Atsuo Maekawa, Hideki Oshima, Akihiko Usui, Yuichi Ueda

Graduate School of Medicine, Department of Cardiac Surgery, Nagoya University, 65 Tsurumaicyo Syowaku, Nagoya, Aichi 466-8550, Japan

The changes of aortic diameter after aortic repair with aortic tailoring technique for chronic type B aortic dissection[†]

Hiroto Suenaga*, Akihiko Usui, Masato Mutsuga, Hideki Oshima, Tomonobu Abe, Yuji Narita, Kazuro Fujimoto and Yoshiyuki Tokuda

European Journal of Cardio-Thoracic Surgery 50 (2016) 1118–1123

脳脊髄障害・感染

Impact of Surgical Stroke on the Early and Late Outcomes After Thoracic Aortic Operations

Noritaka Okada, MD, Hideki Oshima, MD, PhD, Yuji Narita, MD, PhD, Tomonobu Abe, MD, PhD, Yoshimori Araki, MD, PhD, Masato Mutsuga, MD, PhD, Kazuro L. Fujimoto, MD, PhD, Yoshiyuki Tokuda, MD, PhD, and Akihiko Usui, MD, PhD

Background. Thoracic aortic operations still remain associated with substantial risks of death and neurologic injury. This study investigated the impact of surgical stroke on the early and late outcomes, focusing on the physical status and quality of life (QOL).

Methods. From 1986 to 2008, 500 patients (aged 63 ± 13 years) underwent open thoracic aortic repair for root and ascending (31%), arch (39%), extended arch (10%), and descending and thoracoabdominal (19%) aneurysms. Brain protection consisted of retrograde cerebral perfusion (52%), antegrade cerebral perfusion (29%), and simple deep hypothermic circulatory arrest (19%). Surgical stroke was defined as a neurologic deficit persisting more than 72 hours after the operation. QOL was assessed with the Short-Form 36 Health Survey Questionnaire 5.9 ± 4.2 years after the operation.

Results. Stroke occurred in 10.3% of patients. Hospital mortality was 21% in the stroke group and 2.7% in the nonstroke group ($p < 0.001$). At hospital discharge, 76% of survivors in the stroke group had permanent neurologic deficits (PNDs), with sustained tracheostomy in 39%, tube feeding in 46%, and gastrostomy in 14%, and 89% required transfer to other facilities. PND was an independent risk factor for late death (hazard ratio, 2.29; 95% confidence interval, 1.04 to 4.62; $p = 0.041$) in a multivariate analysis. The physical component of the QOL score was worse in the PND group (51% vs 100%; $p = 0.039$), whereas the mental component was similar in both groups (14% vs 14%).

Conclusions. Surgical stroke is associated with high hospital mortality and PNDs that decrease late survival and the physical component score of the QOL survey.

(Ann Thorac Surg 2015;■:■–■)

Neurologic Deficit After Aortic Arch Replacement: The Influence of the Aortic Atherosclerosis

Yoshiyuki Tokuda, MD, PhD, Yuji Narita, MD, PhD, Kazuro Fujimoto, MD, PhD, Masato Mutsuga, MD, PhD, Sachie Terazawa, MD, PhD, Hideki Ito, MD, PhD, Wataru Uchida, MD, PhD, and Akihiko Usui, MD, PhD

Conclusions. **Atherothrombotic lesions found by objectively graded computed tomography were predictors of neurologic deficit. Retrograde perfusion in the presence of a distal atherothrombotic lesion should be avoided whenever possible. Strategies based on the full assessment of the whole aortic morphologic characteristics appear to be mandatory. Anticoagulation therapy should be performed carefully to avoid intracranial hemorrhagic changes.**

(Ann Thorac Surg 2019;108:107–14)

The efficacy and risk of cerebrospinal fluid drainage for thoracoabdominal aortic aneurysm repair: a retrospective observational comparison between drainage and non-drainage†

Junya Sugiura*, Hideki Oshima, Tomonobu Abe, Yuji Narita, Yoshimori Araki, Kazuro Fujimoto, Masato Mutsuga and Akihiko Usui

Interactive CardioVascular and Thoracic Surgery (2017) 1–6

Abstract

OBJECTIVES: We reviewed our experiences with thoracoabdominal aortic aneurysm (TAAA) repair to assess the efficacy of cerebrospinal fluid drainage (CSFD) to prevent the neurological deficits and complications associated with CSFD.

METHODS: Between 2002 and 2015, 118 patients underwent TAAA repair. Seventy-eight patients underwent CSFD for 2.7 ± 1.1 days after surgery. CSFD was not performed for the other 40 patients due to an urgent situation, chronic disseminated intravascular coagulation or anatomical difficulties.

RESULTS: There were 5 in-hospital deaths (4.2%). The neurological complications included paraplegia ($n = 14$, 11.9%), paraparesis ($n = 3$, 2.5%), cerebral infarction ($n = 11$, 9.3%) and intracranial haemorrhage ($n = 1$, 0.85%), none related to CSFD. The complications related to CSFD included headaches ($n = 13$, 11.0%), subdural haematoma (which was treated conservatively) ($n = 1$, 0.85%), a neurological symptom of the bilateral thighs ($n = 1$, 0.85%), pale haemorrhagic discharge ($n = 2$, 1.7%) and a fractured catheter ($n = 1$, 0.85%). Eight patients had paraplegia and 1 patient had paraparesis among the 78 patients who underwent CSFD (9/78, 11.5%); among the 40 patients who did not undergo CSFD, 6 had paraplegia and 2 had paraparesis (8/40, 20.0%). A multivariate analysis demonstrated that CSFD had a significant protective effect for the spinal cord (odds ratio = 0.045, $P = 0.007$).

CONCLUSIONS: CSFD effectively prevented spinal cord dysfunction in TAAA repair. However, some serious complications occurred, including subdural haematoma and a fractured catheter. It is therefore important to recognize both the efficacy and the risks of CSFD in TAAA repair.

Spinal cord injury following aortic arch replacement

Yoshiyuki Tokuda[1] · Kazuro Fujimoto[1] · Yuji Narita[1] · Masato Mutsuga[1] · Sachie Terazawa[1] · Hideki Ito[1] · Yasumoto Matsumura[1] · Wataru Uchida[1] · Hisaaki Munakata[1] · Shinichi Ashida[1] · Tsukasa Ono[1] · Toshihiko Nishi[1] · Daisuke Yano[1] · Shinichi Ishida[1] · Fumiaki Kuwabara[2] · Toshiaki Akita[1] · Akihiko Usui[1]

Surgery Today
https://doi.org/10.1007/s00595-019-01853-2

Abstract

Purpose Postoperative spinal cord injury is a devastating complication after aortic arch replacement. The purpose of this study was to determine the predictors of this complication.

Methods A group of 254 consecutive patients undergoing aortic arch replacement via median sternotomy, with ($n=78$) or without ($n=176$) extended replacement of the upper descending aorta, were included in a risk analysis. The frozen elephant trunk technique was used in 46 patients. The patients' atherothrombotic lesions (extensive intimal thickening of >4 mm) were identified from computed tomography images.

Results Complete paraplegia ($n=7$) and incomplete paraparesis ($n=4$) occurred immediately after the operation (permanent spinal cord injury rate, 1.97%; transient spinal cord injury rate, 2.36%). A multivariable logistic regression analysis identified the use of the frozen elephant trunk technique (odds ratio 36.3), previous repair of thoracoabdominal aorta or descending aorta (odds ratio 29.4), proximal atherothrombotic aorta (odds ratio 9.6), chronic obstructive lung disease (odds ratio 7.1) and old age (odds ratio 1.1) as predictors of spinal cord injury ($p<0.0001$, area under curve 0.93).

Conclusions Spinal cord injury occurs with a non-negligible incidence following aortic arch replacement. The full objective assessment of the morphology of the whole aorta and the recognition of the risk factors are mandatory.

Is Hybrid Repair for an Entire Shaggy Aorta Feasible?

Heart, Lung and Circulation (2021) **30**, 765–772

Masato Mutsuga, MD, PhD*, Yoshiyuki Tokuda, MD, PhD, Yuji Narita, MD, PhD, Sachie Terazawa, MD, PhD, Hideki Ito, MD, PhD, Akihiko Usui, MD, PhD

Conclusions Surgery for an entire shaggy aorta was frequently associated with embolic complications such as stroke, paraplegia, renal failure, and bowel necrosis. However, open surgical repair may produce better early and late outcomes and freedom from aortic events compared with hybrid repair.

Detection of thoracic aortic prosthetic graft infection with ^{18}F-fluorodeoxyglucose positron emission tomography/computed tomography†

European Journal of Cardio-Thoracic Surgery 43 (2013) 1183–1187

Yoshiyuki Tokuda[a,*], Hideki Oshima[a], Yoshimori Araki[a], Yuji Narita[a], Masato Mutsuga[a], Katsuhiko Kato[b] and Akihiko Usui[a]

Abstract

OBJECTIVES: To investigate the diagnostic value of ^{18}F-fluorodeoxyglucose positron emission tomography/computed tomography (FDG-PET/CT) in detecting thoracic aortic prosthetic graft infection.

METHODS: Nine patients with clinically suspected thoracic aortic graft infection underwent FDG-PET/CT scanning. In these patients, the diagnoses could not be confirmed using conventional modalities. The patients' clinical courses were retrospectively reviewed.

RESULTS: On the basis of surgical, microbiological and clinical follow-up findings, the aortic grafts were considered infected in 4 patients and not infected in 5. All 4 patients with graft infection (root: 2 cases, arch: 1 case and descending: 1 case) eventually underwent in situ re-replacement. Two of the 4 patients also had abdominal grafts; however, only the thoracic grafts were replaced because uptake was low around the abdominal grafts. The maximal standardized uptake value (SUV_{max}) in the perigraft area was higher in the infected group than in the non-infected group (11.4 ± 4.5 vs 6.9 ± 6.4), although the difference was not statistically significant. According to the receiver operating characteristic analysis, SUV_{max} >8 appeared to be the cut-off value in distinguishing the two groups (sensitivity: 1.0 and specificity: 0.8).

CONCLUSIONS: FDG-PET/CT is useful for confirming the presence of graft infection by detecting high uptake around grafts and excluding other causes of inflammation. An SUV_{max} value greater than 8 around a graft suggests the presence of graft infection. In addition, FDG-PET/CT can be used to clarify the precise extent of infection. This is especially useful if multiple separated prosthetic grafts have been implanted.

手術手技

Upper thoracoabdominal aortic repair through partial posterior incision of the diaphragm via left thoracotomy

Hideki Ito[1] · Masato Mutsuga[1] · Yoshiyuki Tokuda[1] · Akihiko Usui[1]

General Thoracic and Cardiovascular Surgery (2020) 68:1594–1595

Exclusion Technique for Entire Shaggy Aorta Followed by One-Stage Repair of the Aortic Arch and Descending Aorta

Heart, Lung and Circulation (2020) **29**, e269–e272

Masato Mutsuga, MD, PhD*, Hideki Ito, MD, PhD, Akihiko Usui, MD, PhD

Conclusions The exclusion technique for an entire shaggy aorta followed by one-stage repair of the aortic arch and descending aorta is a durable and feasible operation for preventing atheromatous embolisation.

不整脈外科

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Repetitive atrial flutter complicates with left side simple maze procedure.
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Repetitive Atrial Flutter as a Complication of the Left-Sided Simple Maze Procedure

Akihiko Usui, MD, Yasuya Inden, MD, Shinichi Mizutani, MD, Yasushi Takagi, MD, Toshiaki Akita, MD, and Yuichi Ueda, MD

Background. Of 41 patients who had undergone a left-sided simple maze procedure, 4 (9.8%) developed repetitive tachycardia due to atrial flutter, and required radiofrequency catheter ablation. Linear ablation of the right atrial isthmus was effective to treat atrial flutter.

Methods. We conducted an electrophysiologic study of atrial flutter and determined its reentry circuit on the atrium. We consider how to reduce atrial flutter after the left-sided simple maze procedure.

Results. Common atrial flutter through the right atrial isthmus was induced in all 4 patients, and linear ablation on the right atrial isthmus was effective in 3 of these. An incisional atrial flutter around the right atriotomy was also induced in 2 of 4 patients; both were successfully treated by linear ablation between the right atriotomy and the inferior vena cava.

Conclusions. Common atrial flutter through the right atrial isthmus is a risk after the left-sided simple maze procedure. When a left-sided simple maze procedure is performed, sufficient cryoablation on the right atrial isthmus of the arrested heart should be administered to prevent postoperative atrial flutter.

(Ann Thorac Surg 2002;73:1457–9)

Frequency analysis of F wave can predict defibrillation success by Maze procedure

Rena Usui[1], Masato Mutsuga[1], Yasuya Inden[2], Toyoaki Murohara[2],Akihiko Usui[1]

THE 35TH EACTS ANNUAL MEETING | 13 – 16 OCTOBER 2021

Conclusions

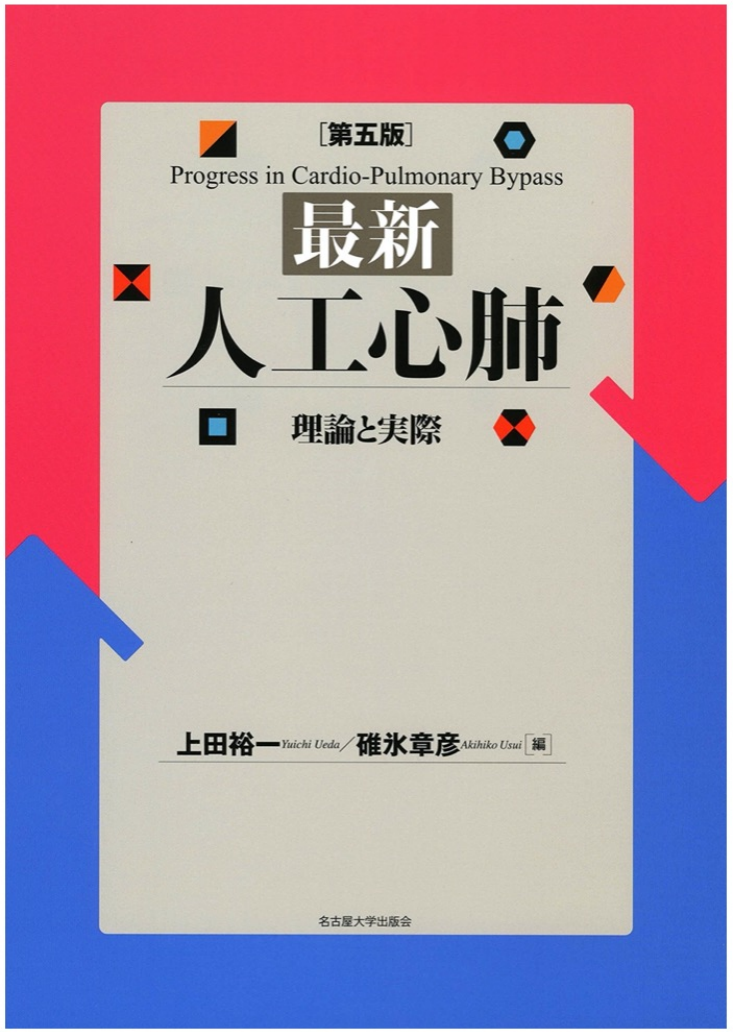
Cases with higher DF and lower voltage, reflecting the most progressed atrial remodeling, showed a poor procedural success rate.

Modified sutureless repair using left atrial appendage flap for acquired left-sided pulmonary vein stenosis

Hideki Ito *, Masato Mutsuga , Yoshiyuki Tokuda and Akihiko Usui

European Journal of Cardio-Thoracic Surgery 58 (2020) 395–397
doi:10.1093/ejcts/ezaa032 Advance Access publication 8 February 2020

人工心肺の病態生理



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Nafamostat Mesilate Reduces Blood–Foreign Surface Reactions Similar to Biocompatible Materials

Akihiko Usui, MD, Manabu Hiroura, Mitsuo Kawamura, MD, Michiaki Hibi, MD, Katsuhiko Yoshida, MD, Fumihiko Murakami, MD, Yasuhiro Tomita, MD, Hideki Ooshima, MD, and Mitsuya Murase, MD

Background. Nafamostat mesilate (FUT-175) is a synthetic serine protease inhibitor that inactivates coagulation, fibrinolysis, and platelet aggregation. Nafamostat mesilate may suppress the blood–foreign surface reaction similar to biocompatible materials by blocking factor XIIa.

Methods. We performed an in vitro study of cardiopulmonary bypass (CPB) with fresh human blood among the following three groups: standard CPB sets (C), biocompatible CPB sets (B), and standard CPB sets with FUT-175 (10 mg/L) (F). A clinical study using these same CPB groups also was performed in 45 patients undergoing aortocoronary bypass operations (15 patients each). We injected FUT-175 at 40 mg/h during CPB.

Results. In the in vitro study, both groups B and F showed significantly lower levels of coagulation factors, thrombin-antithrombin III complex, fibrinopeptide A, β-thromboglobulin, complement C3a, granulocyte elastase, and free hemoglobin than group C at the conclusion of the study. Thrombin-antithrombin III complex and free hemoglobin in group F also were lower than in group B. The platelet count remained at a higher level in group F than in the other groups. Separation of bradykinin was suppressed most significantly in group F. In the clinical study, group F also showed significantly lower levels of α2-plasmin inhibitor plasmin complex and C3a than both groups C and B. There were minimal levels of free hemoglobin in group F.

Conclusions. Nafamostat mesilate may contribute major beneficial effects toward conservation of blood during CPB and prevention of coagulopathy after CPB.

(Ann Thorac Surg 1996;62:1404–11)

Effect of Cardiopulmonary Bypass on Cancer Prognosis

Shuichi Suzuki, MD, Akihiko Usui, MD, Katsuhiko Yoshida, MD[1], Akio Matsuura, MD[2], Toshihiko Ichihara, MD[3], Yuichi Ueda, MD

ABSTRACT

Adverse effects of cardiopulmonary bypass on cancer prognosis are expected but have not been confirmed. Seventy-four cancer patients who underwent cardiac surgery before cancer therapy were followed up for 42 ± 37 months; 45 had cardiac surgery with cardiopulmonary bypass. There was no significant difference in cancer recurrence (40.0%) and deaths (26.7%) among patients who had cardiopulmonary bypass and those who underwent off-pump cardiac surgery (27.6% and 24.1%). There were no significant differences in freedom from cancer-related death at 2 and 5 years after cardiac surgery (78.4% and 68.5%) in the cardiopulmonary bypass group compared to the 29 off-pump group (81.8% and 58.3%). Despite some limitations, this study detected no significant adverse effects of cardiopulmonary bypass on cancer prognosis. Although these results do not verify the safety of cardiopulmonary bypass from an oncologic aspect, they suggest it can be applied in cancer patients who require cardiac surgery.

(Asian Cardiovasc Thorac Ann 2010;18:536–40)

Strategy of Cardiovascular Surgery for Patients With Dementia as Evaluated by Mini-Mental State Examination

Sachie Terazawa, MD, PhD; Hideki Oshima, MD, PhD;
Yuji Narita, MD, PhD; Kazuro Fujimoto, MD, PhD; Masato Mutsuga, MD, PhD;
Yoshiyuki Tokuda, MD, PhD; Tomo Yoshizumi, MD, PhD; Hideki Ito, MD, PhD;
Wataru Uchida, MD, PhD; Akihiko Usui, MD, PhD

Circ J 2018; **82:** 2998–3004

Fibrinogen

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心臓手術への適応外申請が公知該当

IMPACT OF THE INTRAOPERATIVE USE OF FIBRINOGEN CONCENTRATE FOR HYPOFIBRINOGENEMIA DURING THORACIC AORTIC SURGERY

Nagoya J. Med. Sci. **77**. 265 ~ 273, 2015

YOSHIMORI ARAKI, MD, PhD; AKIHIKO USUI, MD, PhD; HIDEKI OSHIMA, MD, PhD; TOMONOBU ABE, MD, PhD; KAZURO FUJIMOTO, MD, PhD; MASATO MUTSUGA, MD, PhD; YOSHIYUKI TOKUDA, MD, PhD; SACHIE TERAZAWA, MD, PhD; KEI YAGAMI, MD, PhD; and HIDEKI ITO, MD

The incidence and risk factors of hypofibrinogenemia in cardiovascular surgery

General Thoracic and Cardiovascular Surgery
https://doi.org/10.1007/s11748-019-01201-8

Toshihiko Nishi[1] · Masato Mutsuga[1] · Toshiaki Akita[1] · Yuji Narita[1] · Kazuro Fujimoto[1] · Yoshiyuki Tokuda[1] · Sachie Terazawa[1] · Hideki Ito[1] · Kimitoshi Nishiwaki[2] · Akihiko Usui[1]

Abstract

Objective Cardiovascular surgery often causes massive bleeding due to coagulopathy, with hypofibrinogenemia being a major causative factor. We assessed the intraoperative incidence of hypofibrinogenemia and explored predictors of hypofibrinogenemia.

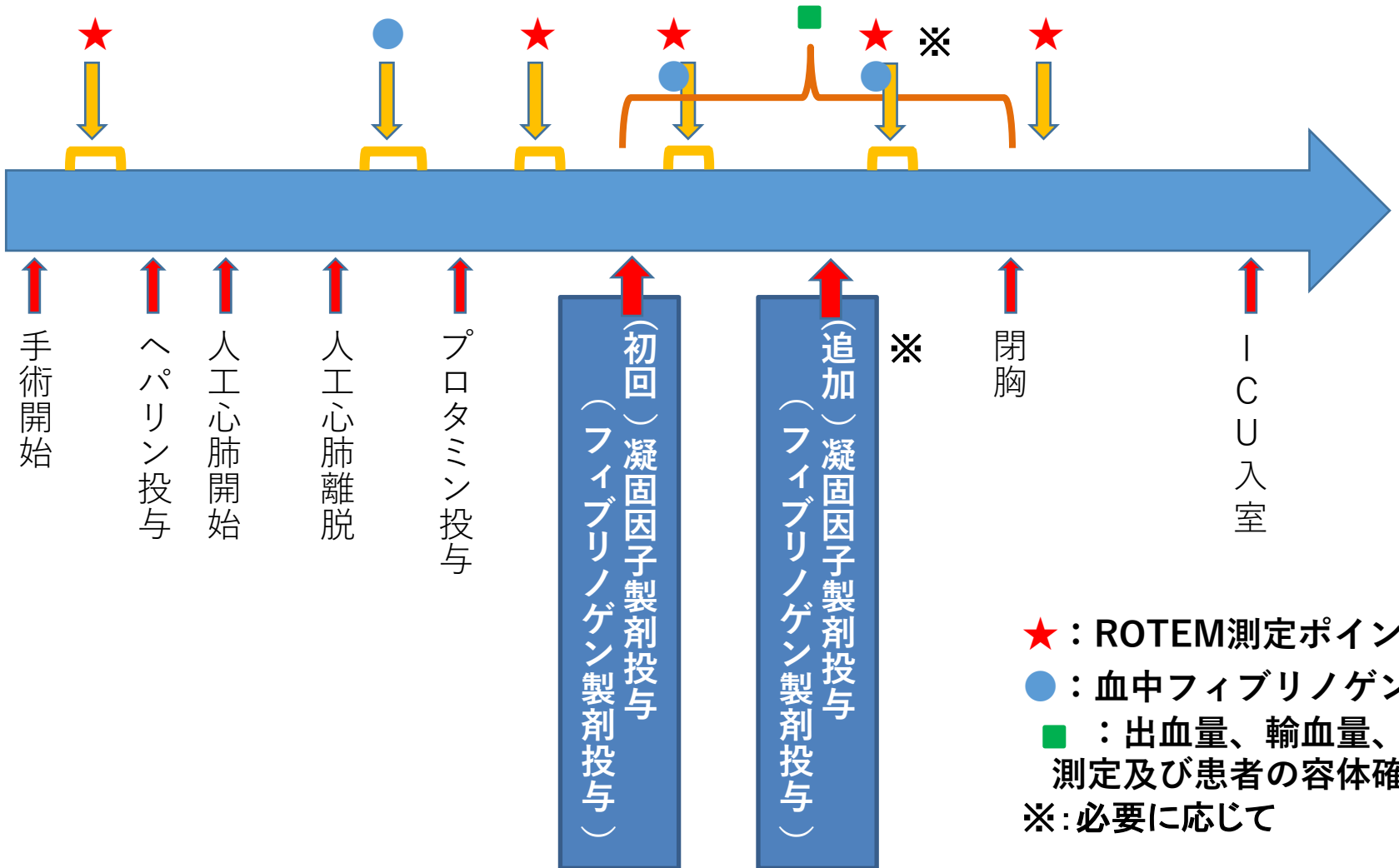
Methods The intraoperative serum fibrinogen level (SFL) was routinely measured in 872 consecutive patients [mean age: 66.9 ± 13.3 years; 598 men (68.6%)] undergoing cardiovascular surgery from July 2013 to November 2016 at Nagoya University Hospital. There were 275 aortic surgeries, 200 cases of coronary artery bypass grafting (CABG), 334 valvular surgeries and 63 other surgeries. We estimated hypofibrinogenemia incidence (intraoperative lowest SFL ≤ 150 mg/dL) and identified its predictors by a logistic regression analysis.

Results The average intraoperative lowest SFL of all cases, aortic surgery, CABG and valvular surgery was 185 ± 71, 156 ± 65, 198 ± 69 and 198 ± 68 mg/dL, respectively. Aortic surgery had a significantly lower intraoperative lowest SFL than CABG ($p < 0.001$) and valvular surgery ($p < 0.001$). The incidence of hypofibrinogenemia was 32.8%, 50.2%, 26.5% and 22.8% in all cases, aortic surgery, CABG and valvular surgery, respectively. The predictors of hypofibrinogenemia were the preoperative SFL, re-do surgery and perfusion time. A receiver operating characteristics curve analysis showed that the best preoperative SFL cutoff value for predicting hypofibrinogenemia was 308.5 mg/dL. Assuming preoperative SFL 300 mg/dL as the cutoff, the odds ratio for hypofibrinogenemia was 7.22 (95% confidence interval 5.26–9.92, $p < 0.001$).

Conclusions The incidence of hypofibrinogenemia in aortic surgery was high. The preoperative SFL, re-do surgery and perfusion time were identified as predictors for hypofibrinogenemia. Intraoperative measurement of SFL is important for detecting hypofibrinogenemia and applying appropriate and prompt transfusion treatment.

多施設観察研究
大動脈手術患者における凝固機能の評価

参加施設：名古屋大、京都大、神戸大
対象：大血管手術32例　フィブリノゲン値150mg/dl以下



★：ROTEM測定ポイント
●：血中フィブリノゲン濃度測定ポイント
■　：出血量、輸血量、各輸血用血液製剤輸血量の測定及び患者の容体確認等
※：必要に応じて

閉塞性肥大型心筋症

Usui A, et.al. Ann Thorac Cardiovasc Surg. 1997;3:121-124
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A needle stick technique for septal myectomy for hypertrophic obstructive cardiomyopathy
Mutsuga M, Usui A, et.al. Semin Thoracic Surg 2020;32:266-8
A floating stitch on the anterior mitral .leaflet can eliminate systemic anterior motion in hypertrophic obstructive cardiomyopathy
Tokuda Y, Usui A, et al. Sutures on the Anterior Mitral Leaflet to Prevent Systolic Anterior Motion, Ann Thorac Surg in press.

A Needle Stick Technique for Septal Myectomy for Hypertrophic Obstructive Cardiomyopathy

Akihiko Usui, MD, Yoshimori Araki, MD, Hideki Oshima, MD, and Yuichi Ueda, MD

Department of Cardiac Surgery, Nagoya University Graduate School of Medicine, Nagoya, Japan

We developed a needle stick technique for treating hypertrophic obstructive cardiomyopathy. Three 21-gauge needles are inserted into the interventricular septum just below the aortic valve annulus beyond the far side of the septal bulge. The right and left needles are both side margins, and the center needle is a guide for the thickness. Each needle plays a role as a mark of resection for the width, length, and thickness. The needles also stabilize the ventricular septum and provide good exposure of the entire septal hypertrophy. This technique is helpful to safely achieve sufficient septal myectomy of a constant thickness.

(Ann Thorac Surg 2013;95:726–8)

A Floating Stitch on the Anterior Mitral Leaflet Can Eliminate Systolic Anterior Motion in Hypertrophic Obstructive Cardiomyopathy

Masato Mutsuga, MD, PhD, Yuji Narita, MD, PhD, and Akihiko Usui, MD, PhD

Reducing the systolic anterior motion is a key way of resolving left ventricular outflow tract obstruction in surgery for hypertrophic obstructive cardiomyopathy. We developed a new technique using a floating stitch on the anterior mitral leaflet (AML). It is applied just to the middle of the tip of the AML and fixed to the annuloplasty ring at the middle of the posterior annulus. The AML is prevented from touching the interventricular septum and systolic anterior motion can theoretically be solved.

Semin Thoracic Surg 32:266–268

Keywords: HOCM, LVOTO, SAM

Sutures on the Anterior Mitral Leaflet to Prevent Systolic Anterior Motion

(Ann Thorac Surg 2021;111:e213-5)

Yoshiyuki Tokuda, MD, PhD, Kazuro Fujimoto, MD, PhD, Yuji Narita, MD, PhD, Masato Mutsuga, MD, PhD, and Akihiko Usui, MD, PhD

Surgery for Anomalous Papillary Muscle Directly Into the Anterior Mitral Leaflet

Masato Mutsuga, MD, PhD, Yoshiyuki Tokuda, MD, PhD, Kazuro Fujimoto, MD, PhD, Sachie Terazawa, MD, PhD, Hideki Ito, MD, PhD, Yuji Narita, MD, PhD, and Akihiko Usui, MD, PhD

Department of Cardiac Surgery, Nagoya University Graduate School of Medicine, Nagoya, Japan

Background. The anomalous insertion of papillary muscle directly into the anterior mitral leaflet is a rare congenital anomaly concomitant with hypertrophic cardiomyopathy. We herein report our surgical technique, which is designed to relieve left ventricular obstruction and preserve the mitral valve and subvalvular apparatus.

Methods. Among 38 patients who underwent septal myectomy from 2007 to 2020, 4 had an anomalous mitral subvalvular apparatus with papillary muscle with direct insertion into the anterior mitral leaflets. In all cases, mitral valve repair was accomplished with excision and reconstruction of all anomalous papillary muscles, concomitant with septal myectomy. In another 34 patients, 20 cases needed mitral valve repair with regard to systolic anterior motion by hypertrophic cardiomyopathy. The comparison study was conducted between the anomalous papillary muscle group (group A) and the others (group B).

Results. There was no early or late death in group A, and there were 3 early deaths and 2 late deaths in group B. The mean peak gradient in the left ventricle was significantly decreased in both groups. Mitral valve regurgitation grade was also significantly decreased from 3 to 0.5 without valve replacement in group A, and from 2 to 0.6 in group B. Six patients needed mitral valve replacement because of the thickness of anterior mitral leaflet in group B.

Conclusions. Hypertrophic obstructive cardiomyopathy associated with the anomalous insertion of papillary muscle can be successfully treated without mitral valve replacement. Excision and reconstruction with the anomalous papillary muscle seems to be a feasible operation to reduce mitral regurgitation and relieve outflow tract obstruction.

(Ann Thorac Surg 2021;111:1512-9)

1981
外科医を志す（大垣市民病院）

- 近藤哲先生が指導医
- 厳しい研修病院を選択
- 一般外科研修

- Man-to-man 指導
- Bedside重視の医療
- 学会発表、論文発表の重要性

1985
大学院生として帰局（胸部外科）

- 呼吸器外科をめざす
- 心臓外科へ転向
- 夜間・休日に愛知県コロニー
  生化学ラボで研究

村瀬充也先生

阿部稔雄先生

加藤兼房先生

Usui A. et.al, Clin Chimica Acta 1987;164:47-53
Usui A. et.al, Clin Chimica Acta 1988;175:109-112
Usui A. et.al, Cardiovascular Research 1989;23:737-40
Usui A. et.al, Clinical Chemistry 1989;35:1942-4
Usui A. et.al, Jpn Circ J 1989;53:95-100
Usui A. et.al, Clinical Chemistry 1990;36:639-641
Usui A. et.al, Clinical Chemistry 1991;37:458-461
Usui A. et.al, Jpn Circ J 1992;56: 1206-1213
Usui A. et.al, J Neurological Science 1994;123:134-139

1987
心臓外科医をめざし留学

- Toronto General Hospital で修練
- 症例数に圧倒
  - 年間2500例の心臓手術数
- 充実した2年間の心臓外科研修
  - 執刀120例、助手500例

Mickeleborough先生

David先生

1989：
大学院復学　Researchに邁進

- Researchなら世界に通じる
  - 逆行性脳灌流法に関する研究

動物実験

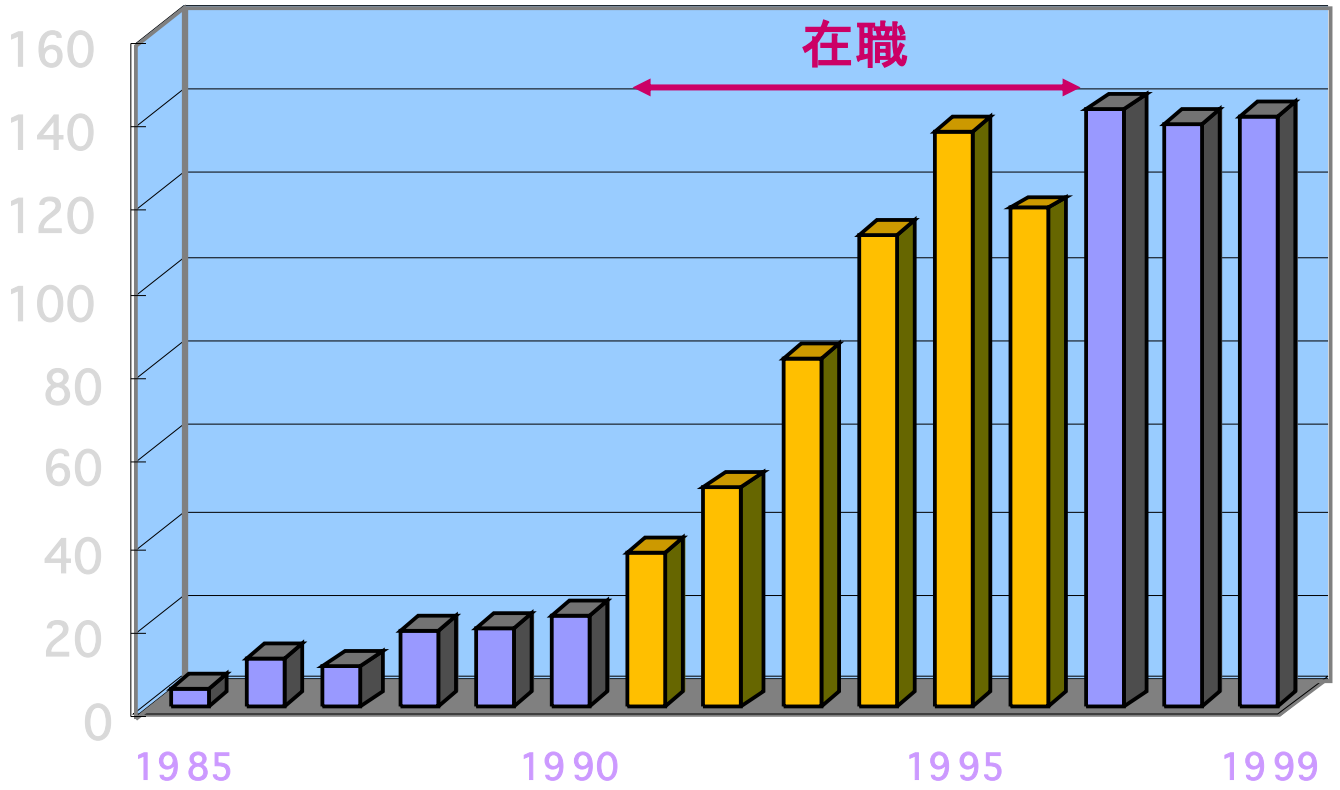
Usui A. et.al, Ann Thorac Surg 1992; 53: 47-53
Usui A. et.al, Cardiovascular Surgery 1993;1:107-112
Usui A. et.al, J Thorac Cardiovasc Surg 1994;107:300-308
Usui A. et.al, J Thorac Cardiovasc Surg 1994;107:1228-1236
Oohara K, **Usui A**, et al,. Ann Thorac Surg 58;139-145,1994
Oohara K, **Usui A**, et al, J Thorac Cardiovasc Surg 109;772-779,1995
Usui A. et.al, J Thorac Cardiovasc Surg 1997;114:440-7.

臨床研究

Usui A. et.al, Ann Thorac Surgery 1996;62:94-104.
Usui A. et.al, Cardiovascular Surgery 1997;5:510-515.
Usui A. et.al, European J Cardio Thoracic Surgery 1999;15:571-8.
Usui A, Ueda Y, Maltimedia Manual of Cardiothoracic Surgery 2007
Usui A, et al., Gen Thorac Cardiovasc Surg 2012;60:132-9

1991
県立尾張病院立ち上げ

- 自分の責任で行う症例の重みを実感



川村光男先生

1993 年6月8日　**中日新聞**

1996
名古屋大学での試練

- 1995:村瀬教授就任
- 1996：後進のために帰局
- 1997：教授汚職事件で叱責

  直属部下、医局長として叱責

  母校の名誉を失墜させた呵責

四面楚歌

まだ上と下が空いている

1999年8月　上田裕一教授就任

碓氷先生、先生には失望した！

2001年　准教授昇進

2012
心臓外科教授就任

横井香平先生

名古屋大学心臓外科教室の復権

3年以内に目標に目処を立てよ！

松尾清一機構長

重症心不全治療

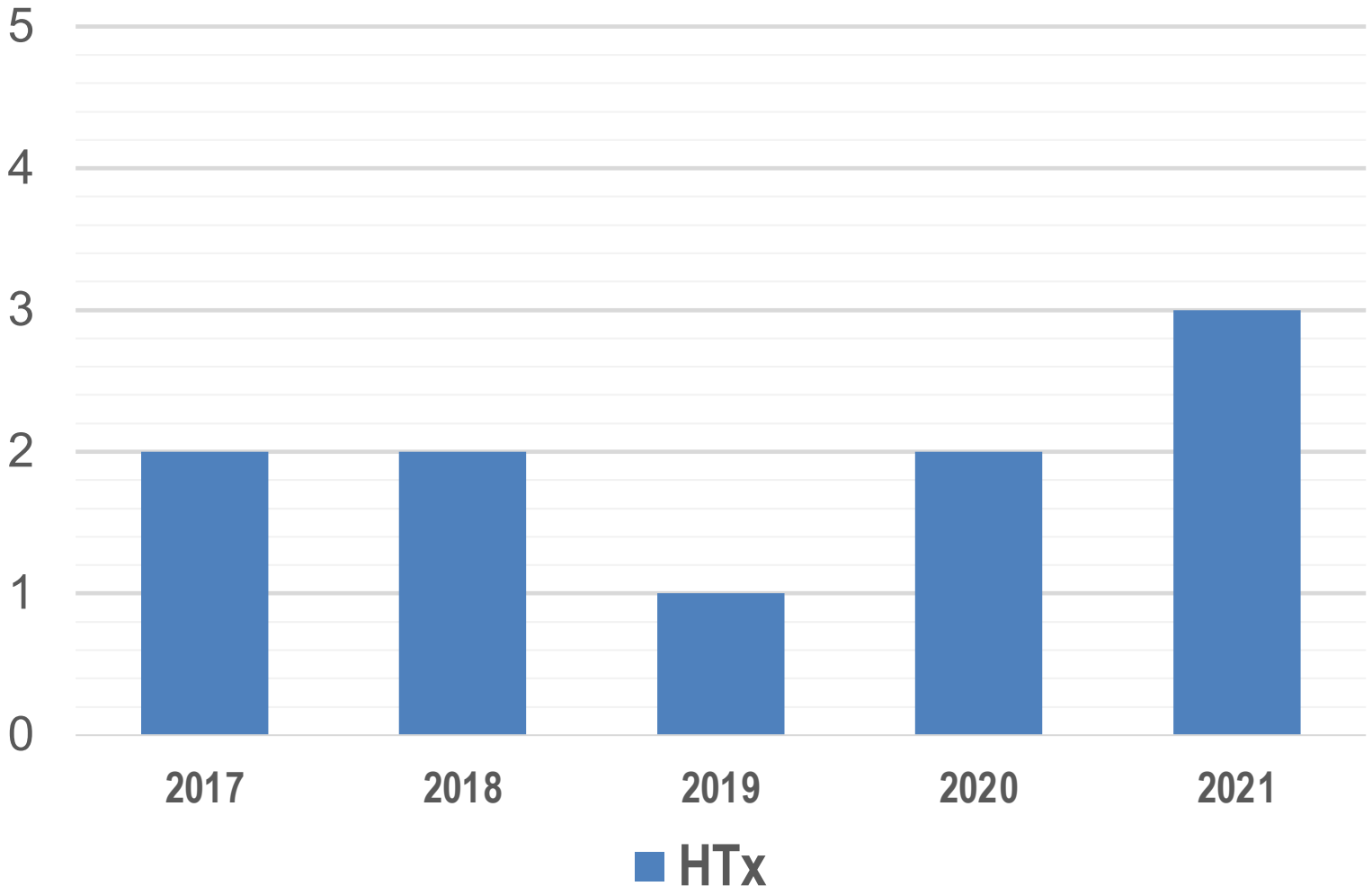
2011.11	遠心ポンプによる長期体外式VAD
2013.1	植込型VAD施設認定
2013.10	植込型VAD 第１例
2016.7	重症心不全治療センター設置
2016.12	成人心臓移植実施施設認定
2017.4	心臓移植 第１例

心臓移植 名大第１例

遠心ポンプによる長期体外式VAD

六鹿雅登准教授　室原豊明教授　奥村貴裕病院講師　石黒直樹前病院長

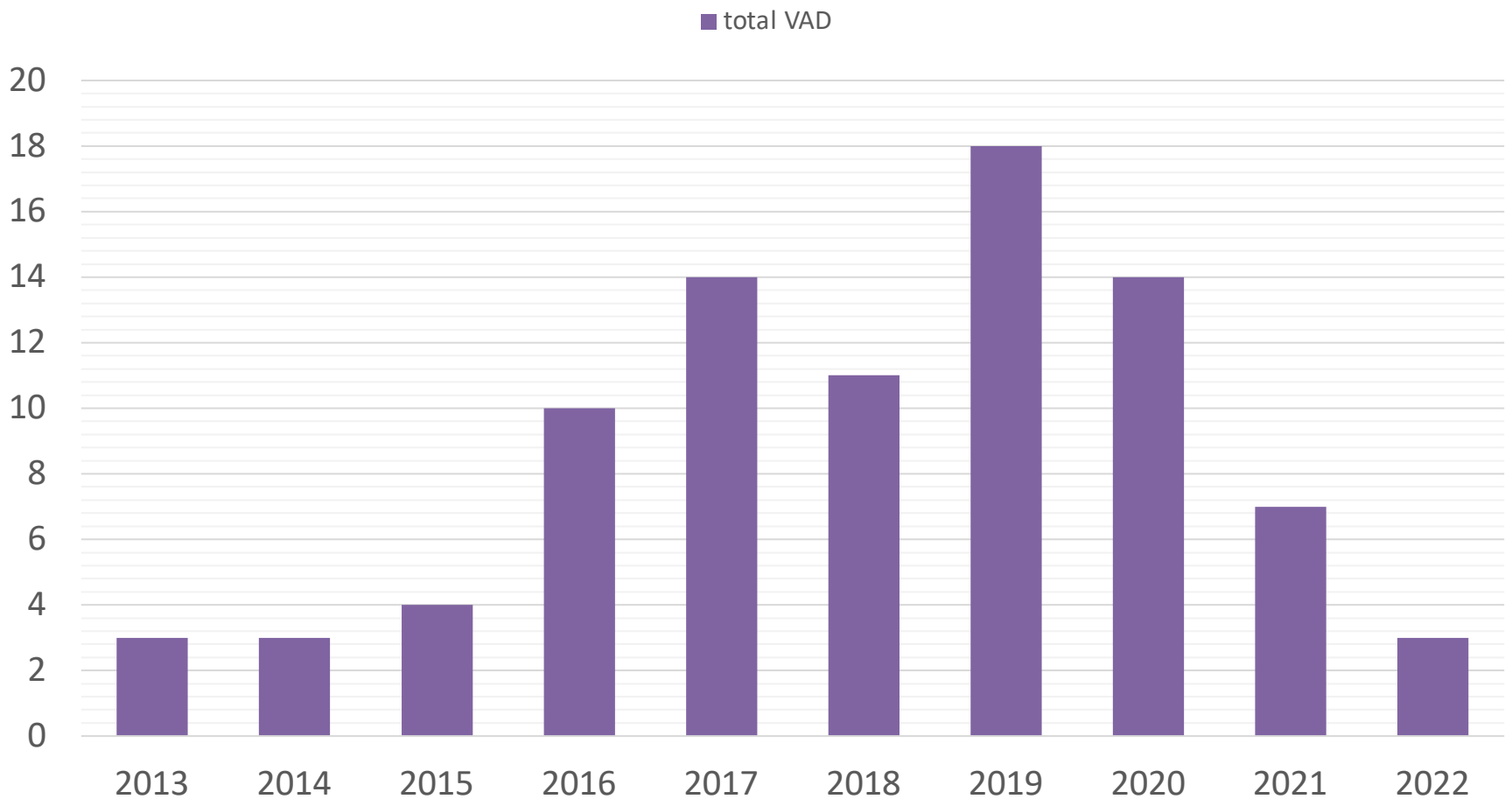
心臓移植 10例に到達



Implantable LVAD cases(2013～2022)

Total 67cases / 87 procedure

HTx:平均待機期間1603日（1255-2171日）

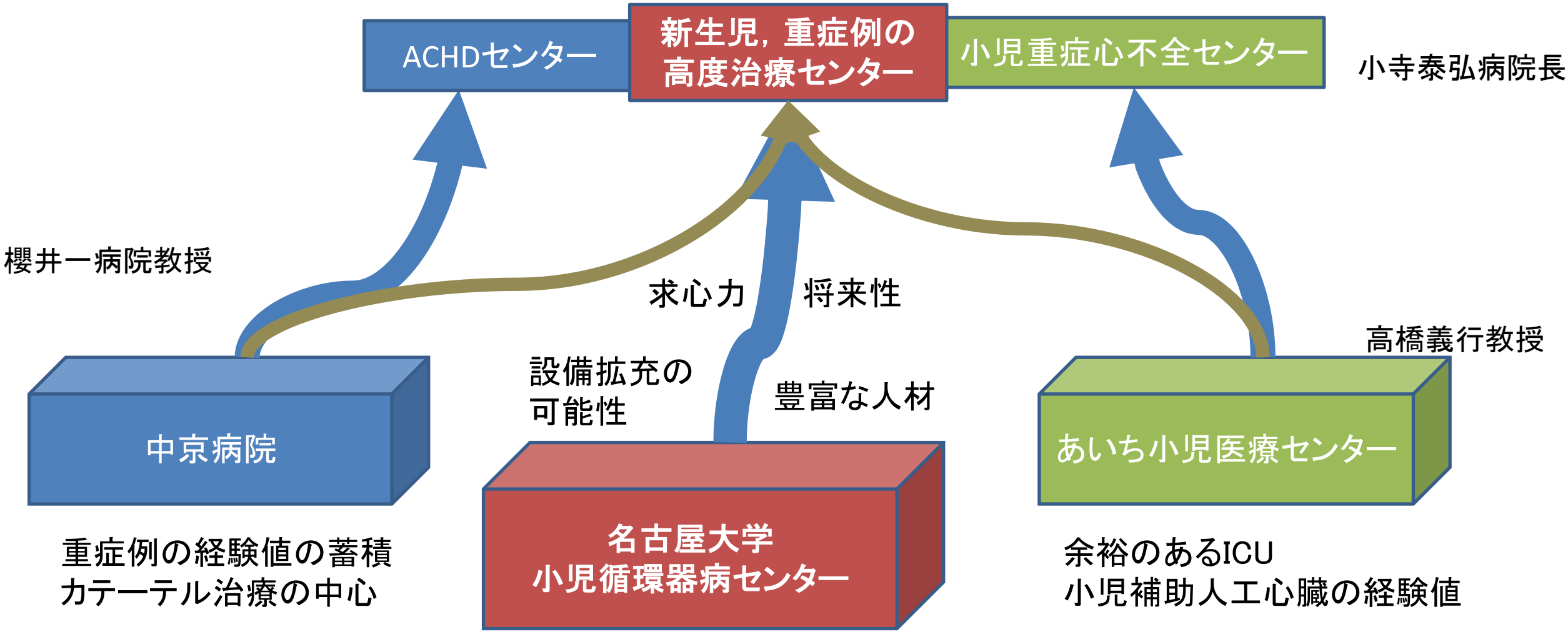


HMII:42c/54p

HM3:22c /30 p

HVAD:1

名古屋大学小児循環器病センター



名大病院心臓外科の診療規範

チームの一員であることを意識せよ！

●私たち心臓外科のミッション

●私たちの大事な患者さんに心臓・大動脈手術を行い元気に社会復帰していただく

・関連診療科の総力で診療にあたる

・手術適応や術式の選択は科内のコンセンサスを得る（心臓外科医の個人の集まりではない）

・すなわち，私たちのベストの医療を提供することが大前提である

●心臓外科医の育成と熟成

●心臓外科治療の基本的考え方と診療体制を共有する

●術式の改良と手技の修練を継続的に展開する

●自施設の手術成績（近接および遠隔）を常に意識して、臨床研究を推進する

（ガイドラインはもちろんのこと、自らのエビデンスに基づく外科治療を行う）

チーム医療の推進

大動脈チーム

　　大動脈Hybrid治療

ハートチーム

　　重症心不全治療センター

小児ハートチーム

　　小児循環器センター

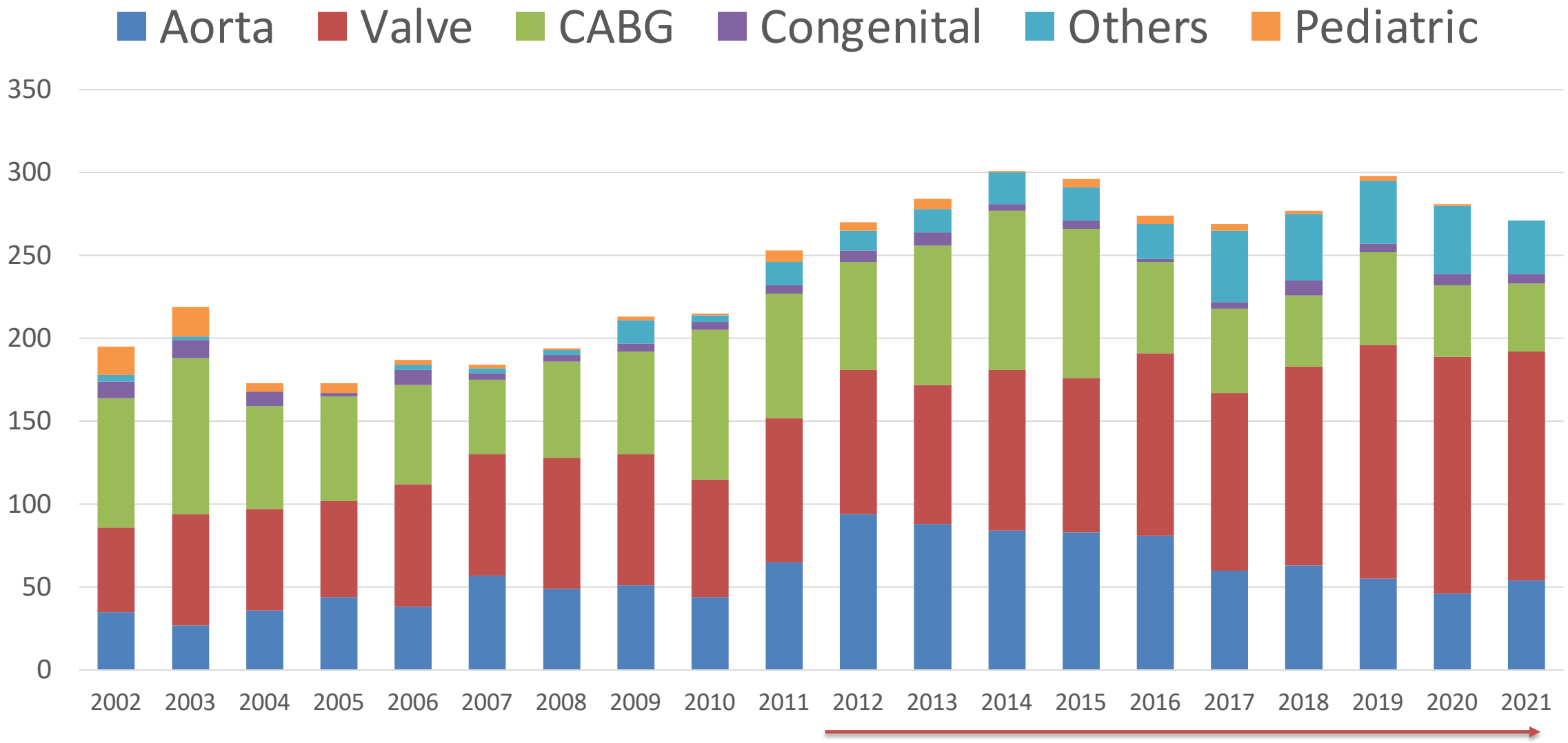
古森公浩教授

室原豊明教授

西脇公俊教授

櫻井一病院教授　　高橋義行教授

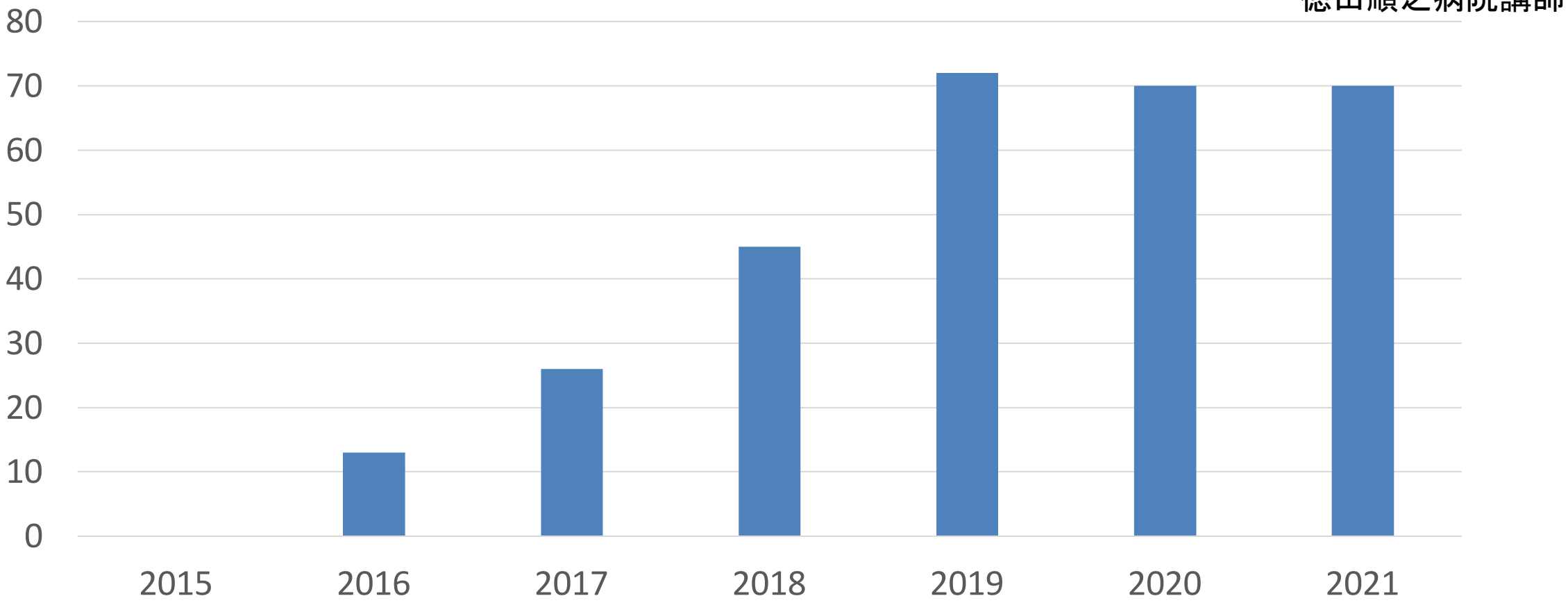
名大心臓大血管外科手術数推移



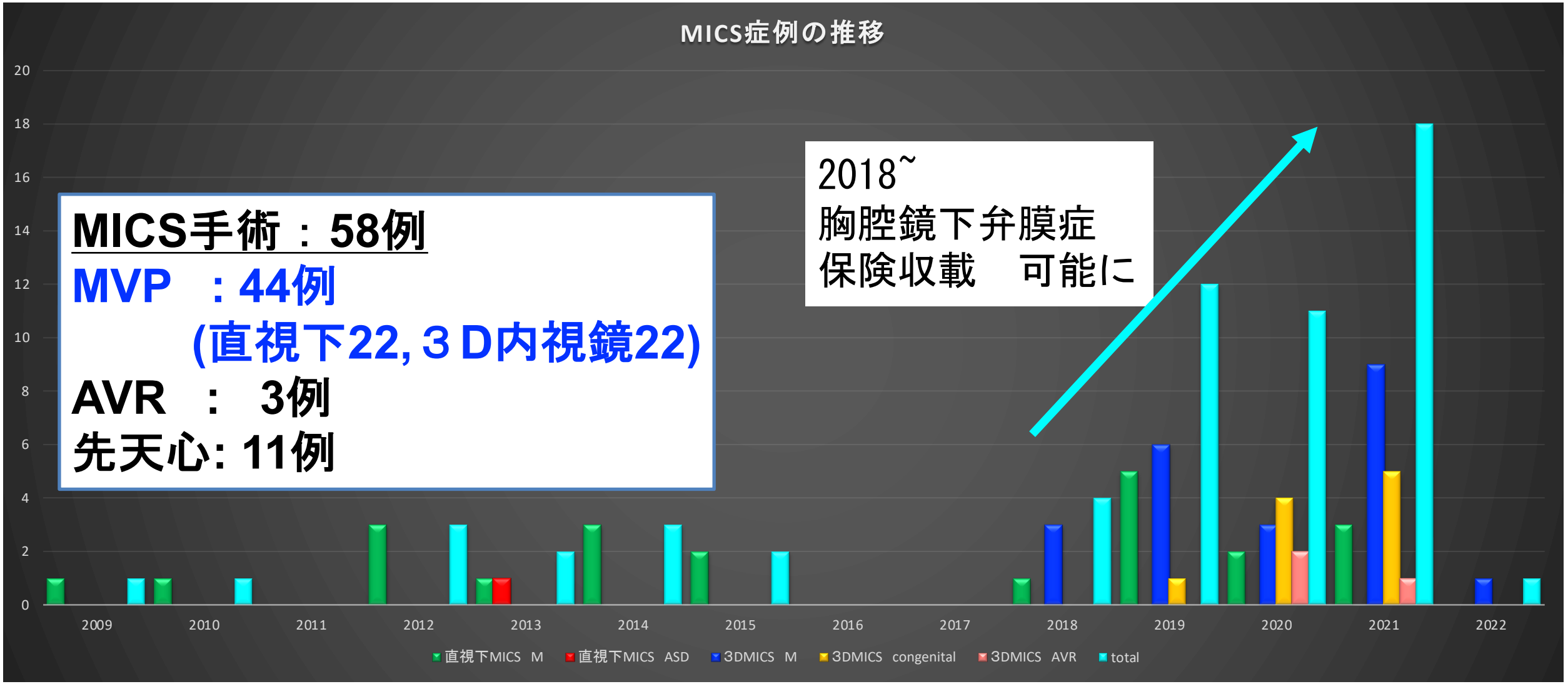
カテーテル式弁置換 TAVR

2016年施設認定
2022年300例達成

徳田順之病院講師



MICS 低侵襲心臓手術



MICS手術：58例

MVP　：44例

(直視下22, 3D内視鏡22)

AVR　：　3例

先天心: 11例

2018~
胸腔鏡下弁膜症
保険収載　可能に

名大病院のリード抜去術の成績
（海外の大規模臨床研究との比較）

	名大 (2011.9-2022.1)	LExlCon*1 (US)	ELECTRa*2 (Euro)
症例数(リード数)	179 (374)	1449 (2405)	3555 (6493)
年齢	66.6 (18-91)	63.4	64.8
性別 (%男)	78.2%	71.8%	72.2%
ICD/CRT	44.6%	29.2%	47.1%
感染	73.7%	56.9%	52.8%
留置期間 (年)	9.4	6.8	6.4
臨床的成功率	97.8%	97.7%	96.7%
完全抜去成功率	95.9%	96.5%	95.7%
主要合併症	0.6%	1.4%	1.7%
手術死亡	0%	0.28%	0.3%
病院死亡	1.2%	1.86%	1.4%

成田裕司講師

*1: J Am Coll Cardiol 2010;55:579-86
*2: Euro Heart J 2017;38:2995-3005

研究プロジェクト; 新しい大動脈瘤治療の開発

Fu XM, Yamawaki-Ogata A, Usui A, Narita Y. J Transl Med 2013;11:175
Yamawaki-Ogata A, Narita Y, Usui A. Eur J Cardiothorac Surg 2014;45:e156-65
Yamawaki-Ogata A, Hashizume R, Usui A, Narita Y. World J Stem Cells 2014;6:278-287.
Yamawaki-Ogata A, Oshima H, Usui A, NaritaY. Cytotherapy 2017;19:1167-1175
Uchida W, NaritaY, Yamawaki-Ogata A, Usui A. J Vasc Surg 2018;68:82S-92S
Kawai Y, Narita Y, Yamawaki-Ogata A, Usui A. Biomed Res Int. 2019.
Akita N, NaritaY, Yamawaki-Ogata A, Usui A. Cell Tissue Res 2020; in press

成田裕司講師

緒方 藍歌
特任講師

心臓サポートネット

多施設共同臨床研究プロトコール（feasible, single arm study）

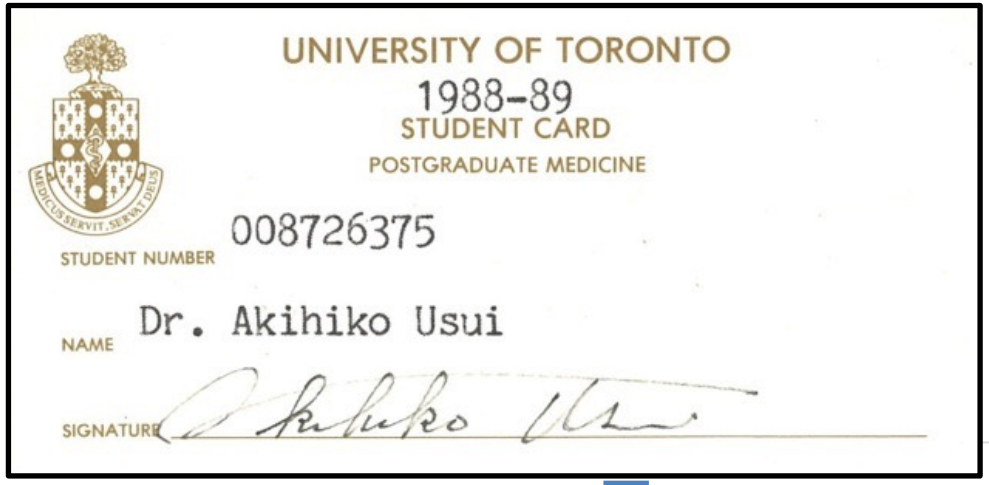
- ✓ 拡張型心筋症　8 名～
- ✓ 適応基準
  - 年齢 20～75 yrs
  - NYHA III
  - LVDd>60mm, LVDDi(30ml/m²)
  - LVEF<35%
- ✓ 主要評価項目（Follow up to 2 years)
  - ✓ 全死亡
  - ✓ 主要な心臓合併症
- ✓ 副次評価項目
  - ✓ NYHA classの変化
  - ✓ QOL（MHFS、EQ-5D), 6 MWT,
  - ✓ 心機能リモデリング指標（LV volume, sphericity index
  - ✓ 追加心臓手術
  - ✓ 呼吸安定化指数（RSI)
  - ✓ 生存率（Seatle Heart Failure modeとの比較）

【臨床POC】

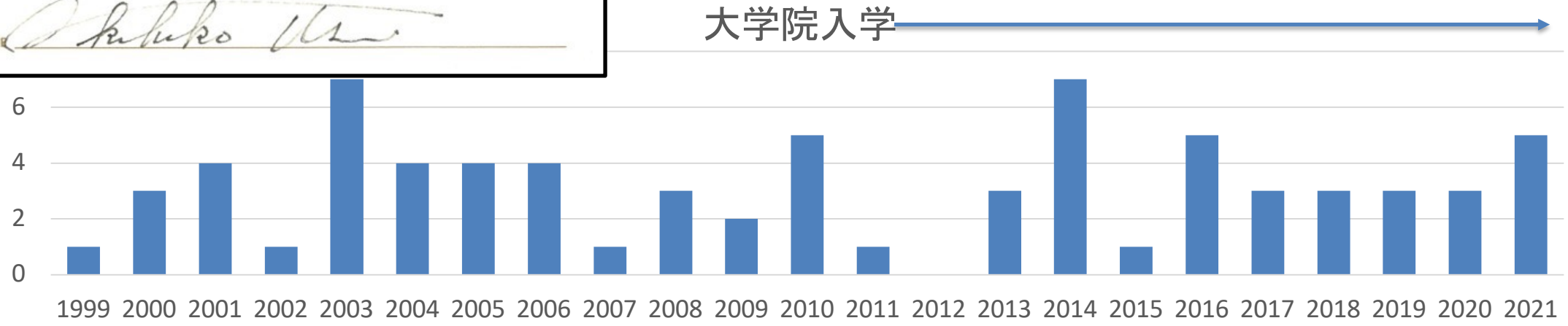
- 安全性評価（有害事象発生率）
  - 全死亡、追加心臓手術
  - 合併症（出血、感染、その他）
- 有効性評価
  - 心機能改善(LVEF, Sterling curve, BNP, wall motion)
  - 心臓リバースリモデリング
    - LVEDV, LVESV, Sphericity index
  - QOL改善（NYHA, MLWHF, EQ-5D, 6MWT)
  - 生存率比較（vs. Seattle Heart Failure model)
  - 心臓シミュレーション結果との照合（LVEF, Emax）

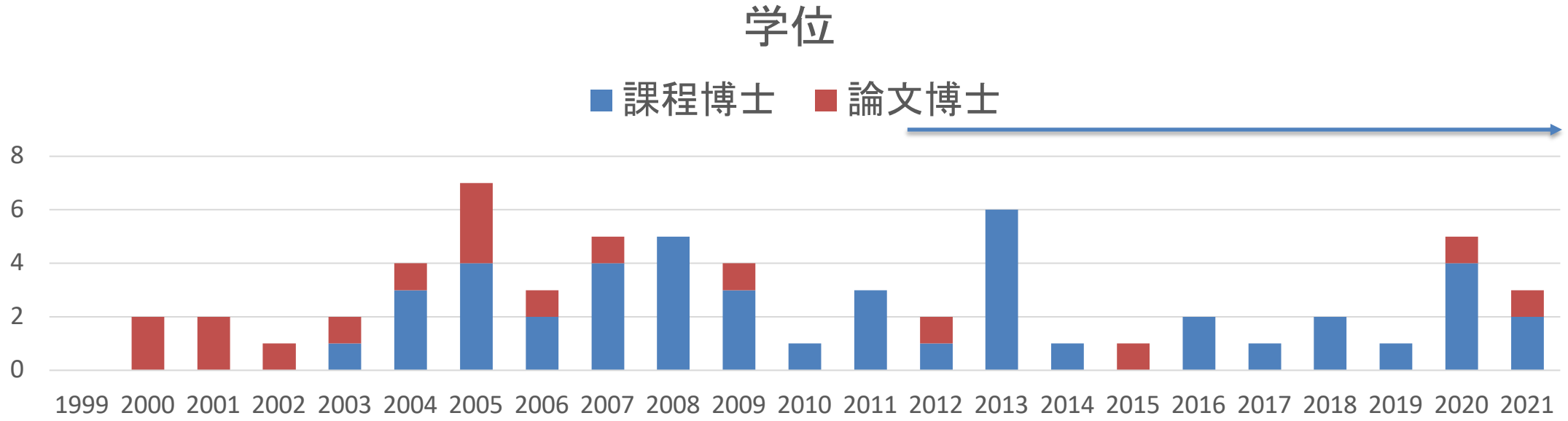
AMED preC
医師主導治験

秋田利明　特任教授

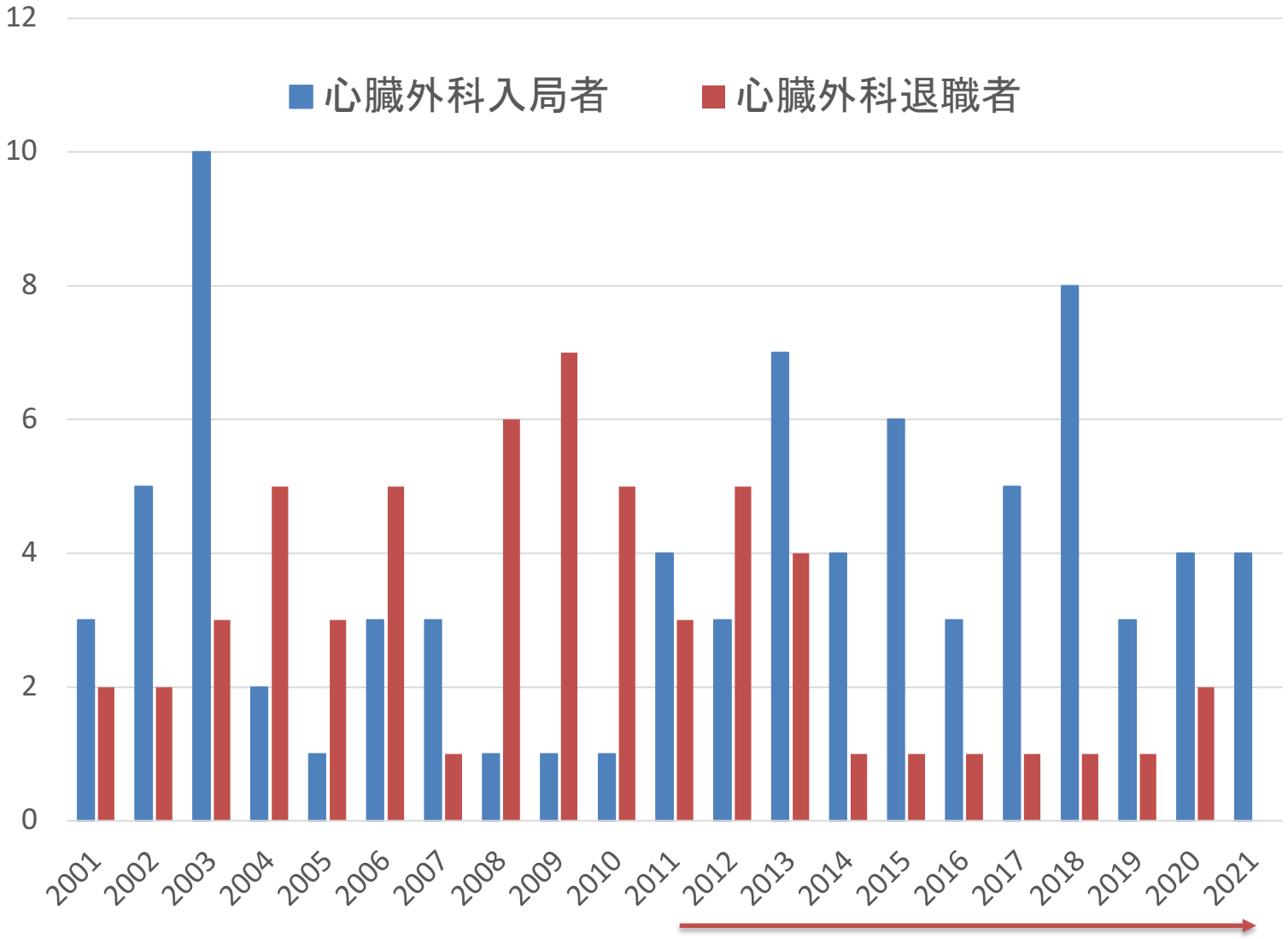

UNIVERSITY OF TORONTO
1988–89
STUDENT CARD
POSTGRADUATE MEDICINE
STUDENT NUMBER 008726375
NAME Dr. Akihiko Usui
SIGNATURE

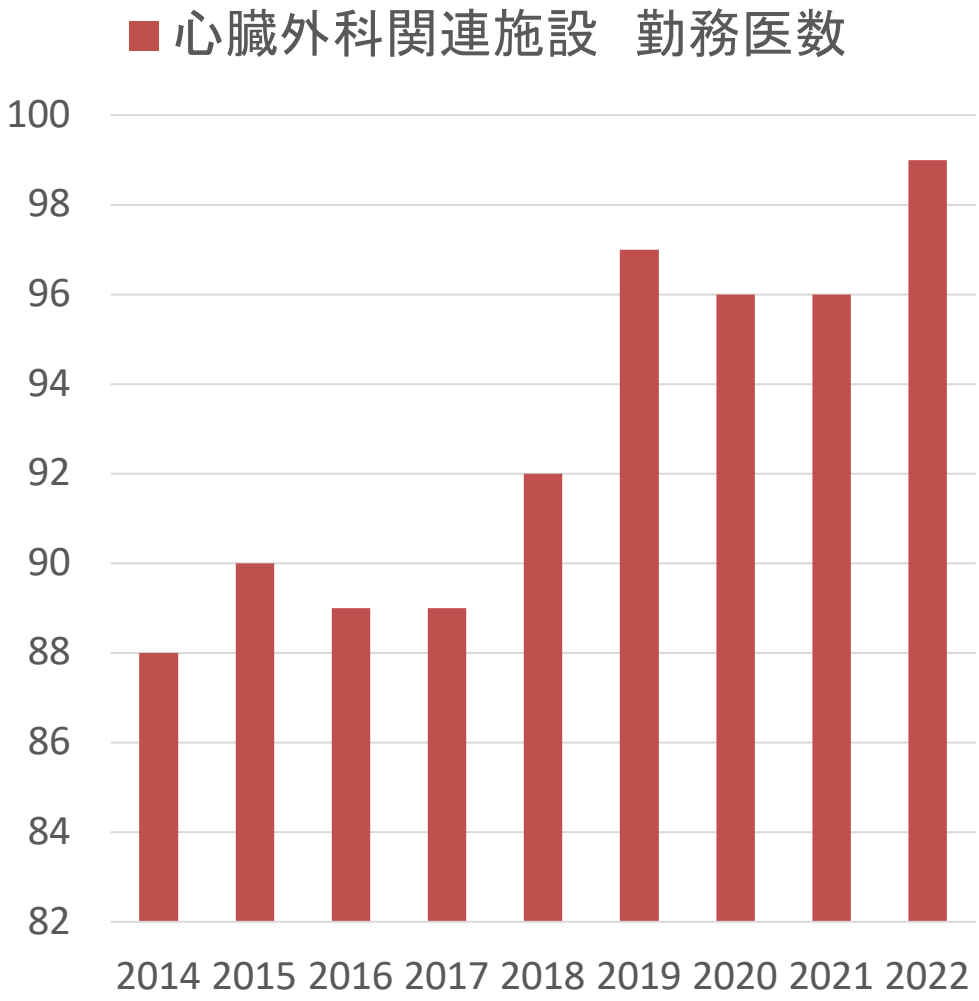
大学院教育





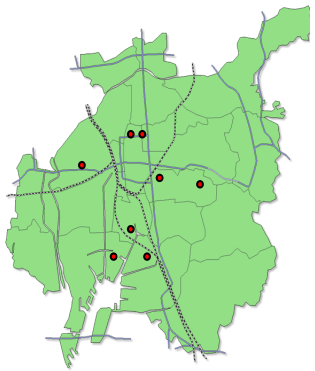
入局者、退局者の年次推移

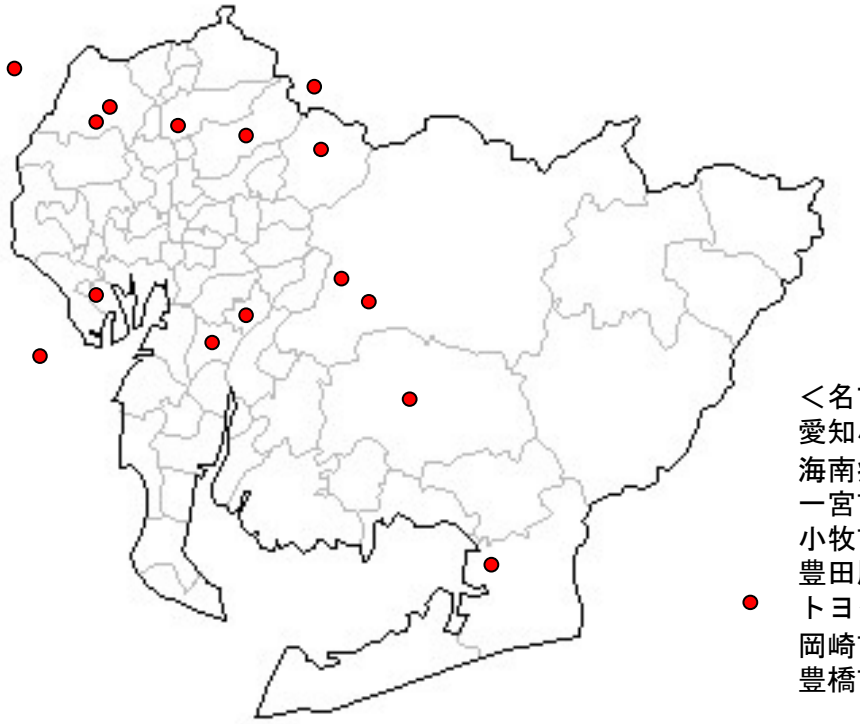




心臓外科関連病院

＜名古屋市内＞８施設
名古屋大学病院
名古屋第一日赤病院
名古屋第二日赤病院
中京病院
名古屋掖済会病院
中部労災病院
名城病院
名古屋医療センター





＜名古屋市外＞
愛知小児保健センター
海南病院
一宮市民病院
小牧市民病院
豊田厚生病院
トヨタ記念病院
岡崎市民病院
豊橋市民病院

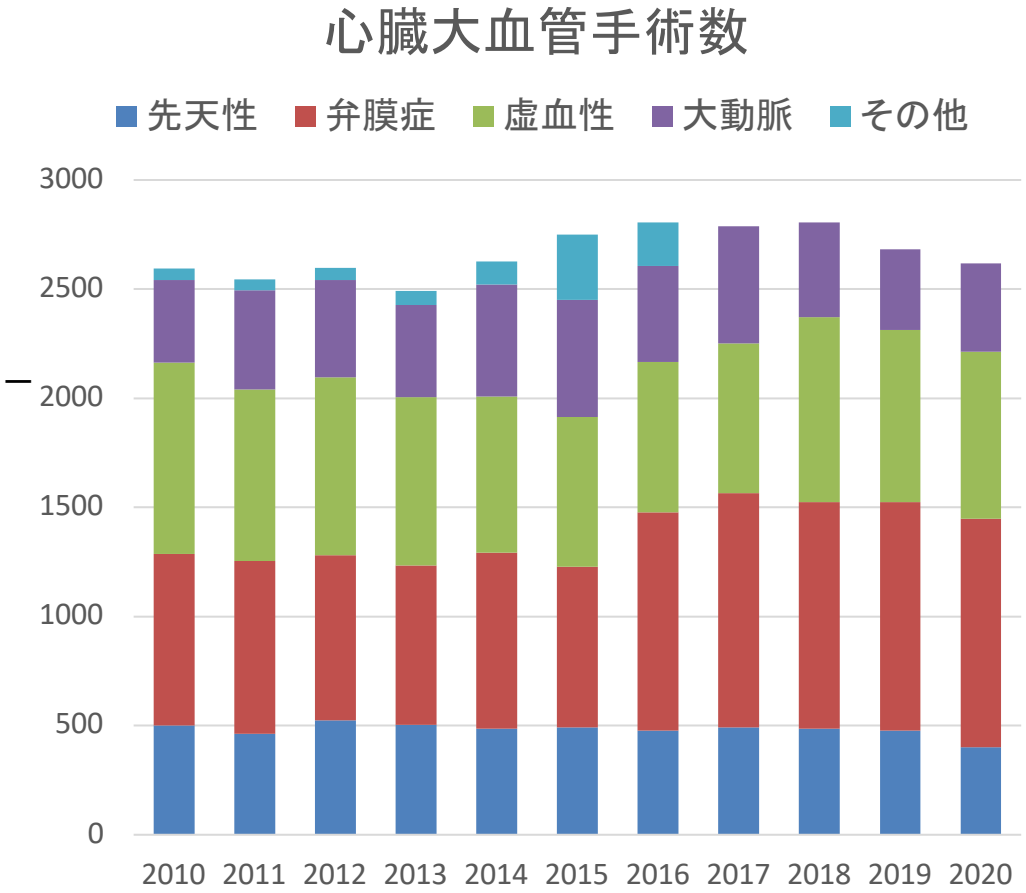
＜岐阜県＞
県立多治見病院
大垣市民病院

＜三重県＞
四日市市民病院

＜静岡県＞
静岡済生会病院

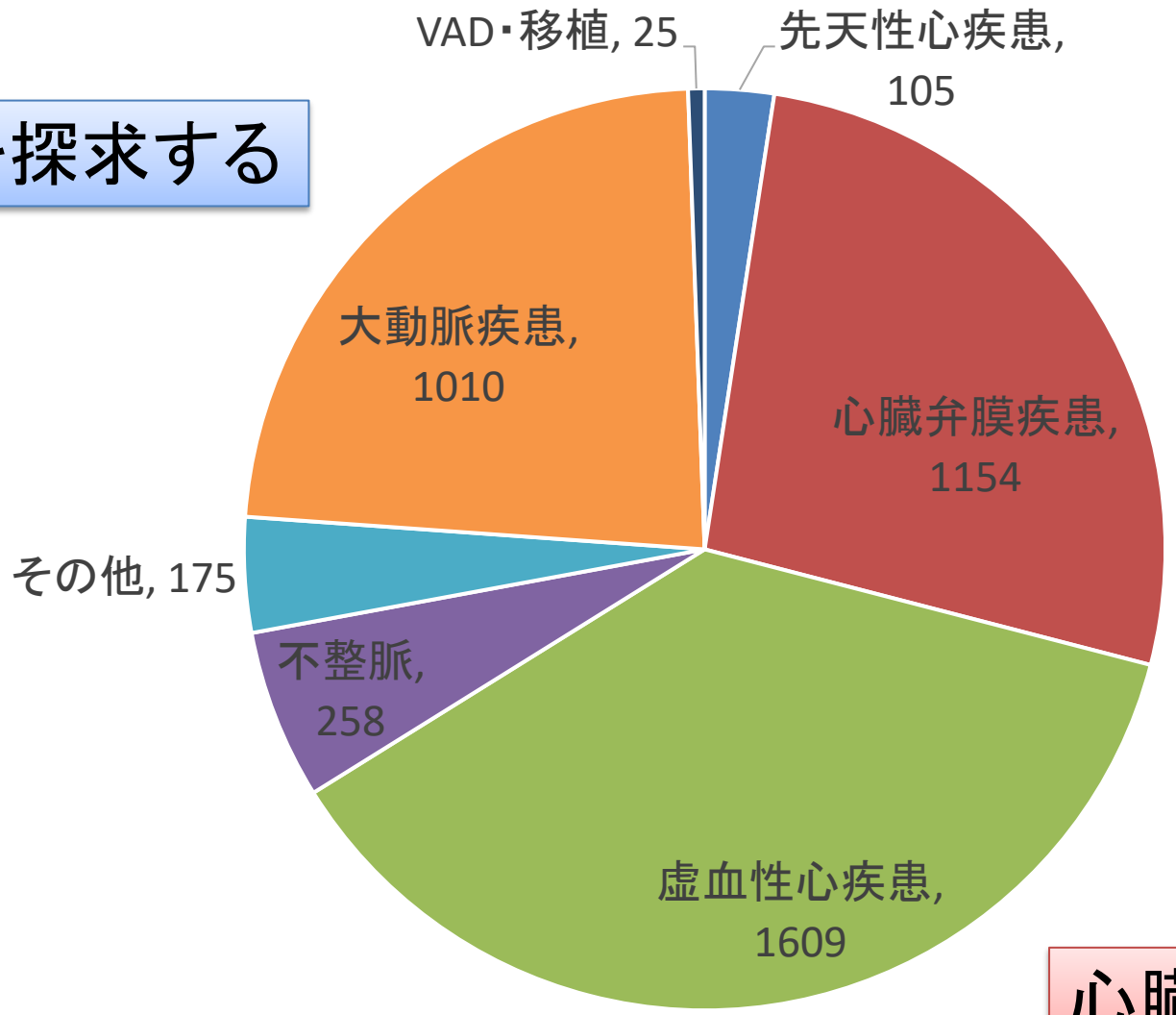
関連　20施設

関連大学
- 藤田医科大学
- 愛知医科大学
- 群馬大学



私の心臓大血管手術数（術者・指導） 4336例

より良い手術を探求する



心臓外科医は手術が基盤

Thank you for your attention!