

# 心臓弁膜症の外科治療

—基礎から最新治療まで—



榊原記念病院 心臓血管外科  
高梨 秀一郎

July 17th 2015



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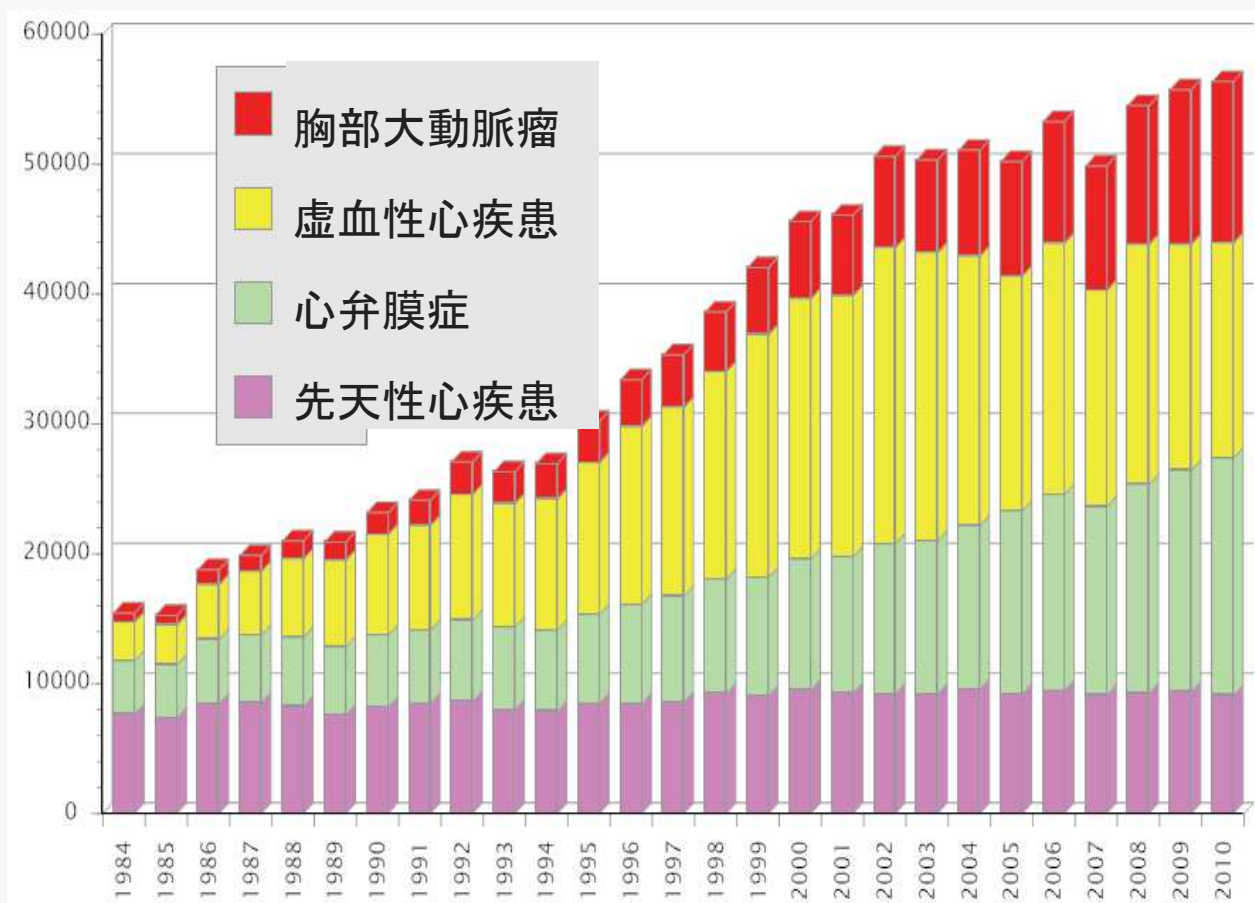
## Agenda

1. Introduction
2. 心臓弁膜症
3. 僧帽弁疾患
4. 大動脈弁疾患
5. 最新の外科治療
6. 弁膜症治療の今後

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## 本邦における心臓血管外科手術件数の推移



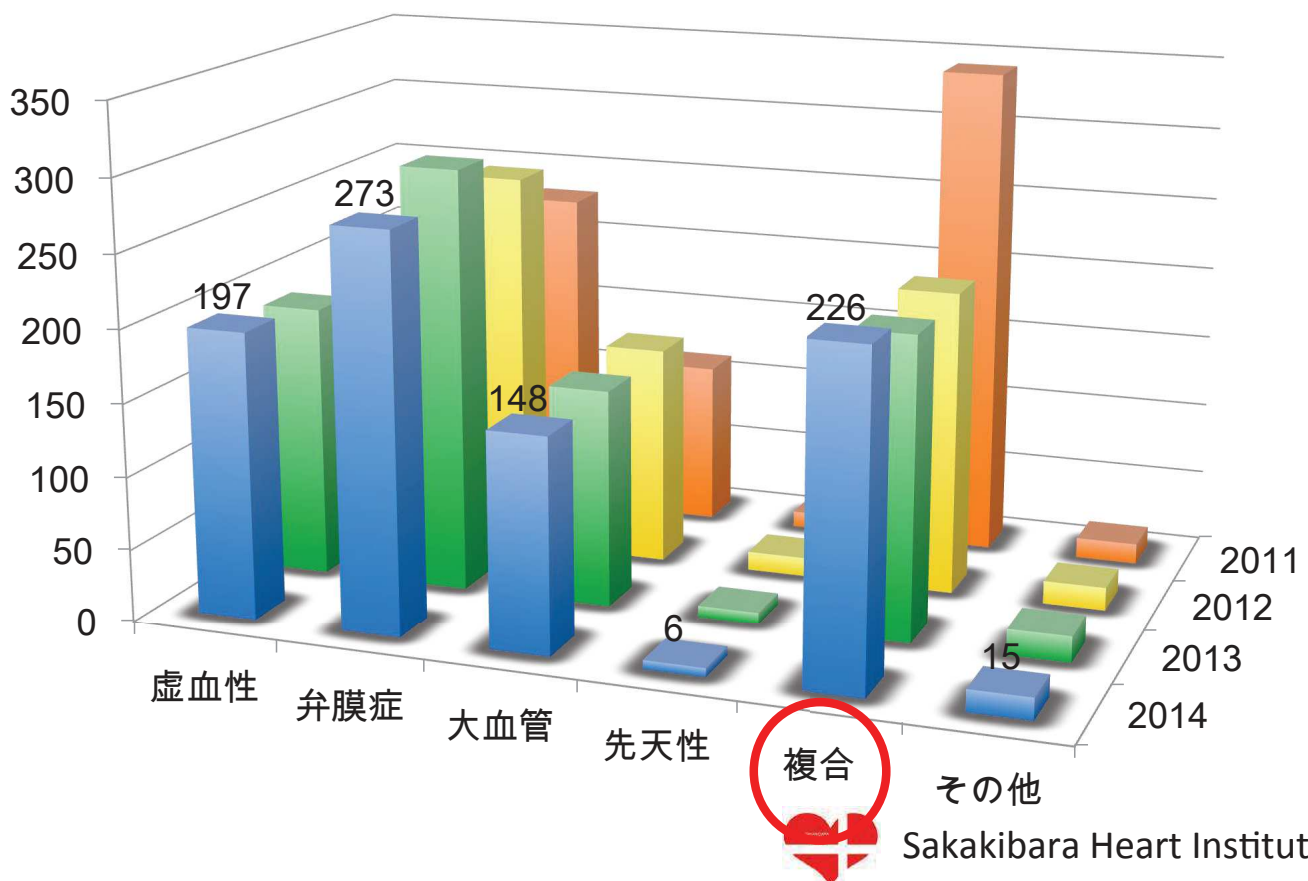
# 2014年 心臓血管手術(成人部門)

成人開心術	865	
先天性	6	
単独虚血性(AMI合併症)	197	(7)
単独弁膜症	273	
単独胸部大血管	148	
複合手術 (虚血性・弁膜症・大血管)	226	
その他(腫瘍・心内血栓・収縮性心膜炎)	15	
腹部大血管(ステントグラフト)	130	(53)
胸部大血管ステントグラフト	9	
総手術数	1004	
(緊急手術	207)	



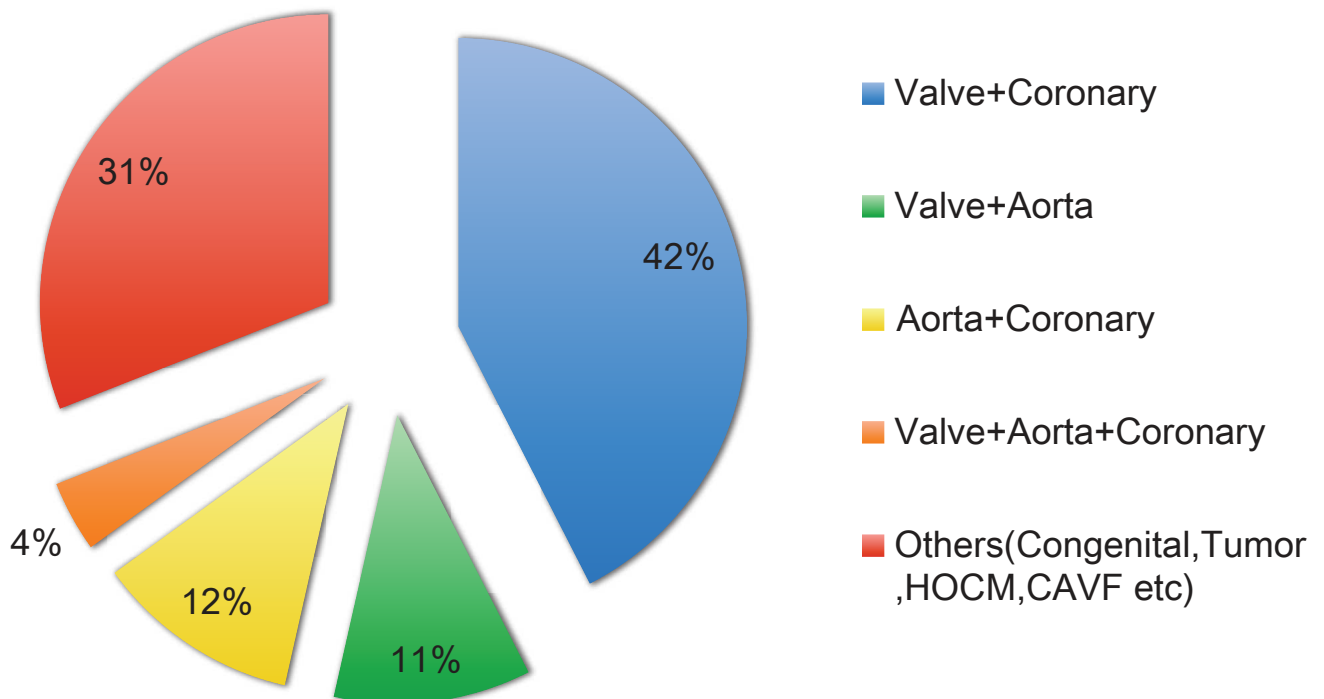
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## 心臓血管手術(成人部門)



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# 複合手術 -226例-



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## 心臓の構造

- 心房（血液を受ける部屋）
  - 右心房 (Right Atrium=RA)
  - 左心房 (Left Atrium=LA)
- 心室（血液を押し出すポンプ機能の部屋）
  - 右心室 (Right Ventricle=RV)
  - 左心室 (Left Ventricle=LV)

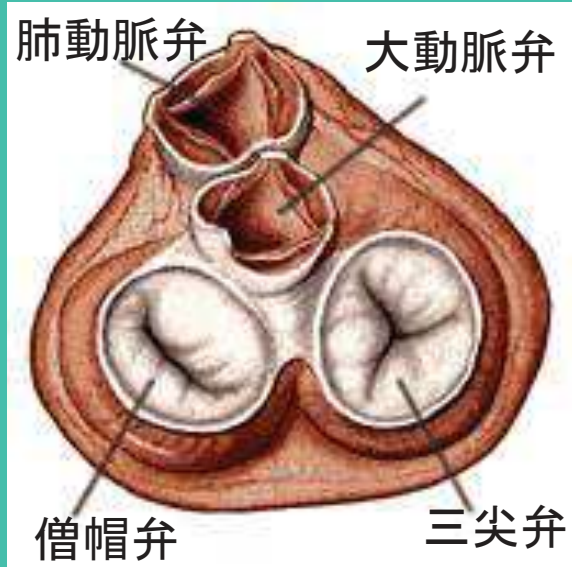




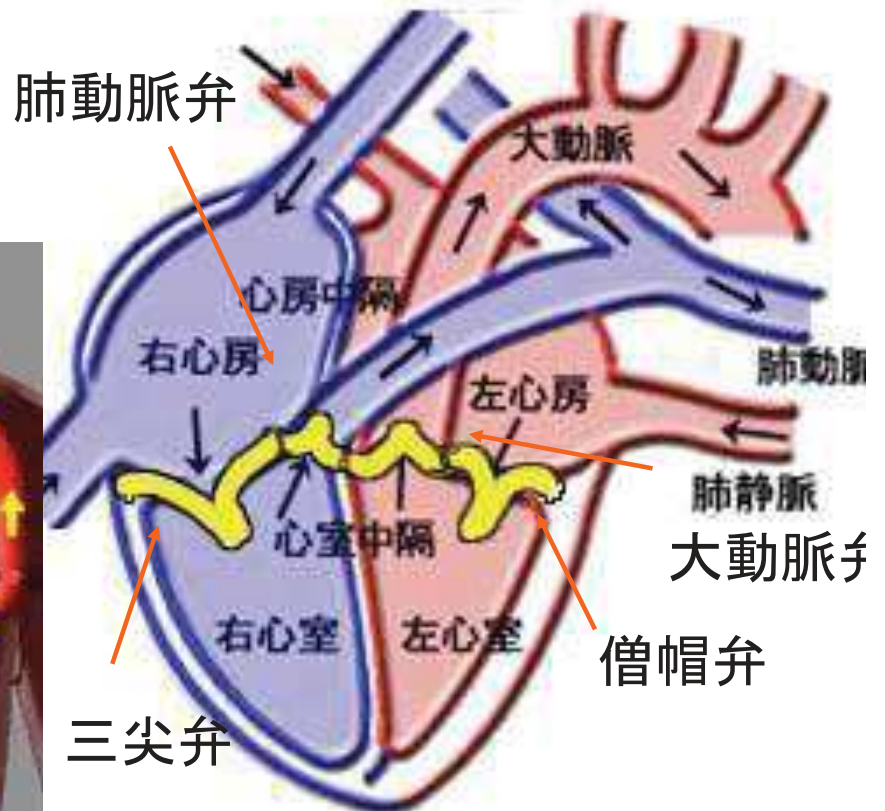
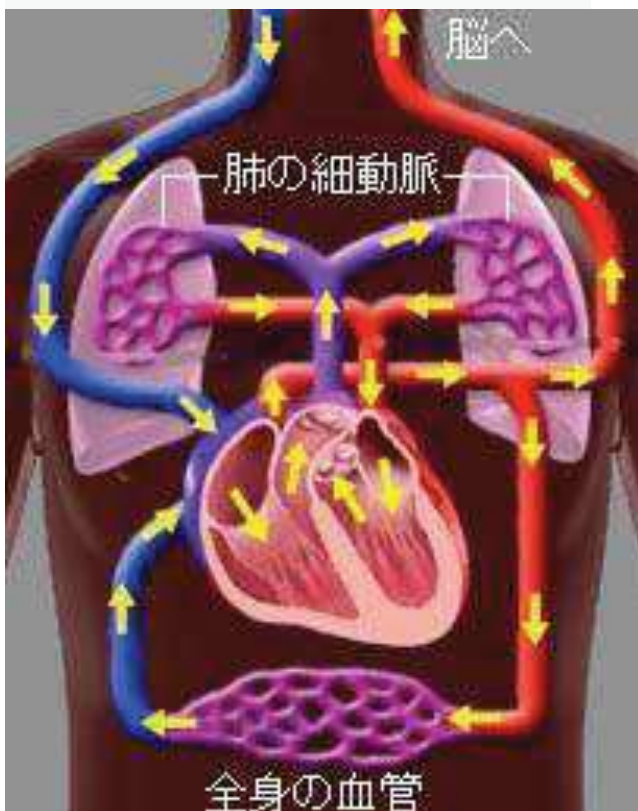
# 心臓弁

- ・ 血流を正しい方向に促し、逆流を防止する
- ・ 心臓が拍動する度に、それぞれの心臓弁は開閉する

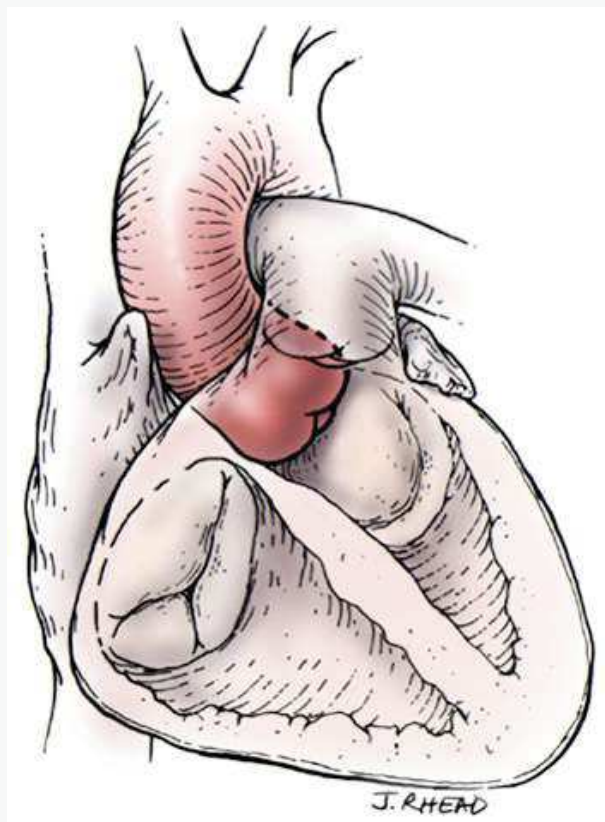
- ・ 四つの心臓弁
  - 三尖弁 (房室弁)
  - 僧帽弁 (房室弁)
  - 肺動脈弁 (動脈弁)
  - 大動脈弁 (動脈弁)



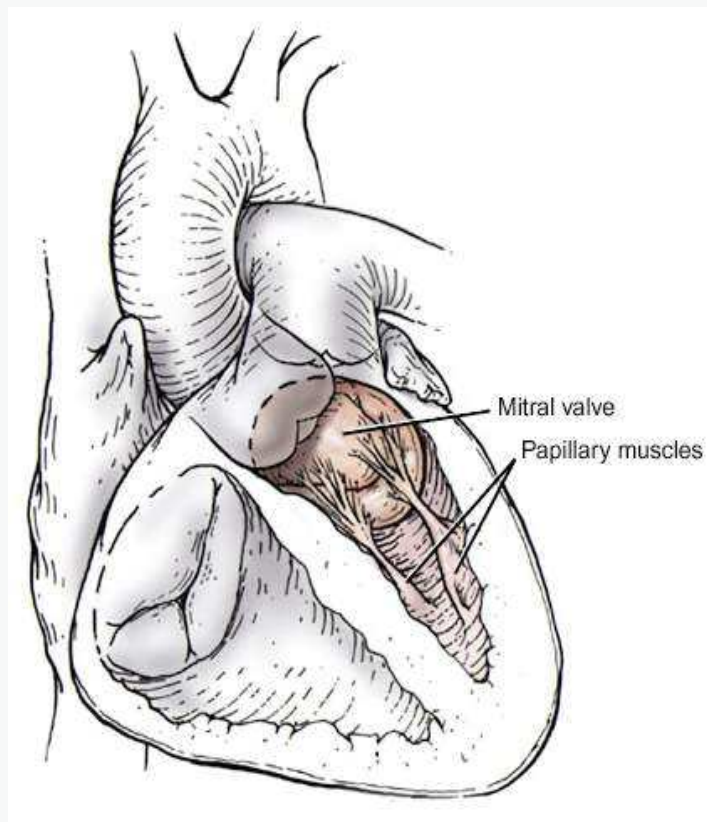
# 血液循環



# 大動脈弁



# 僧帽弁

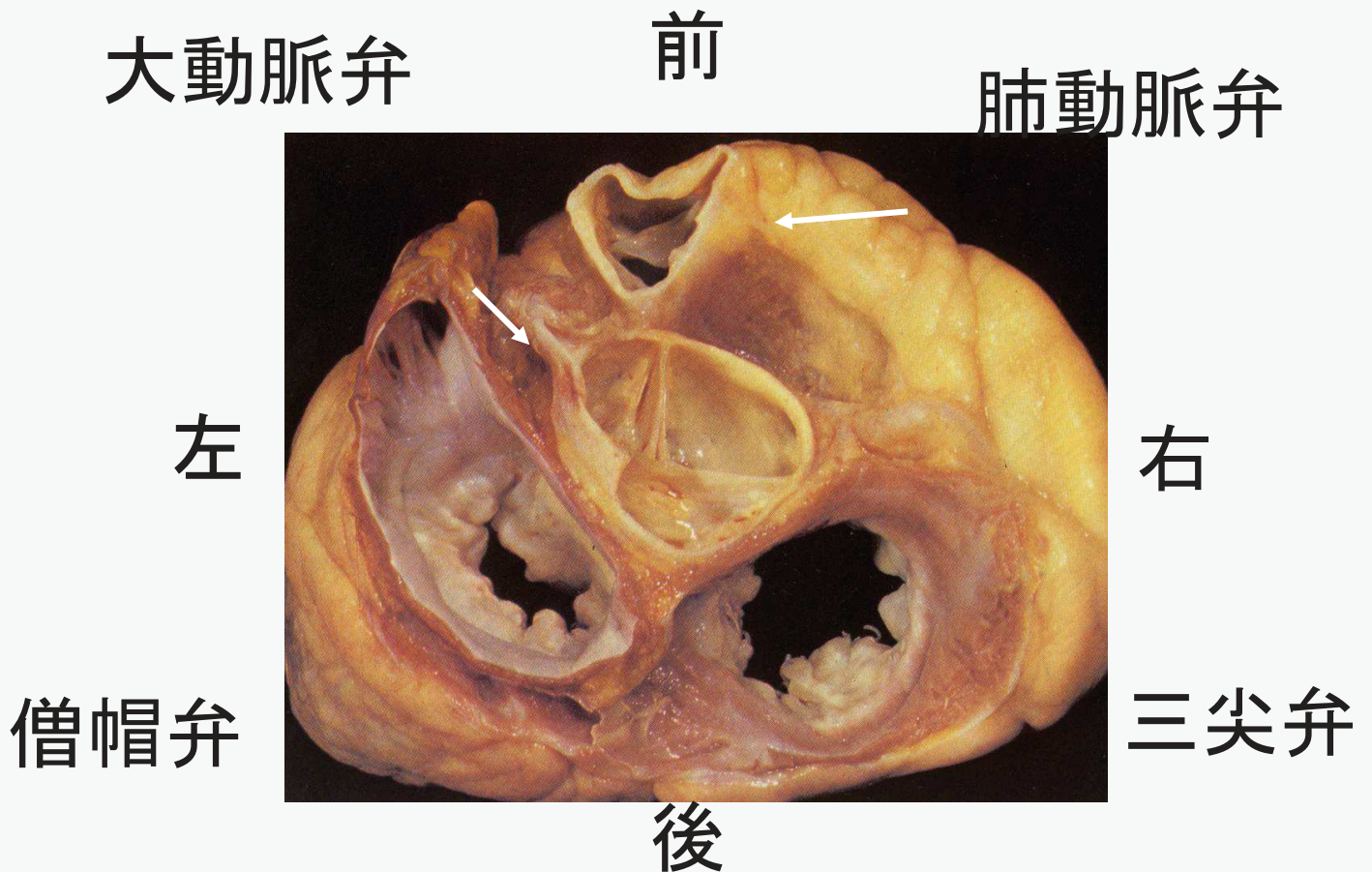


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# 心臓を頭から見ると...



## 心臓弁膜症

弁膜の変形により弁の作用が傷害され、血流に異常を生じたもの

- ・狭窄症;癒合により弁口が狭くなり、血流の通過障害を起こすもの
- ・閉鎖不全症;弁の閉鎖が不完全なために逆流が生じる



# 高齢者循環器疾患の特徴

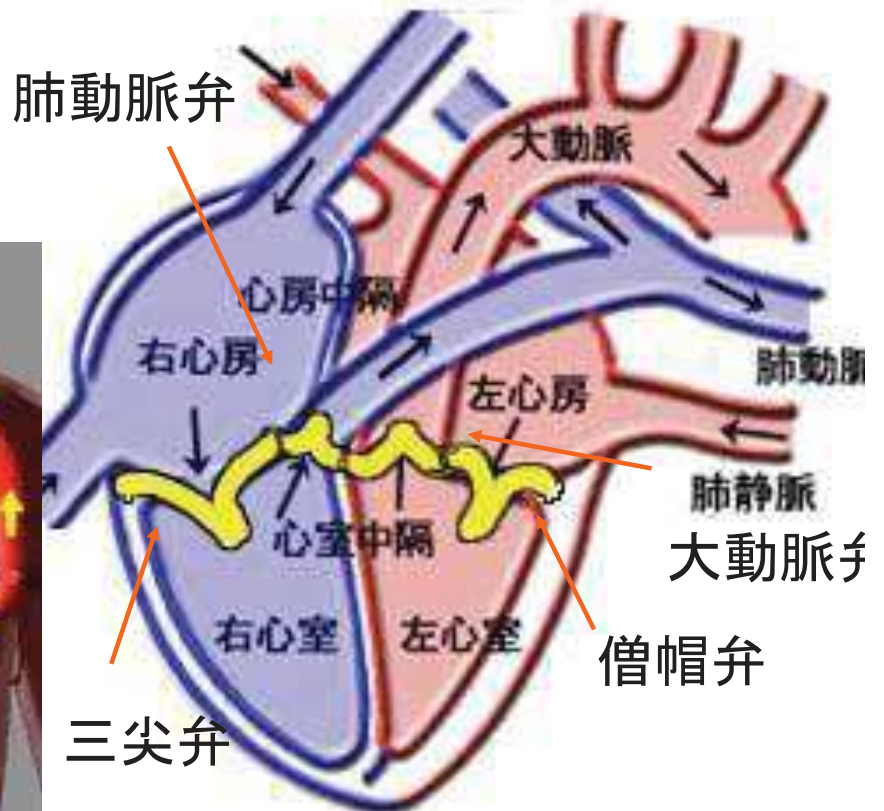
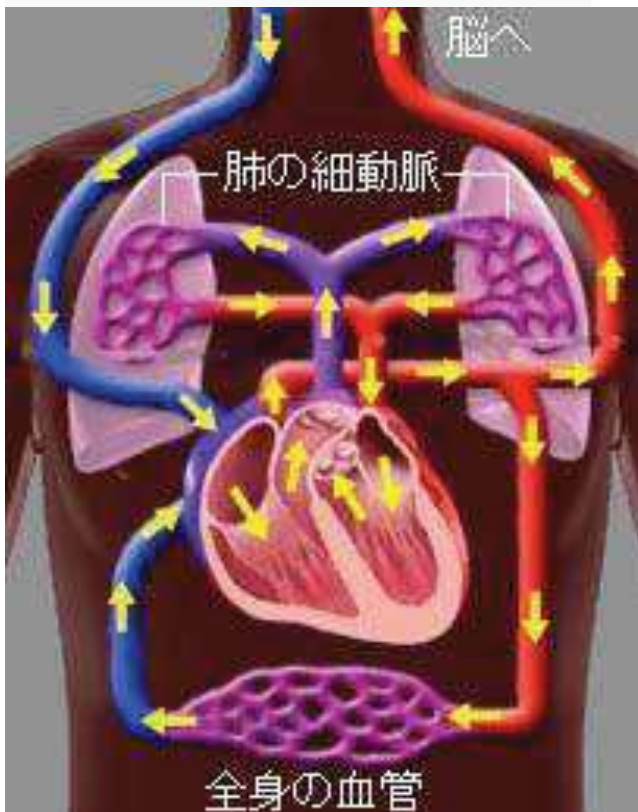
心臓血管組織(弁膜、弁輪)の石灰化をきたしていることが多い

- ・弁膜の石灰化(大動脈弁狭窄症)
- ・弁輪の石灰化(僧帽弁石灰化)
- ・大動脈石灰化



手術時の処置に困難  
合併症の発生頻度増加

## 血液循環



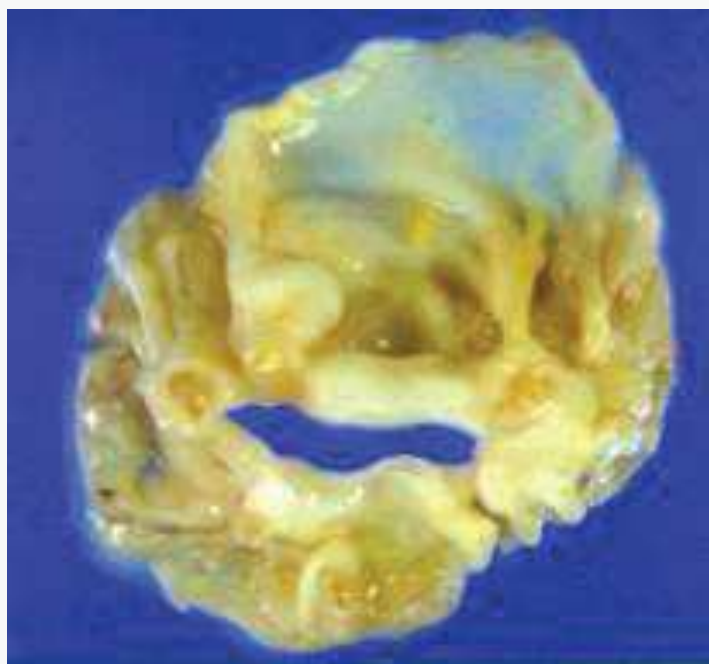
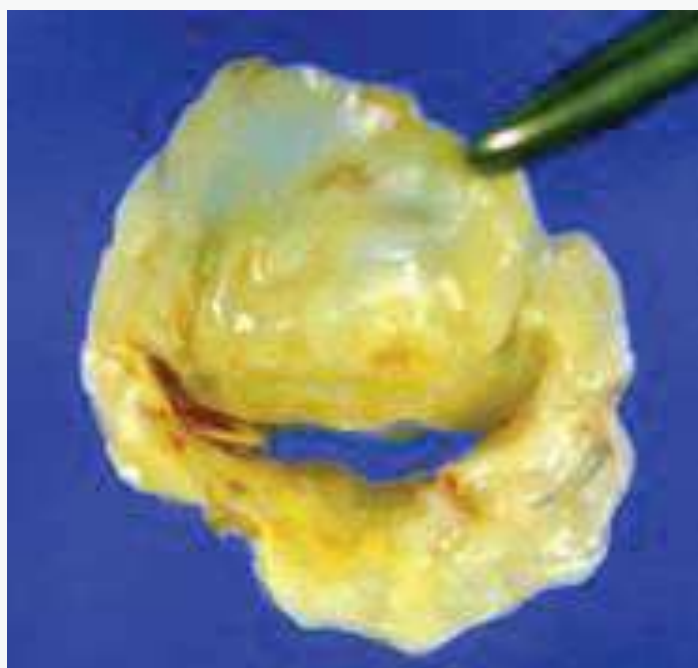


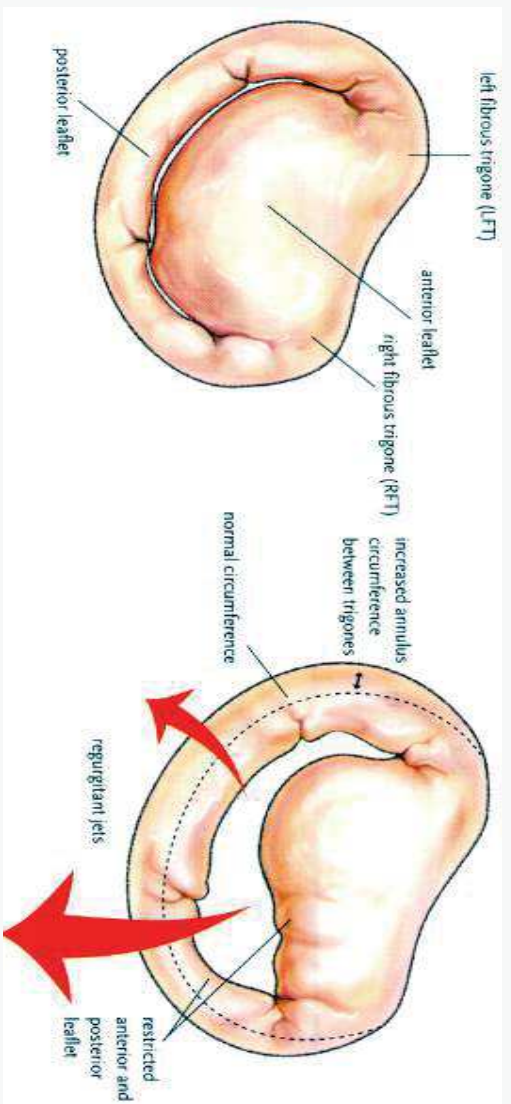
# Agenda

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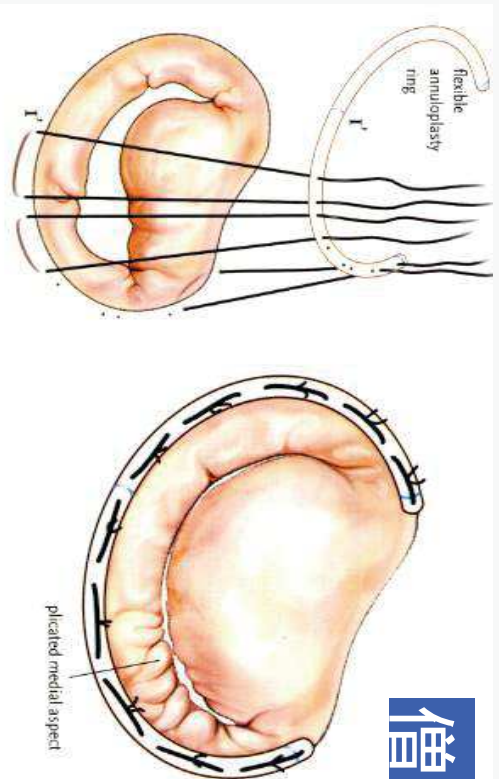
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## 僧帽弁狭窄症

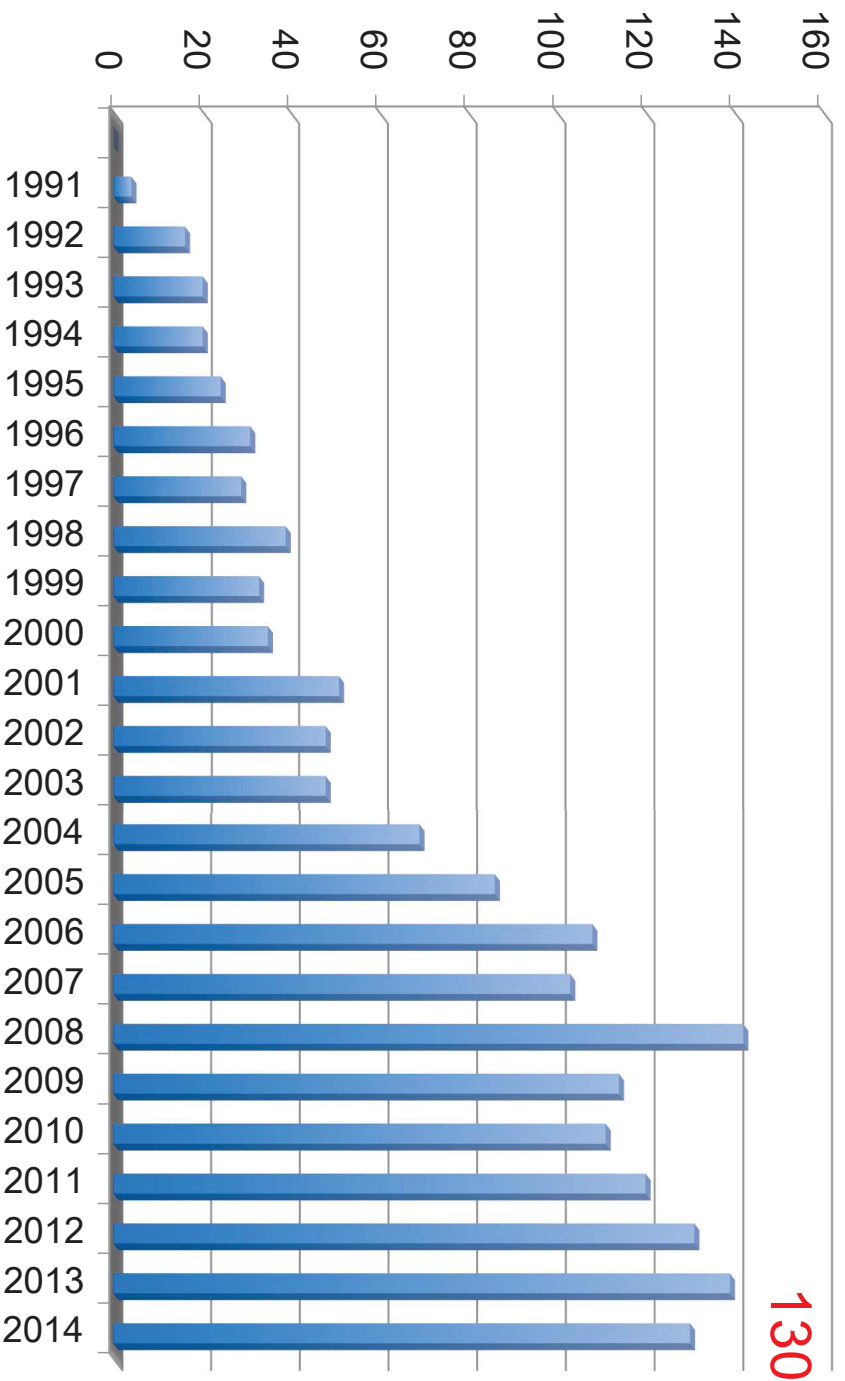




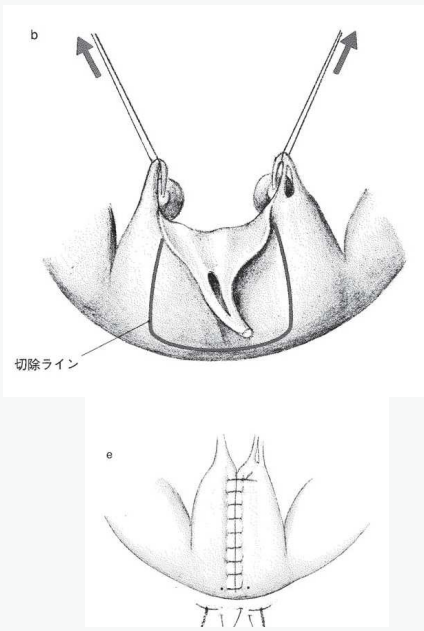
## 僧帽弁形成術



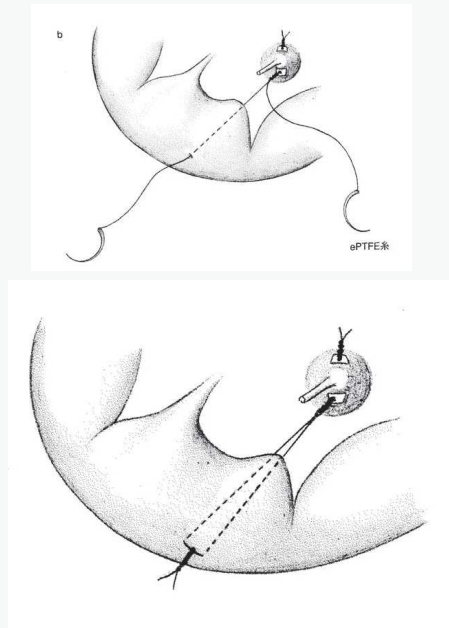
## 僧帽弁形成術の推移



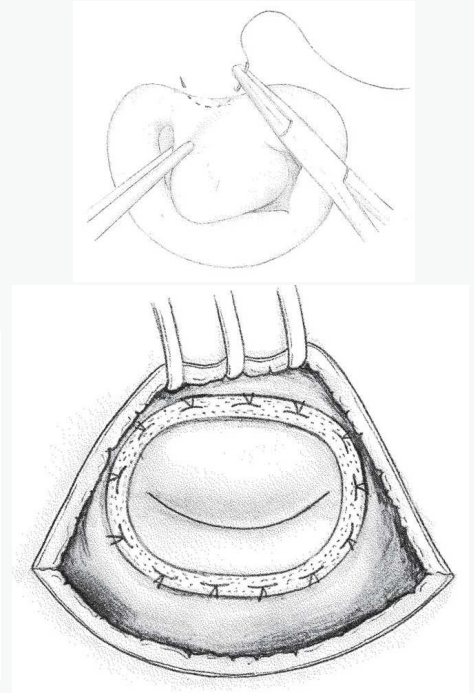
# 僧帽弁形成術の方法



弁尖切除

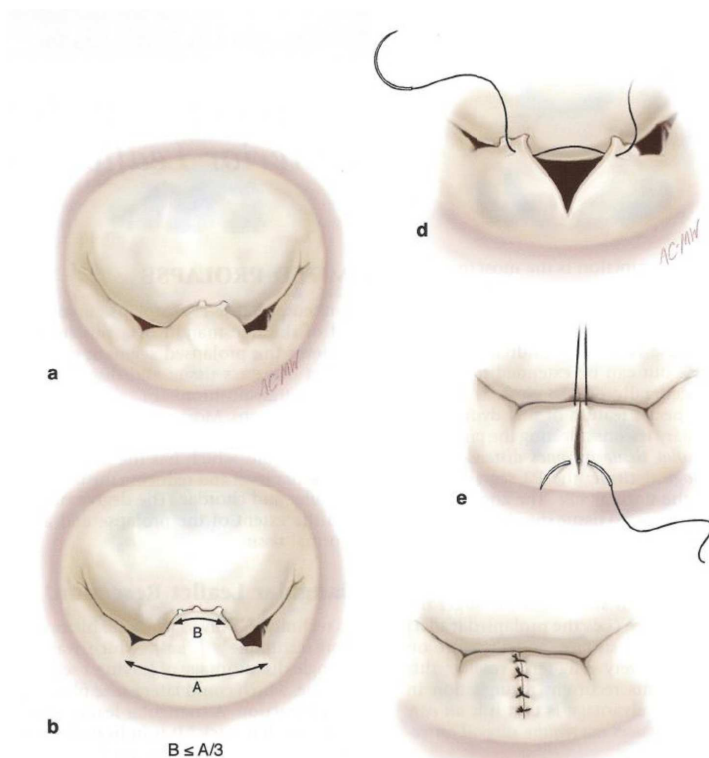


人工腱索再建



弁輪縫縮(MAP)

## Resection & suture

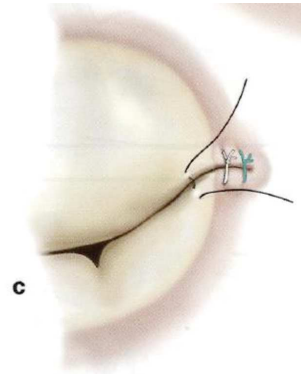
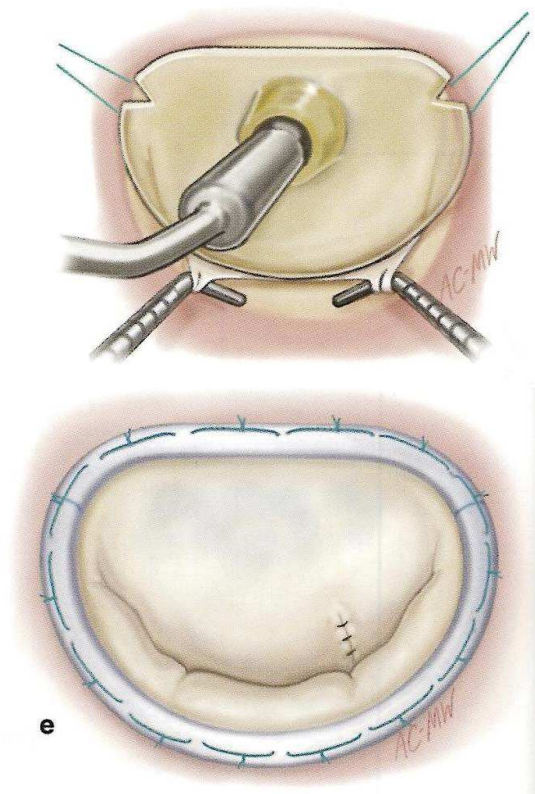


- ✓ 余剰な組織があれば切除する
- ✓ 三角切除、butterfly resectionなど

- ✓ 変性がある場合には切除  
しかし余剰な組織が無い場合もあるのではじめから大きく切らない





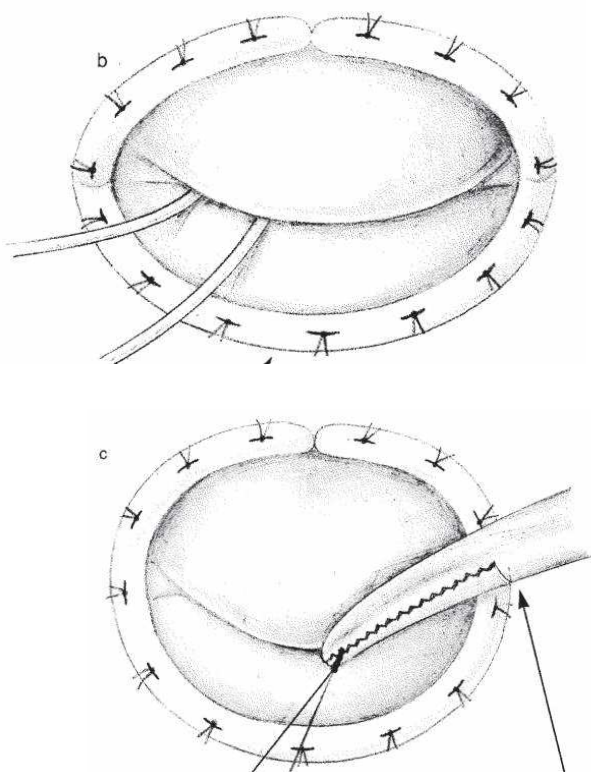


- ✓ 前尖の大きさにあわせて人工ringの大きさを選択する
- ✓ 最後に交連部から逆流を認める場合にmagic sutureをおくこともある



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## 人工腱索再建



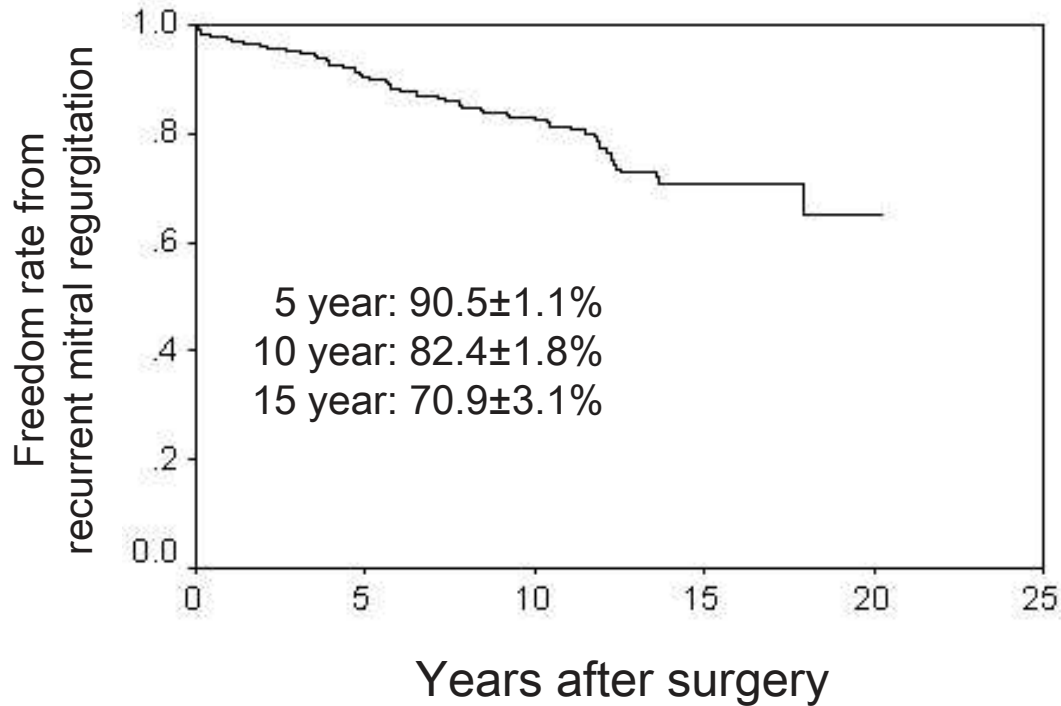
長さを決めて結紮する



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# Freedom from recurrent MR



Number at risk

1078

492

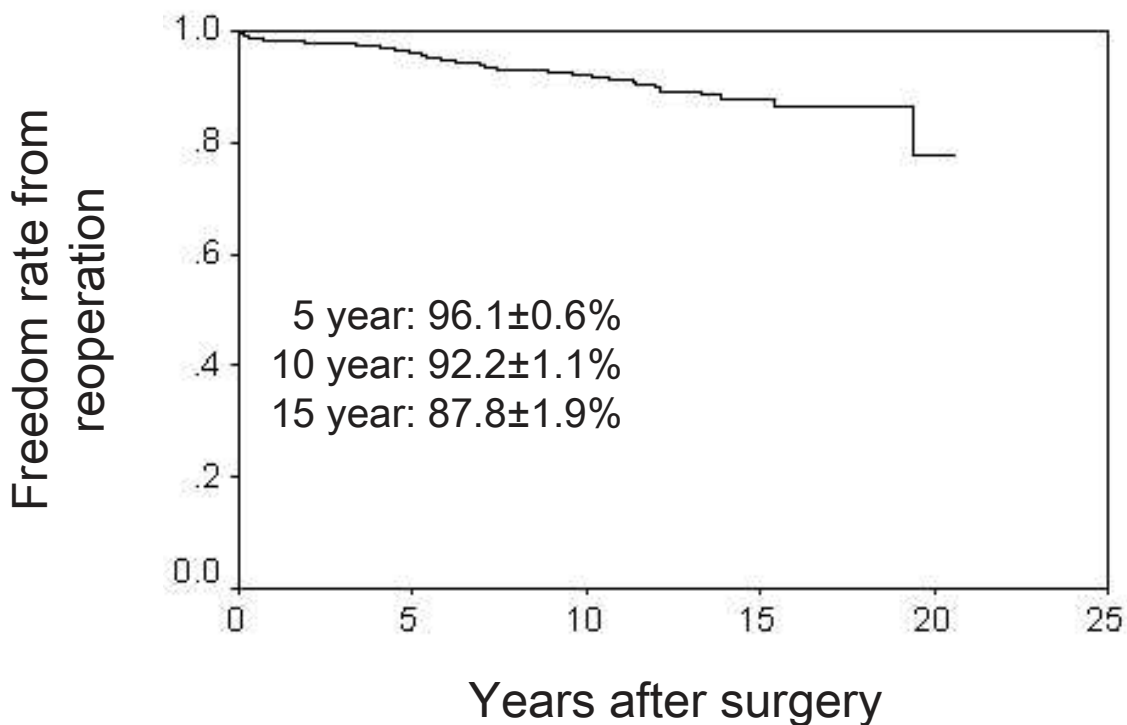
167

44



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# Freedom from reoperation



Number at risk

1078

650

242

74

5



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## 大動脈弁狭窄症

先天性二尖弁

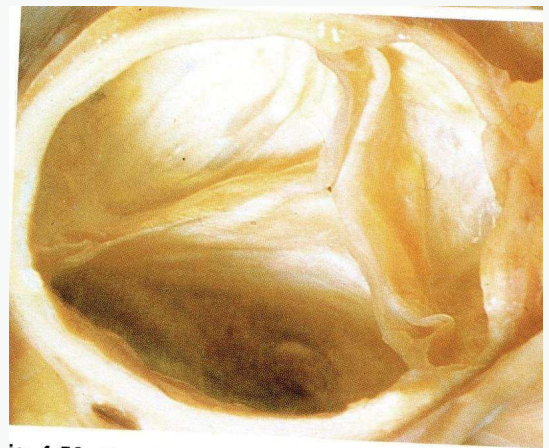
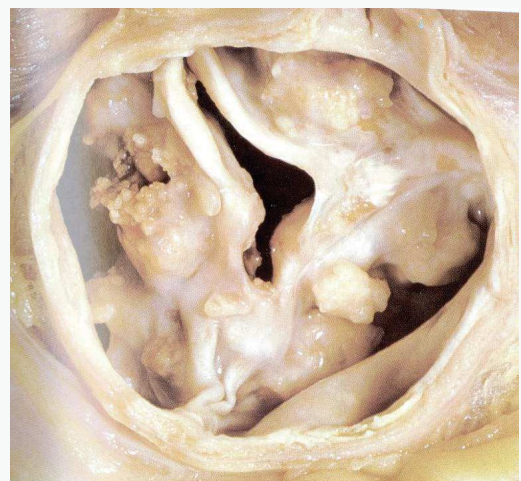
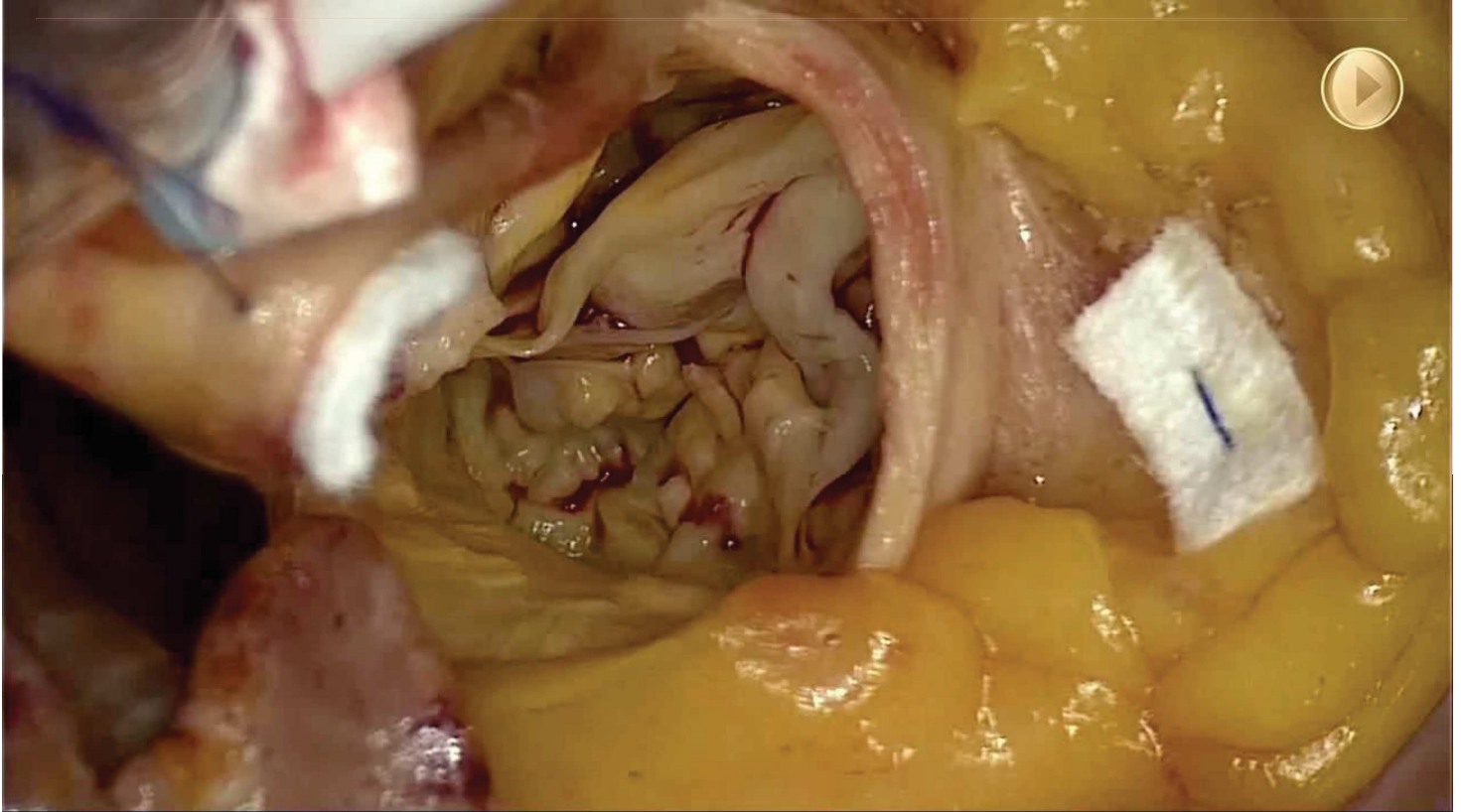


Fig. 4.56. Normal aortic valve.

石灰化した大動脈弁



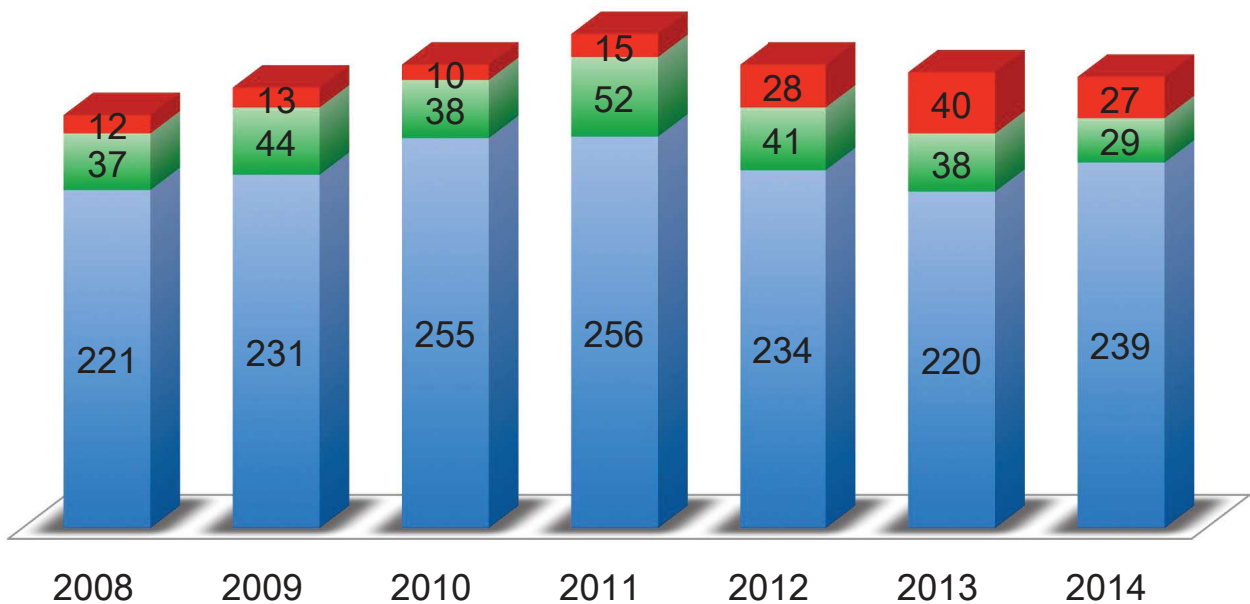
# 大動脈弁置換術(生体弁)



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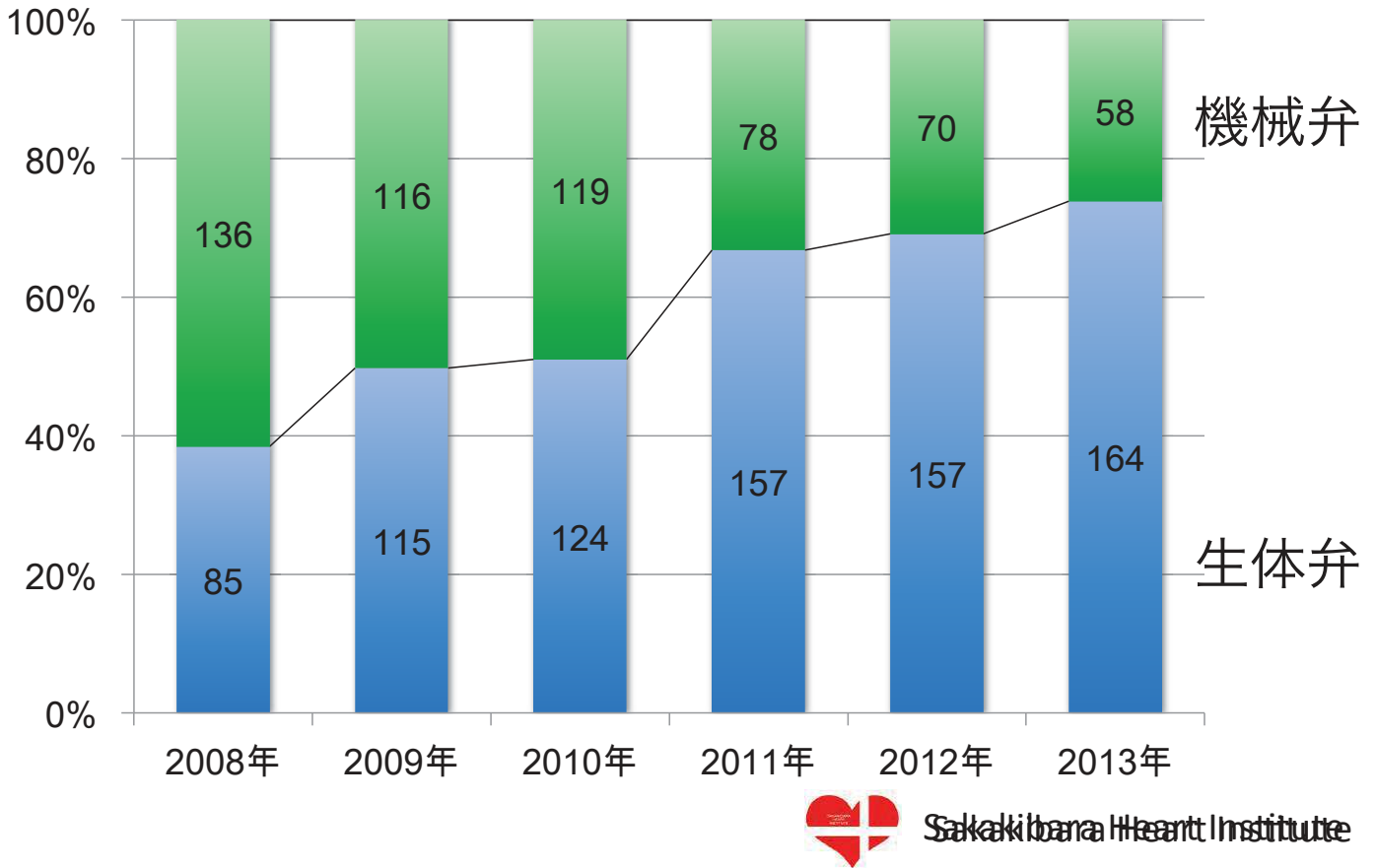
## 大動脈弁手術

■ AVR ■ Bentall ■ 自己弁温存手術

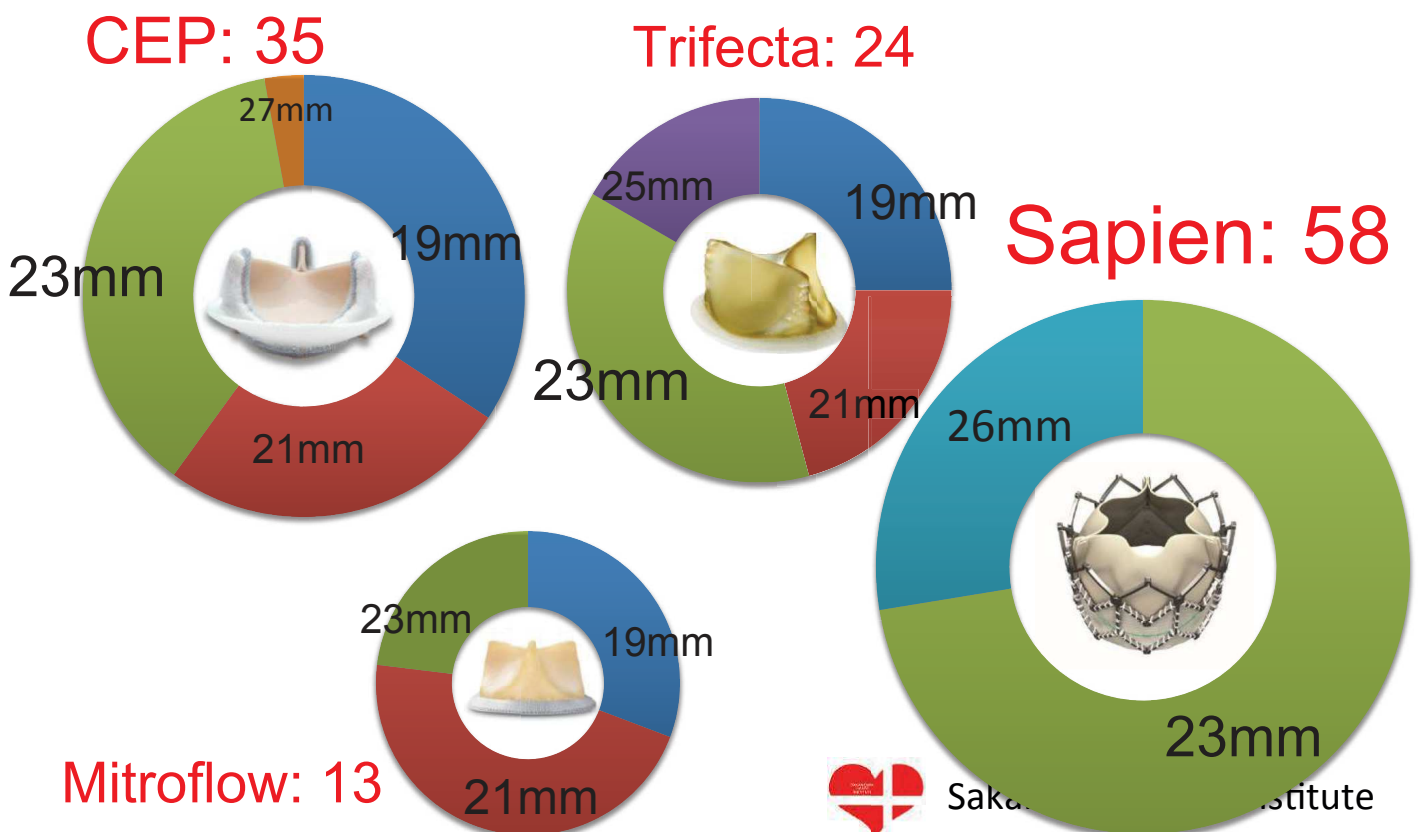


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# 生体弁と機械弁

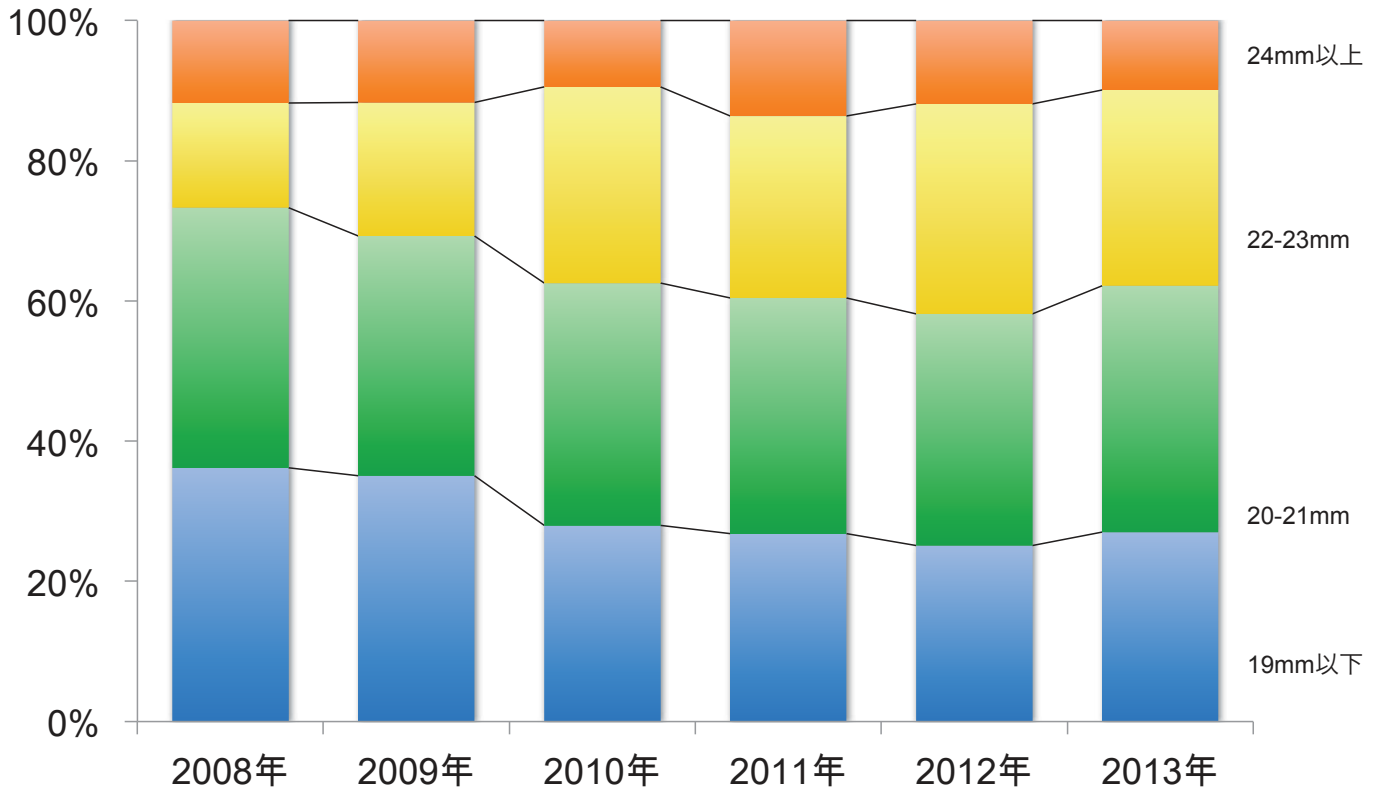


## Valve selection (Oct.2013-Dec.2014)



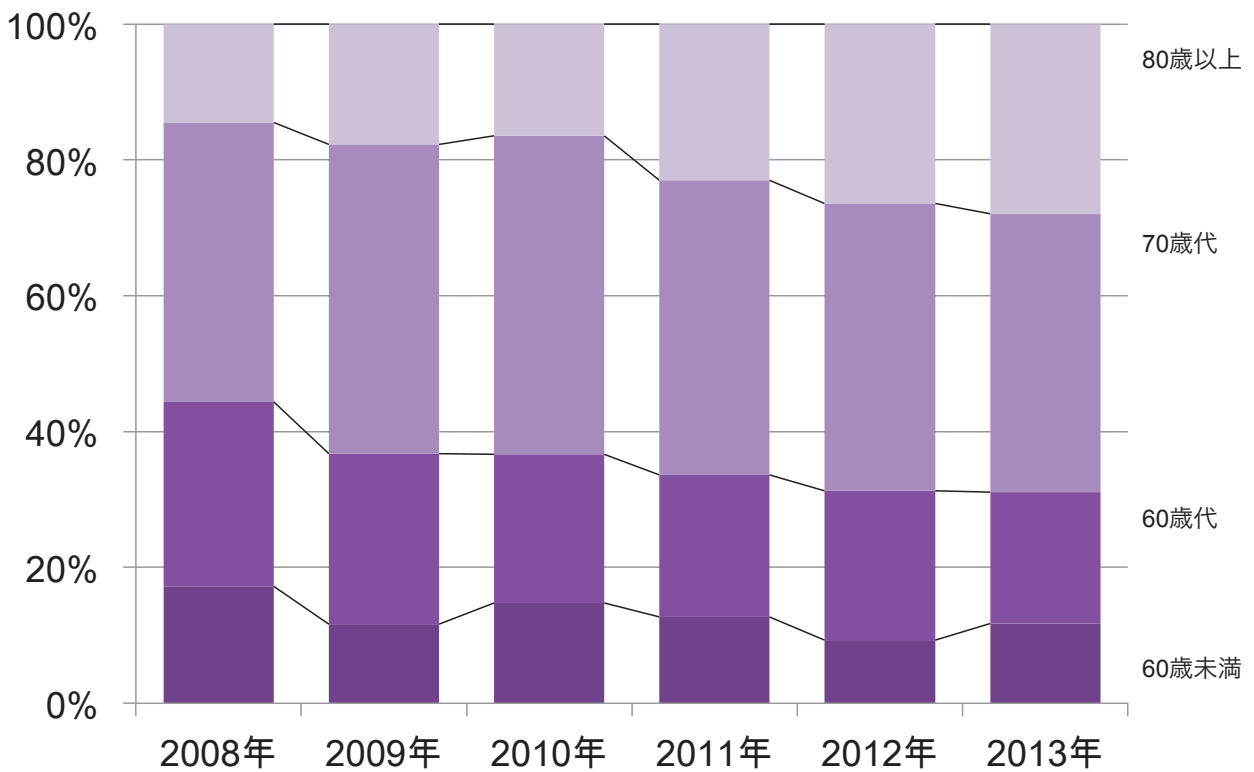


# 人工弁サイズ



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# 年齢分布



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# sAVR for 85 years of age or older

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## Patients

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247 octogenarians and 10 nonagenarians (total 257) underwent elective SAVR or SAVR+CABG for severe AS from July 2004 through May 2014.

These patients was divided to two groups

**Under 85 years old** ( $85 >$ ) N=191

**85 years of age or older** ( $85 \leq$ ) N=69



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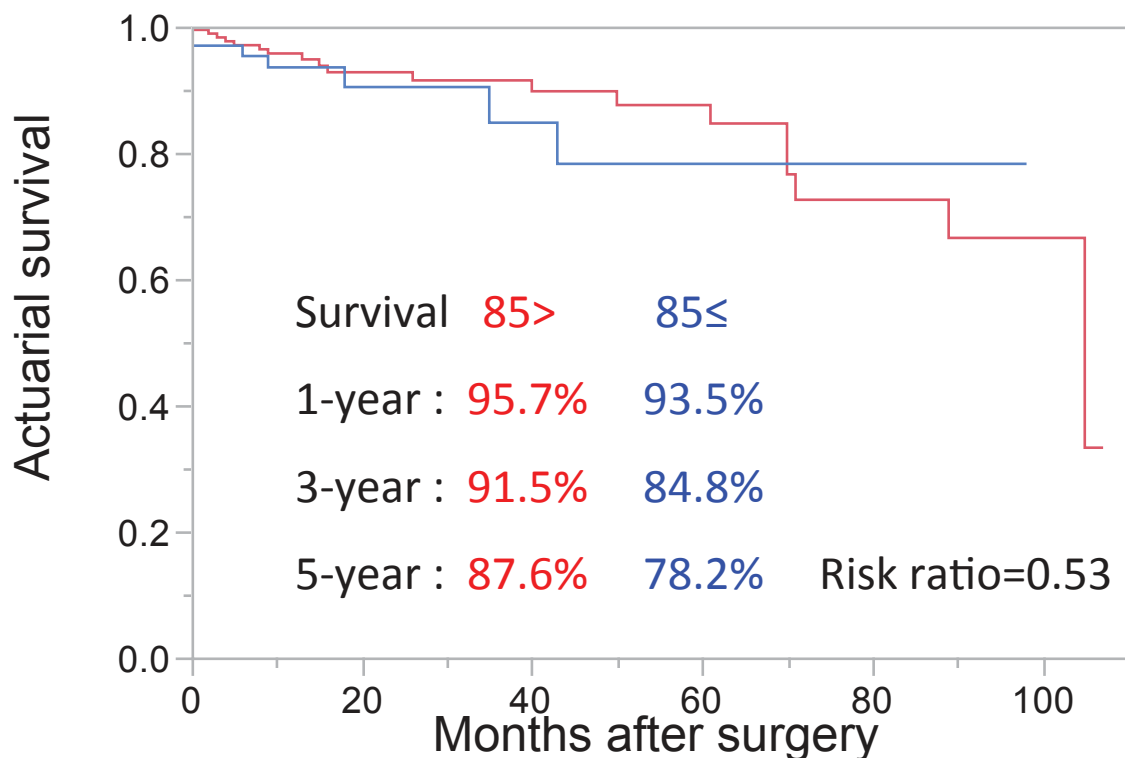
# Postoperative Outcomes

	85> (N=191)	85≤ (N=66)	p
Operative death	1 (0.52%)	3 (4.6%)	0.053
Stroke	2 (1.1%)	1 (1.5%)	1.00
Deep SSI	4 (2.1%)	1 (1.5%)	1.00
Intubation (hr)	10.7 ± 11.2	10.9 ± 9.4	0.94
ICU stay (days)	1.7 ± 3.7	1.6 ± 1.6	0.84
Hospital stay (days)	15.0 ± 9.7	25.4 ± 89.6	0.12



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## Actuarial Survival



# at risk 191 89 53 33 15 4  
66 25 14 5 2



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# 生体弁 と 機械弁

長所

短所

機械弁

丈夫

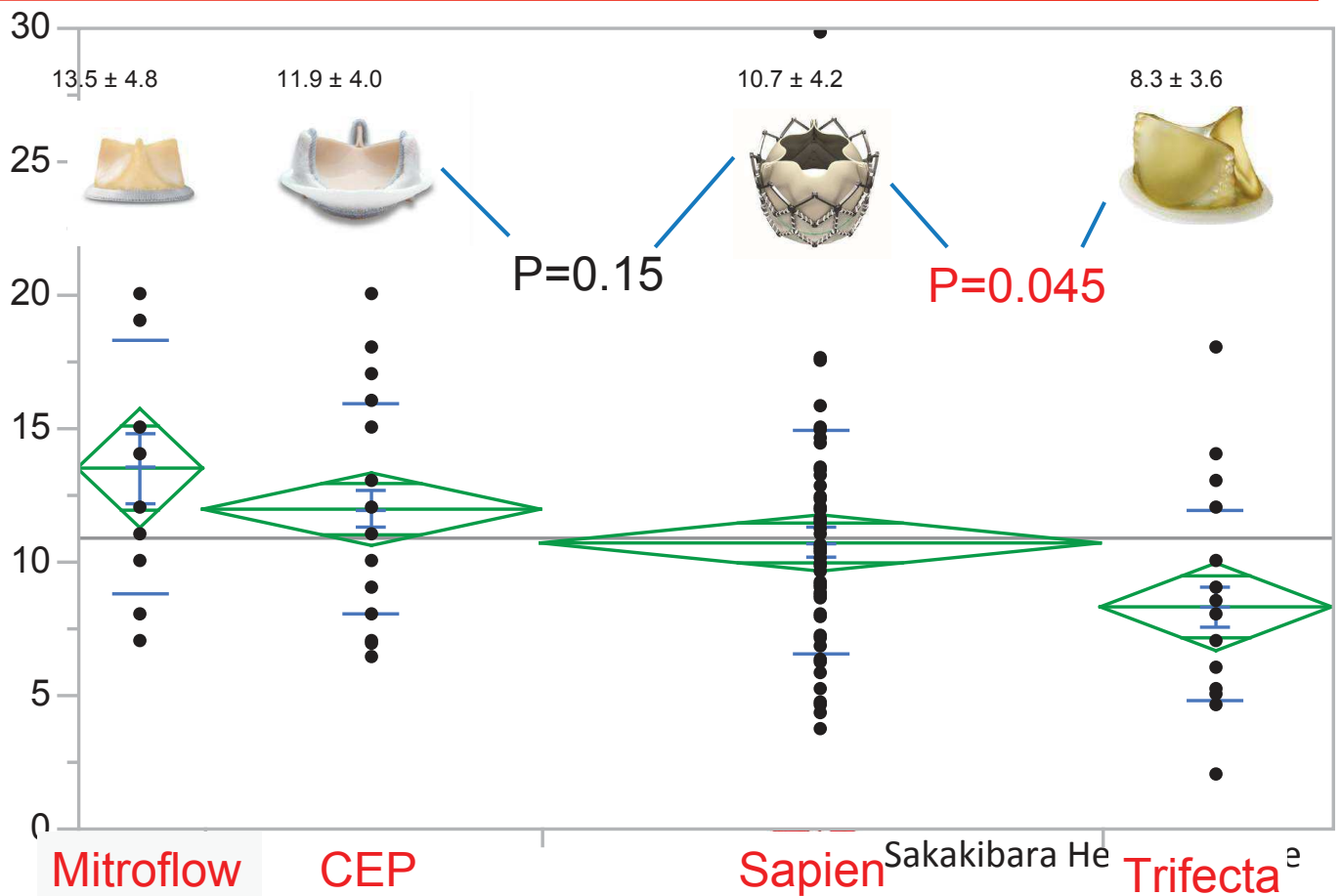
抗凝固療法  
要

生体弁

抗凝固療法  
不要

耐久性

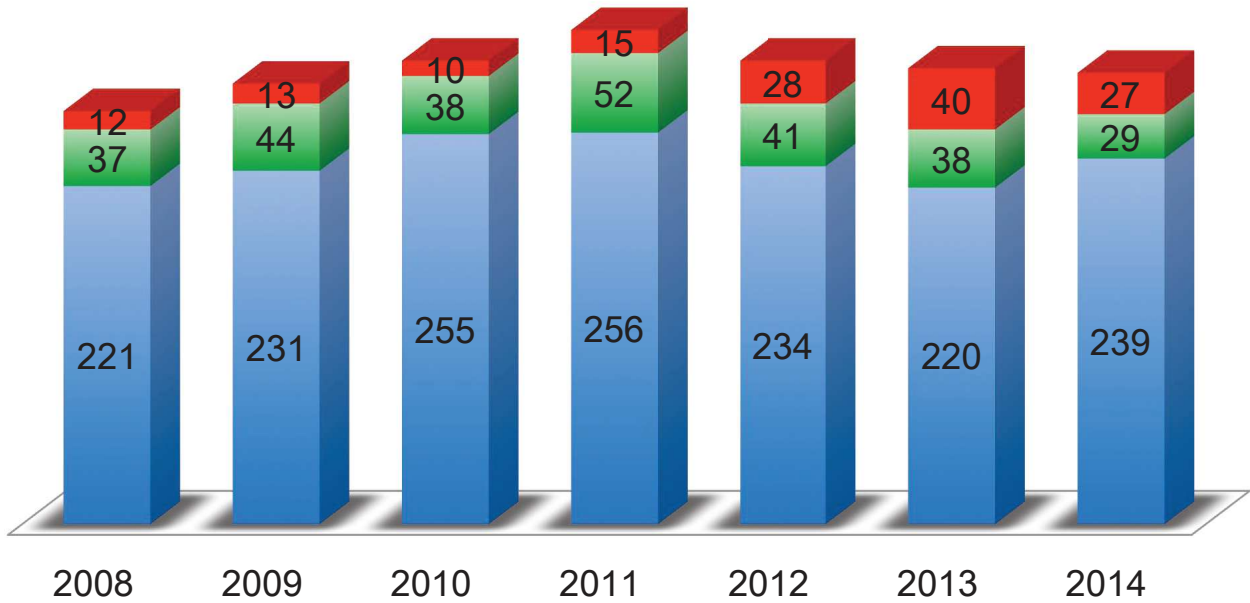
## Postop Mean Gradient (mmHg)





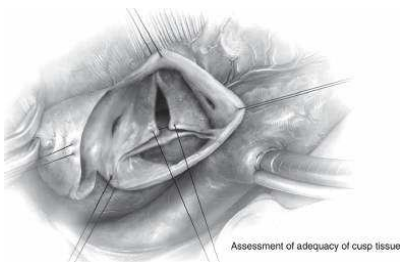
# 大動脈弁手術

■ AVR ■ Bentall ■ 自己弁温存手術

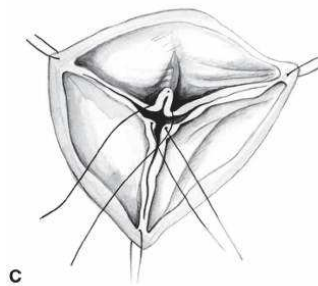


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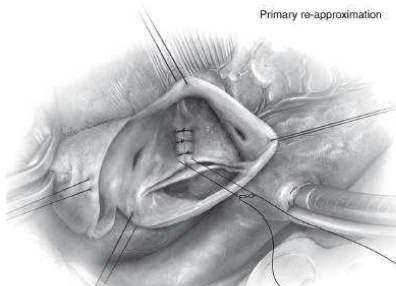
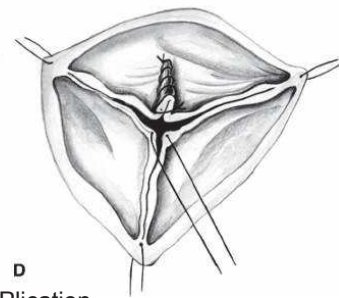
# 大動脈弁形成術



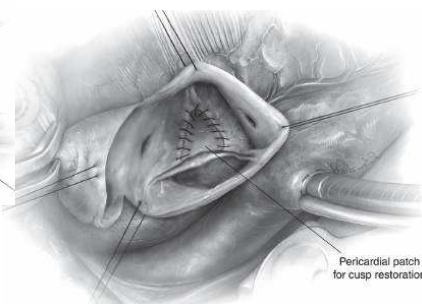
Triangulär Resection



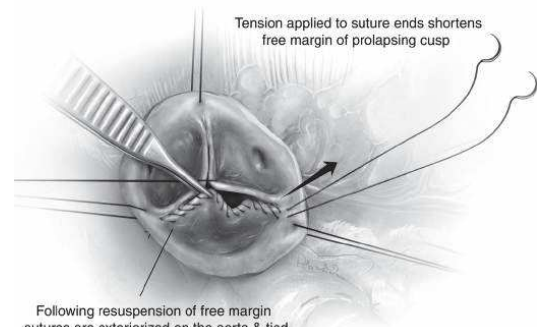
Central Plication



Simple Suture



Pericardial patch for cusp restoration



Free Margin Resuspension



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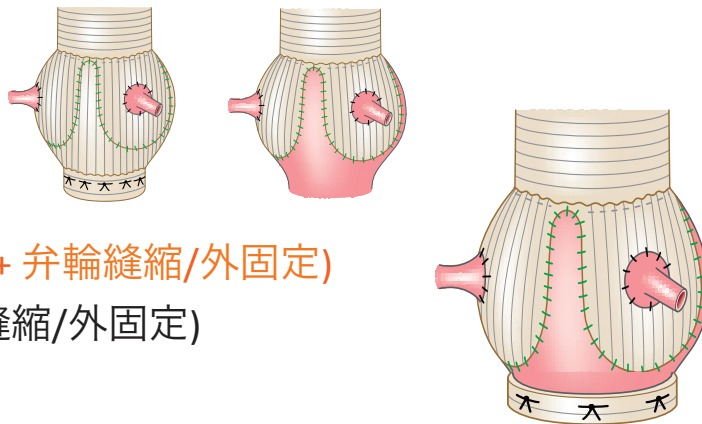
# 自己弁温存基部再建・大動脈弁形成術

## ・ <適応>

- 大動脈解離・大動脈弁輪拡張症による大動脈閉鎖不全症
- 単独大動脈弁閉鎖不全症
  - ・ ※有意な大動脈弁狭窄症・弁尖変性のあるものは除外

## ・ <術式>

- Reimplantation (=David)手術
- Remodeling (=Yacoub)手術
- **modified Yacoub手術 (Yacoub + 弁輪縫縮/外固定)**
- 単独大動脈弁形成術 (±弁輪縫縮/外固定)



## ・ <大動脈弁形成>

- central plication : 弁尖逸脱の矯正(effective height測定)
- 自己心膜パッチ : 変性弁尖の補填、短縮弁尖の延長、欠損部分の補填

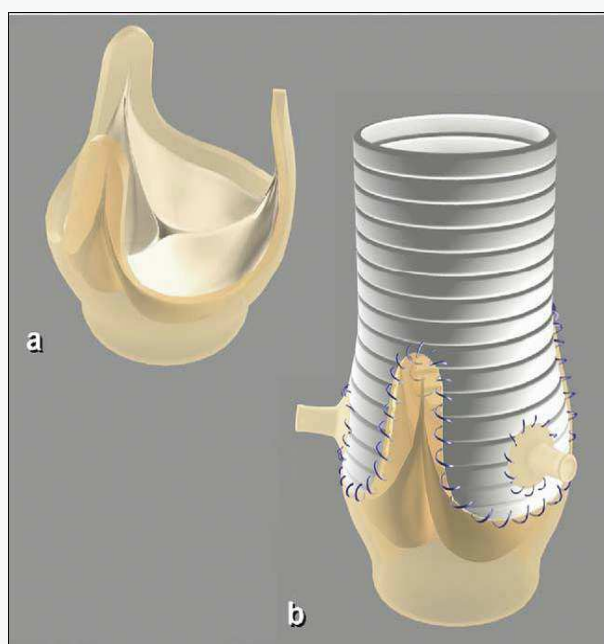
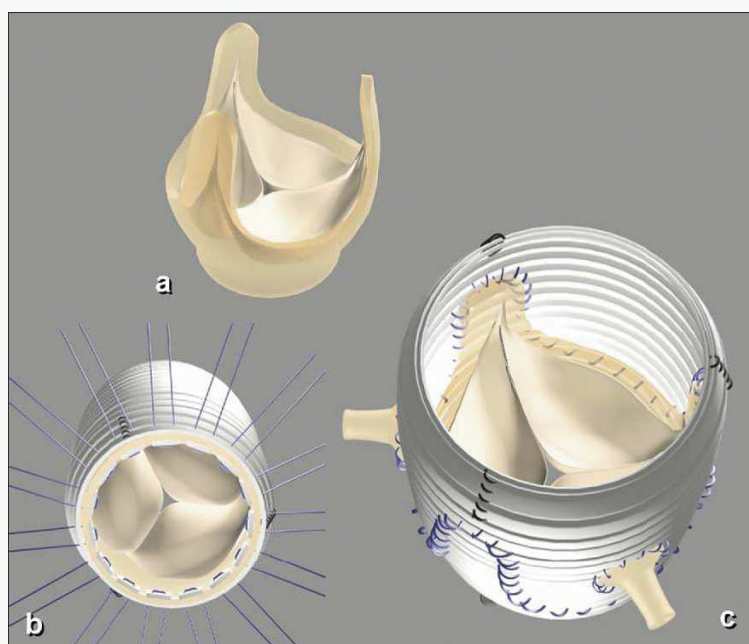


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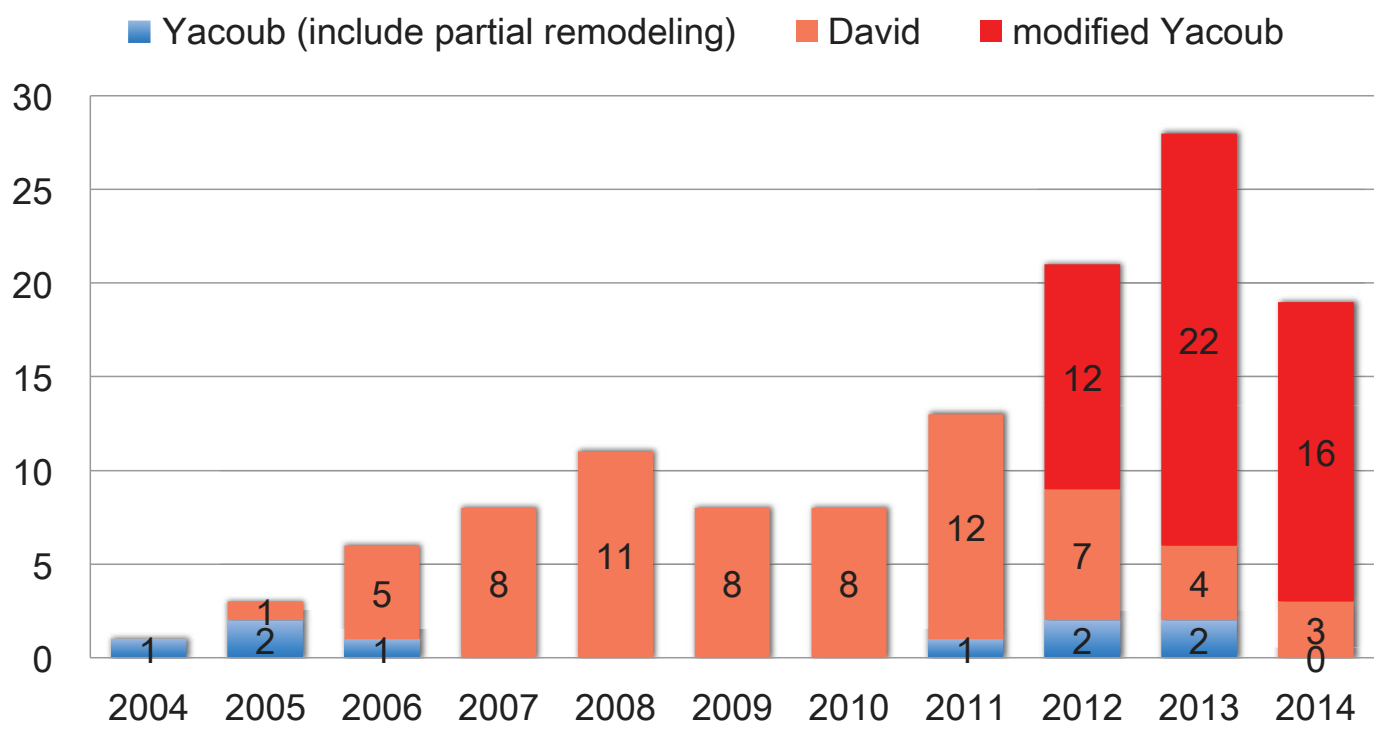
# 自己弁温存大動脈基部置換術

*Reimplantation*  
(David法)

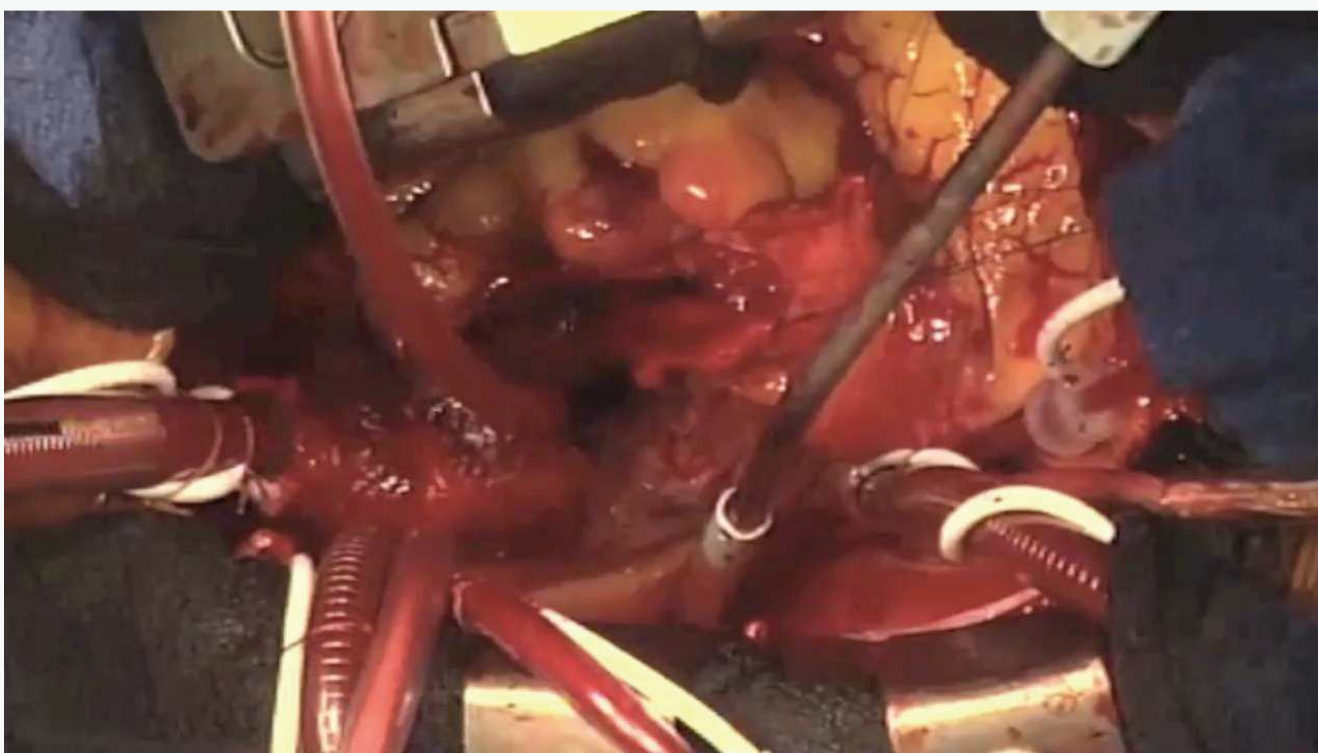
*Remodeling*  
(Yacoub法)



# 自己弁温存基部置換術の術式変遷

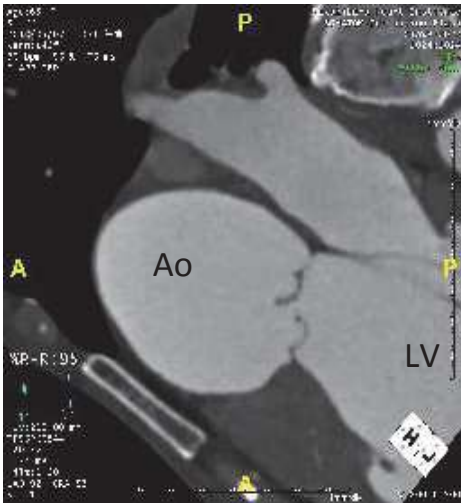


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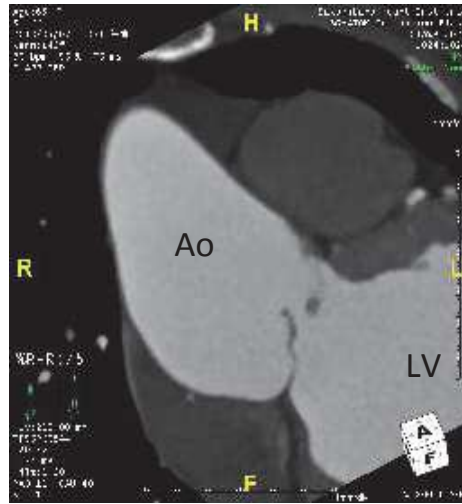




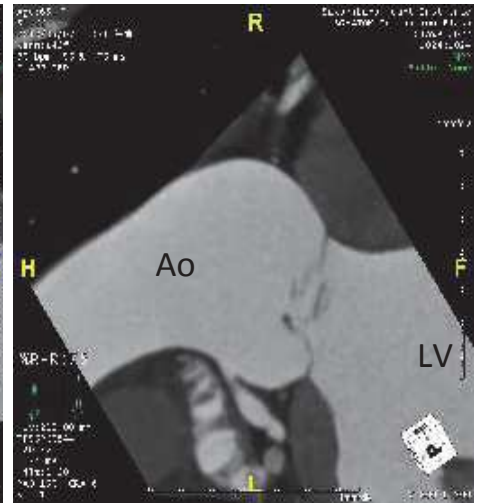
# Cusp motion -CT-



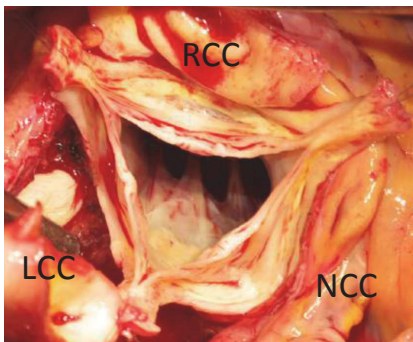
RCC : prolapse



NCC : partial bending



LCC : normal



64 y.o. female

Dd/Ds 72/61, EF 35%, severe AR (AAE+cusp prolapse)

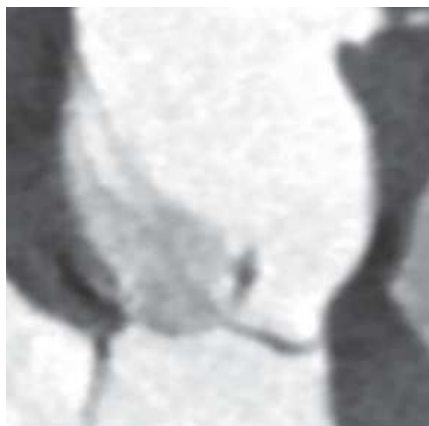
→modified Yacoub with AVP



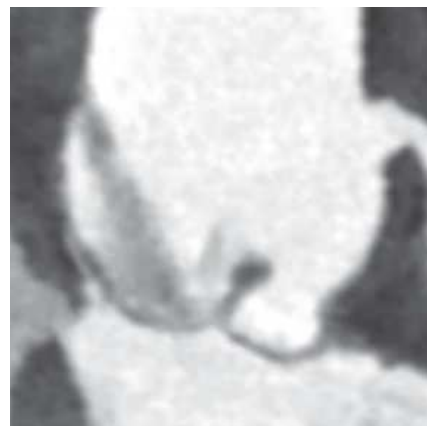
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47

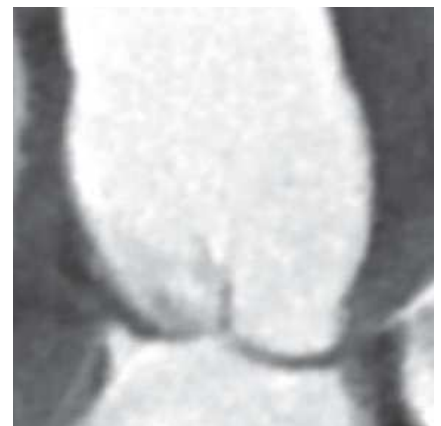
## postoperative cusp configuration



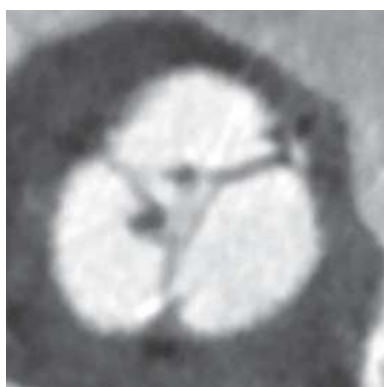
RCC



LCC



NCC



- RCC and LCC were performed central plication  
→ Perioperative eH of all cusp were more than 9mm

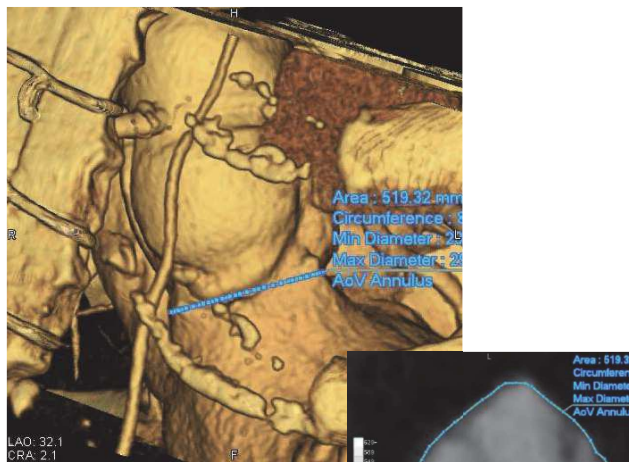
It was possible to evaluate in detail cusp configuration



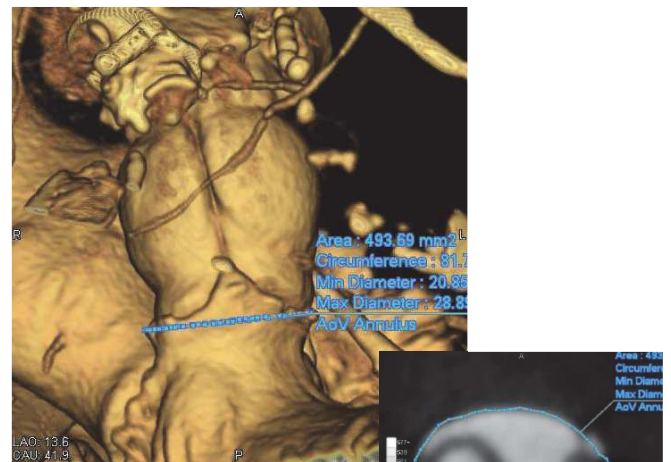
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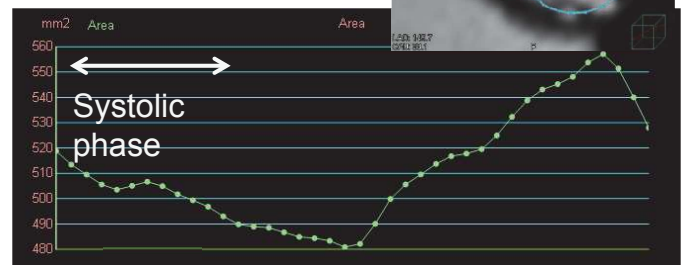
# AVJ measuring -PhyZiodynamics-



mod. Yacoub



David



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## Our indication for Aortic Valve Sparing

- Age <75 years old
- Normal or **repairable** aortic valve cusps
- Isolated AR
  - Every pathology: uni, bi, tri, qu
  - Acceptable GH
- Root or Asc. Aorta dilatation
  - Aneurysm
  - Root size: >(40-)45mm
- Acute Aortic Dissection



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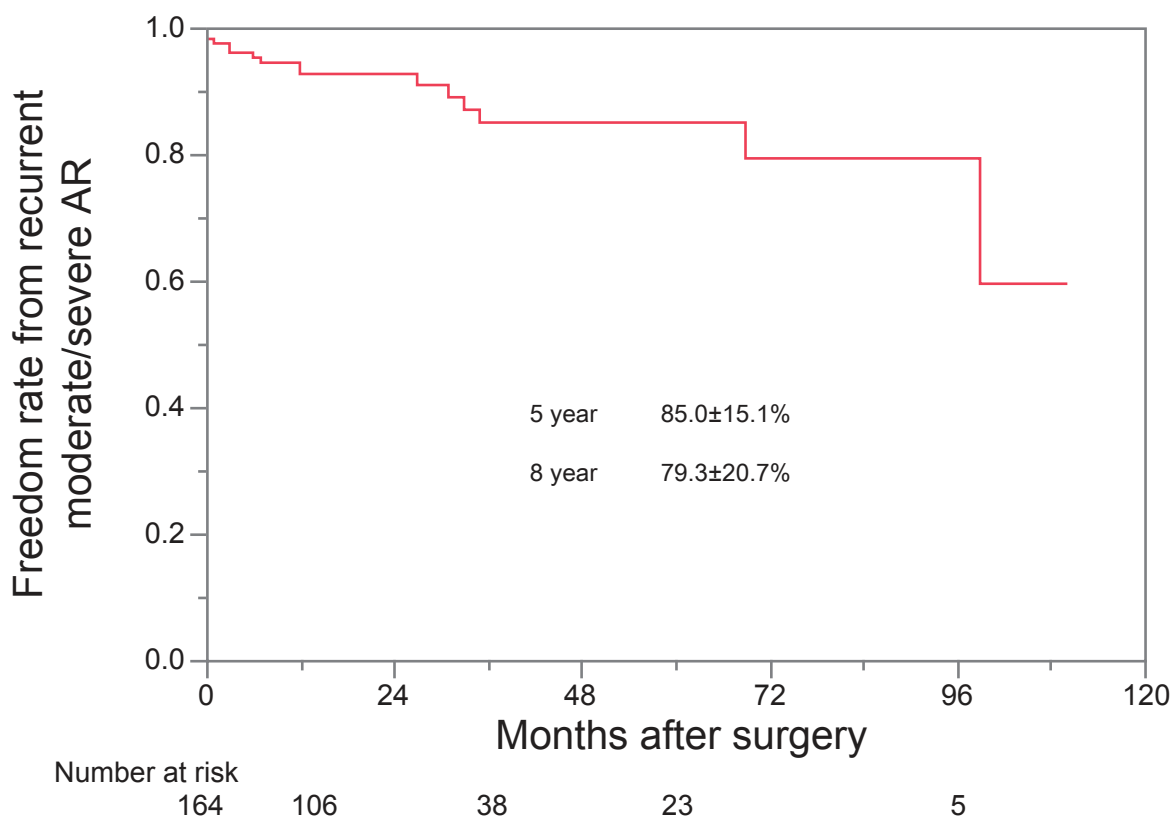
# Expanding the indication for aortic valve sparing

- Age >75 years old
- Abnormal aortic valve cusps
  - Fenestration, Severe prolapse, Cusp restriction
- Isolated AR
  - Every pathology: uni, bi, tri, qu
  - Acceptable GH
- LV dysfunction



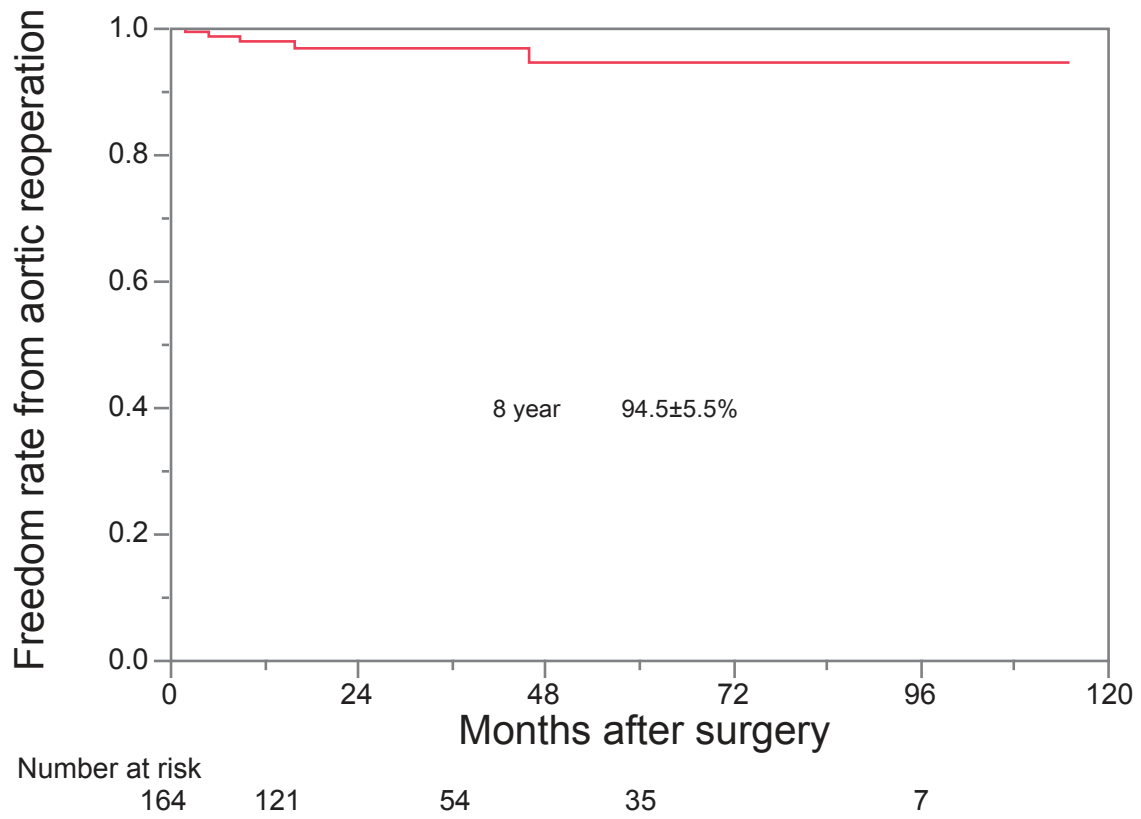
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## Freedom from recurrent moderate/severe AR



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# Freedom from aortic reoperation



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# Agenda

1. Introduction
2. 心臓弁膜症
3. 僧帽弁疾患
4. 大動脈弁疾患
5. 最新の外科治療

## 当院におけるMICS(低侵襲心臓手術)

### 皮膚 小切開

- ・ 胸骨正中切開
- ・ 何センチ以下??

### 直視下 小開胸

- ・ 半胸骨切開
- ・ 小肋間開胸

### Port Access

- ・ 小肋間開胸
- ・ 胸腔鏡・  
ロボット補助下

### ???

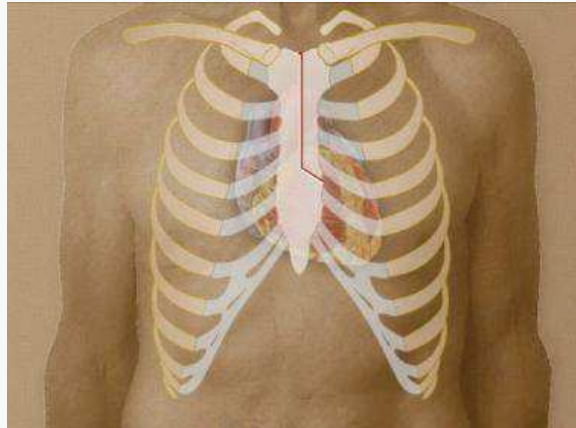
- ・ Transcatheter valve
- ・ 3Dエコー補助下  
オフポンプ心内手術?





# 直視下小開胸手術

- 上半胸骨切開
  - 大動脈弁
  - 上行大動脈
- 下半胸骨切開
- 右小開胸
  - 僧帽弁・三尖弁
  - ASD, VSD
  - 心房腫瘍
  - Maze

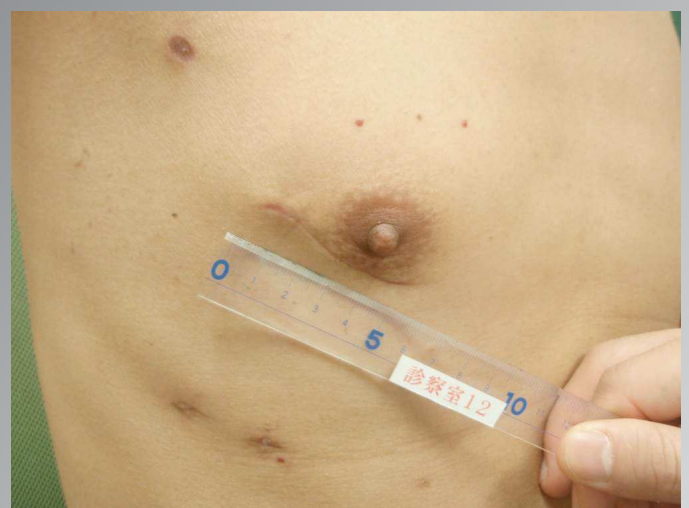


## 創部写真その1

男性A氏(術後1週間)



男性B氏(術後3週間)



## 創部写真その2

---

女性C氏(術後5日目)



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## 当院におけるMICSアプローチの対象手術

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- 僧帽弁形成術・置換術
- 三尖弁形成術・置換術
- ASD/PFO閉鎖術
- Maze手術

\* 心房腫瘍(Myxomaなど)摘出術も可能であるが、腫瘍の破片を見失う恐れがあるため、現在は正中切開で行っている。

# 当院におけるMICS術後リハビリテーション

---

## 5日目退院プログラム

- 術後数時間で抜管
- ドレーン・CVカテーテルは翌朝ICUで抜去
- 1POD: 病棟にてデイルーム内歩行
- 2POD: 午前100m歩行、午後200m歩行
- 3POD: 午前400m歩行、午後リハビリ室にて有酸素運動
- 4POD: リハビリ室にて有酸素運動
- 5POD: 退院



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## 利点と潜在的欠点

---

### [利点]

- 胸骨骨髓炎や胸骨動揺のリスクがない
- 術後疼痛の軽減
- 創が目立たない
- 術後の回復が早い！

### [潜在的欠点]

- 手術時間が長くなる (Learning curveあり)
- 末梢血管操作による合併症
- 正中切開またはクラムシェルへのconversionの可能性

# ハイリスク大動脈弁狭窄症例 に対する治療戦略

榊原記念病院 外科

高梨秀一郎



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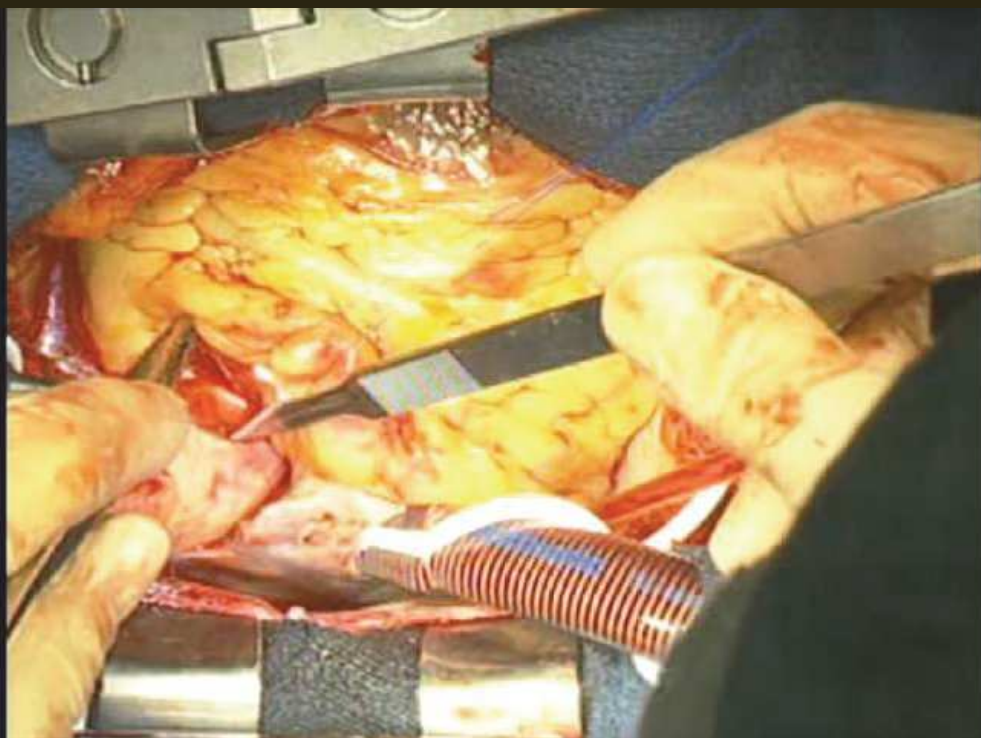
## 高齢者大動脈弁狭窄症 に関する今日の課題

- 心不全に罹患した超高齢者の患者が近年増加
- 石灰化大動脈弁狭窄症が成因の大きな一つ
- 慢性心不全により、QOLが大きく制限  
    労作時呼吸困難、胸痛、失神が出現
- 繰り返す急性心不全
- 薬物治療の効果は限られる。
- 高率な合併症のため、外科治療を受ける例は少ない
- 症状出現例の予後は極めて悪い

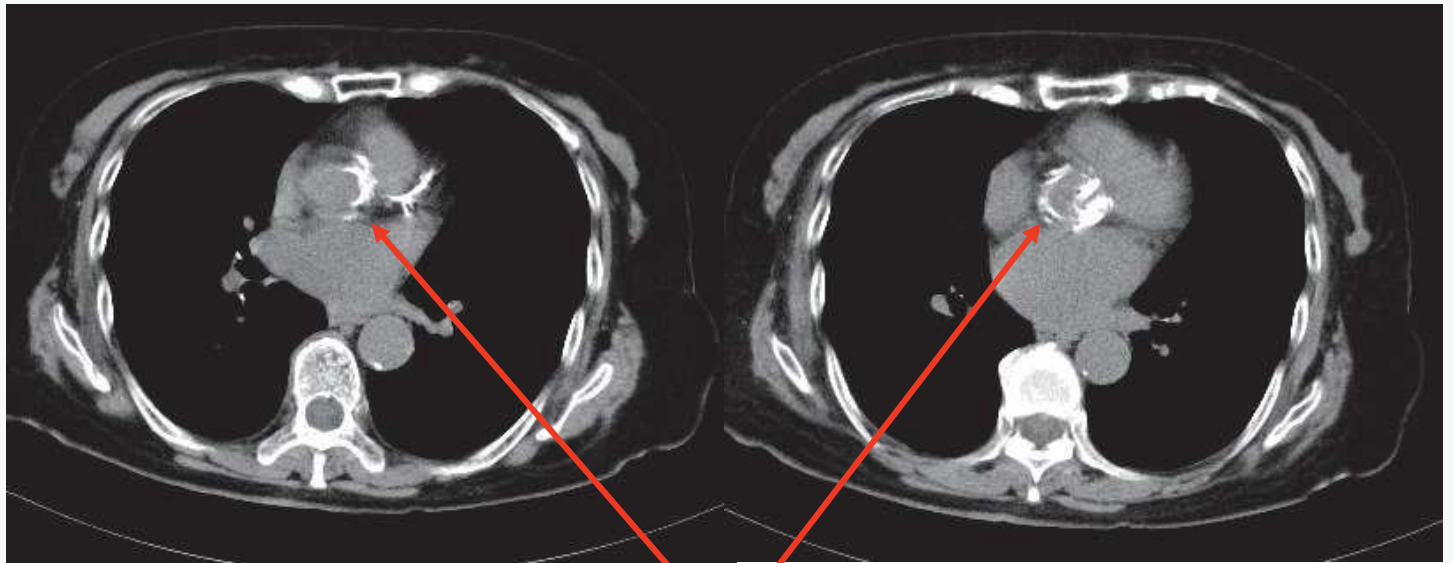




## 手術



# CT



弁輪～大動脈壁の石灰化

## Transcatheter Aortic Valve Replacement (TAVR)

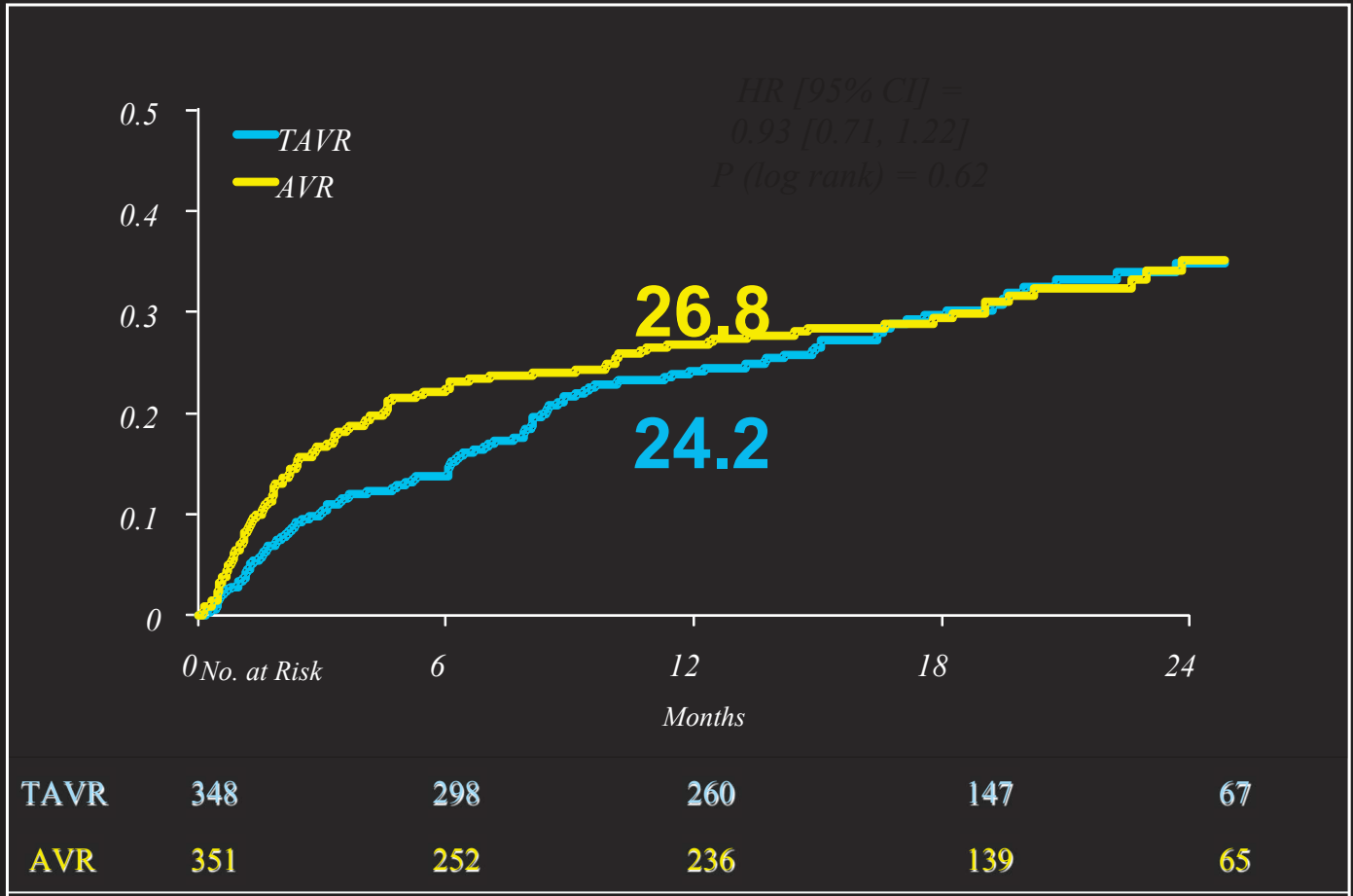
症状のある severe AS で外科的 AVR のリスクが高い症例



- ・末梢血管悪い
- ・Aorta汚い
- ・逆行性難しい



# PARTNER US Cohort A (TAVR vs AVR) All-Cause Mortality at 1 Year



## Secondary Endpoint -Physician based NYHA Improvement-

### Transapical Approach

Matrix		NYHA Functional Class (Doctors' assessment)			Death
		Improved	No change	Worsened	
Analyzable number of patient	24				
AVA at 6 months f/u	$\geq 1.0\text{cm}^2$	79.2% (19/24)	0% (0/24)	0% (0/24)	20.8% (5/24)
	$1.0\text{cm}^2 <$	0% (0/24)	0% (0/24)	0% (0/24)	

Improvement Rate\* 95%CI

[57.8, 92.9]

# TAVRの適応

---

症状のあるsevere ASで外科的AVRのリスクが高い症例

- 高齢者
- STS scoreやEuroscoreの高い症例
- Frailty(+) (低ADLや認知障害)
- 高度大動脈石灰化の症例



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## Case

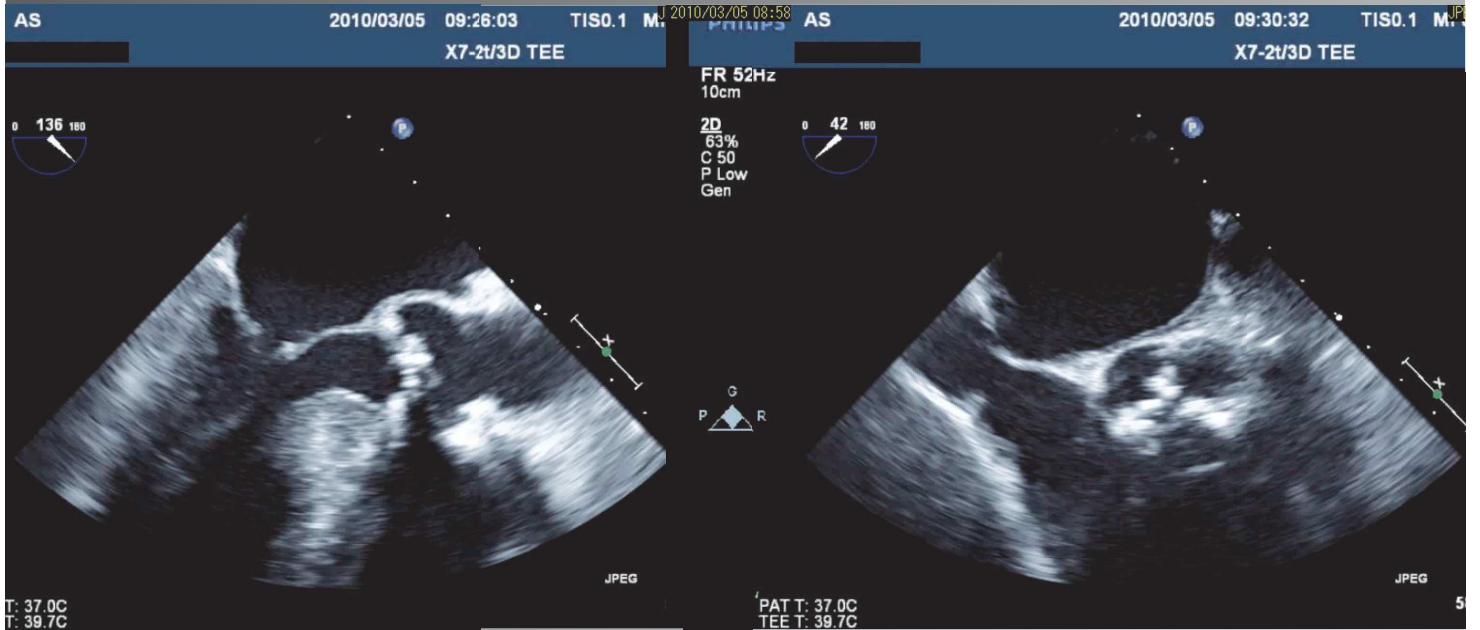
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- 81 yo female with severe AS
- NYHA class II
- History of hypertension and gastric ulcer
- STS score 4.3%
- Positive frailty
- 142cm, 46kg



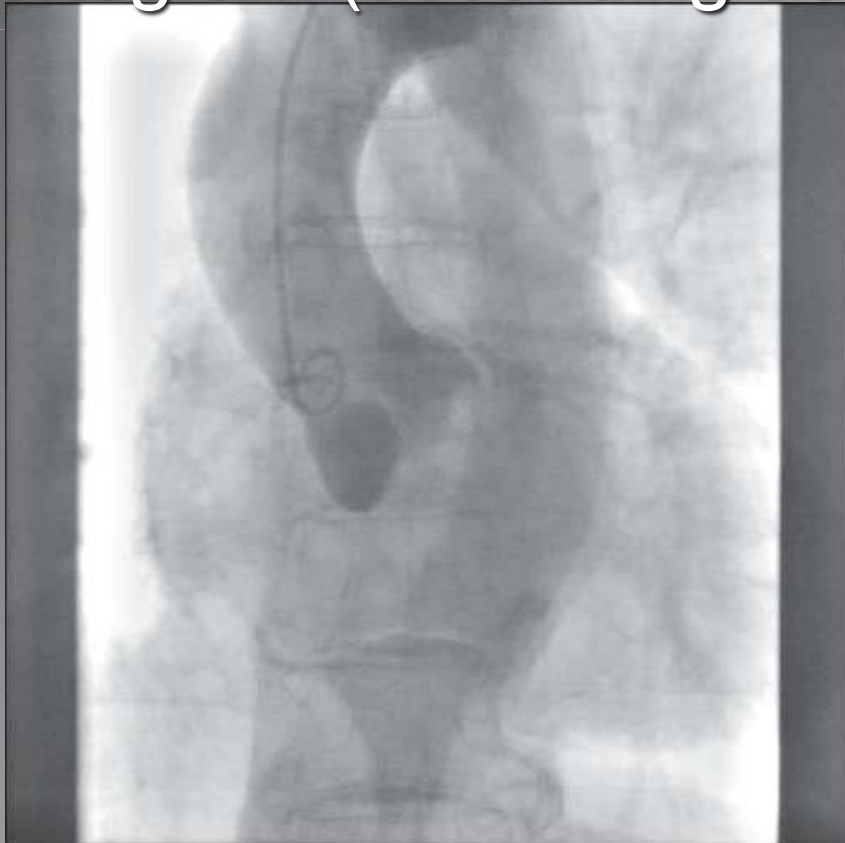


# TEE images



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## Aortogram (ascending aorta)

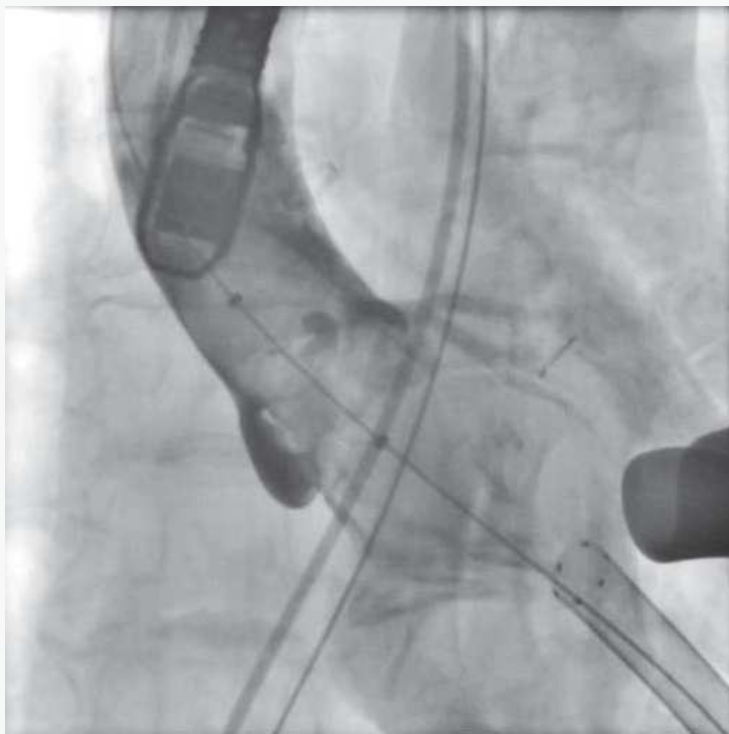


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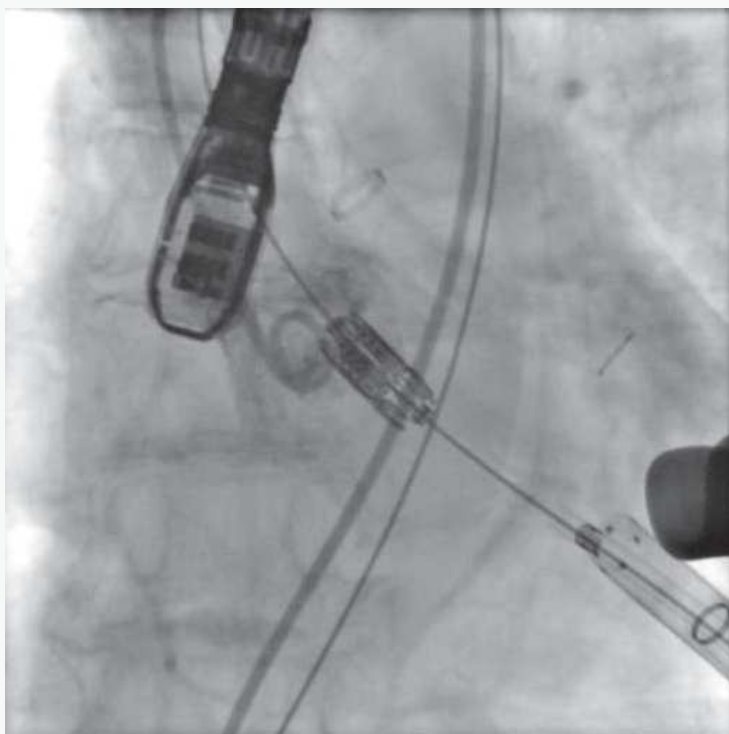
## Procedural image



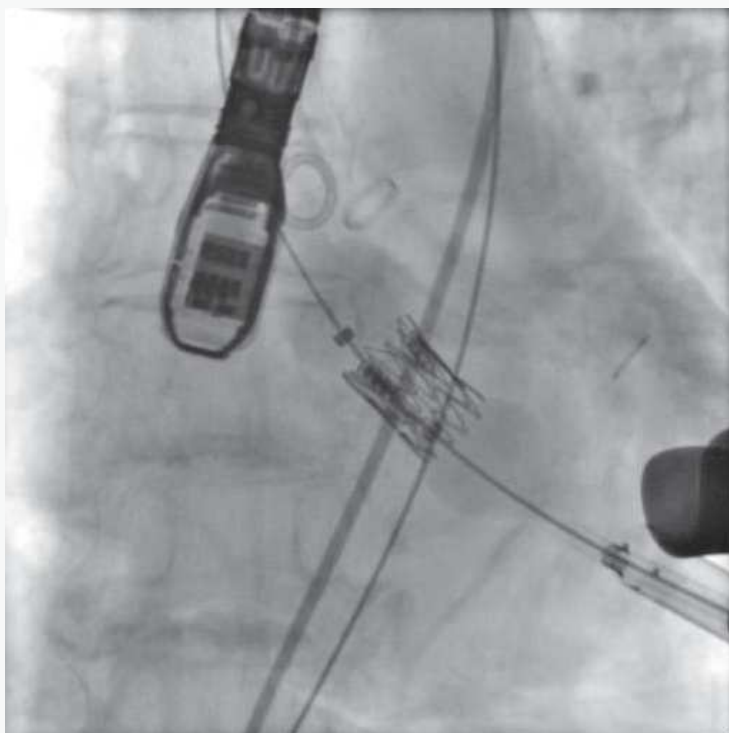
## Procedural fluoro images



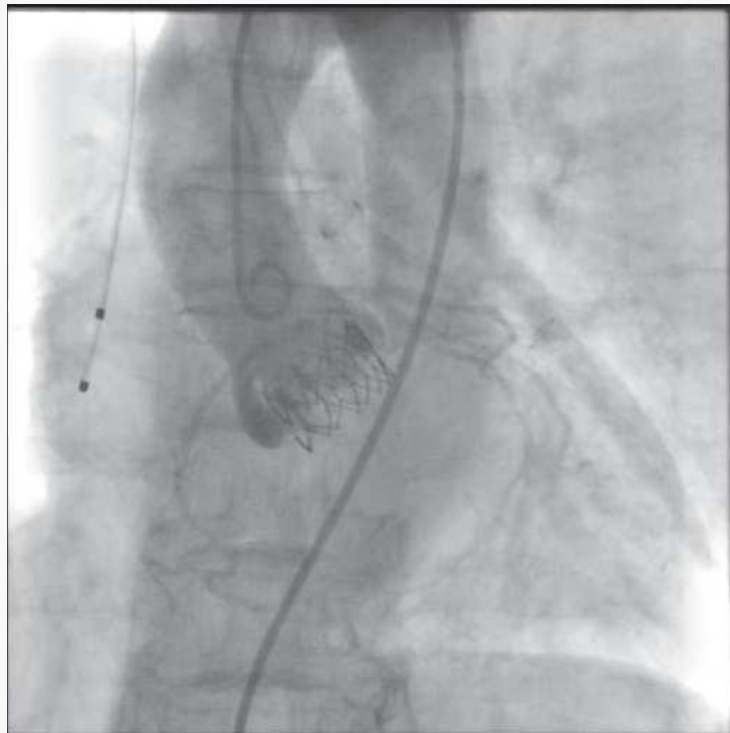
# Procedural fluoro images



# Procedural fluoro images



# Procedural fluoro images



## CHOICE OF INTERVENTION

### 3.2.4. Choice of Intervention: Recommendation

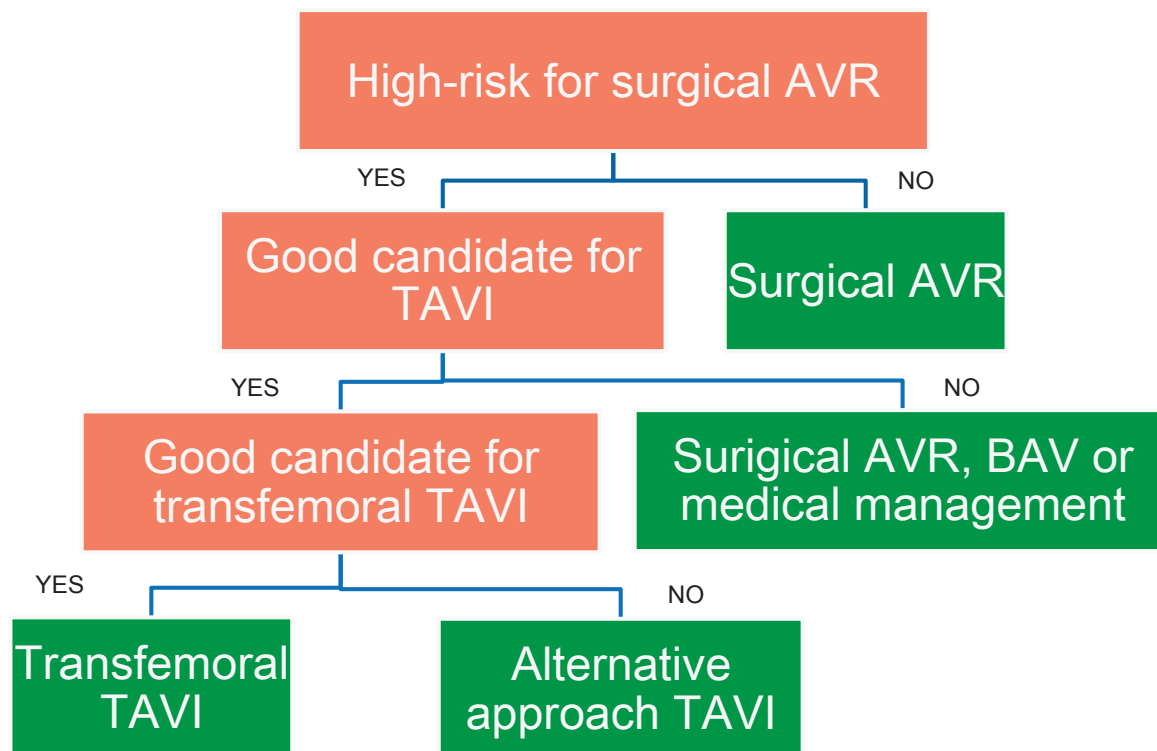
**Table 10. Summary of Recommendations for AS: Choice of Surgical or Transcatheter Intervention**

Recommendations	COR	LOE	References
Surgical AVR is recommended in patients who meet an indication for AVR (Section 3.2.3) with low or intermediate surgical risk	I	A	(74, 149)
For patients in whom TAVR or high-risk surgical AVR is being considered, members of a Heart Valve Team should collaborate to provide optimal patient care	I	C	N/A
TAVR is recommended in patients who meet an indication for AVR for AS who have a prohibitive surgical risk and a predicted post-TAVR survival >12 mo	I	B	(170, 171)
TAVR is a reasonable alternative to surgical AVR in patients who meet an indication for AVR (Section 3.2.3) and who have high surgical risk (Section 2.5)	IIa	B	(172, 173)
Percutaneous aortic balloon dilation may be considered as a bridge to surgical or transcatheter AVR in severely symptomatic patients with severe AS	IIb	C	N/A
TAVR is not recommended in patients in whom existing comorbidities would preclude the expected benefit from correction of AS	III: No Benefit	B	(170)

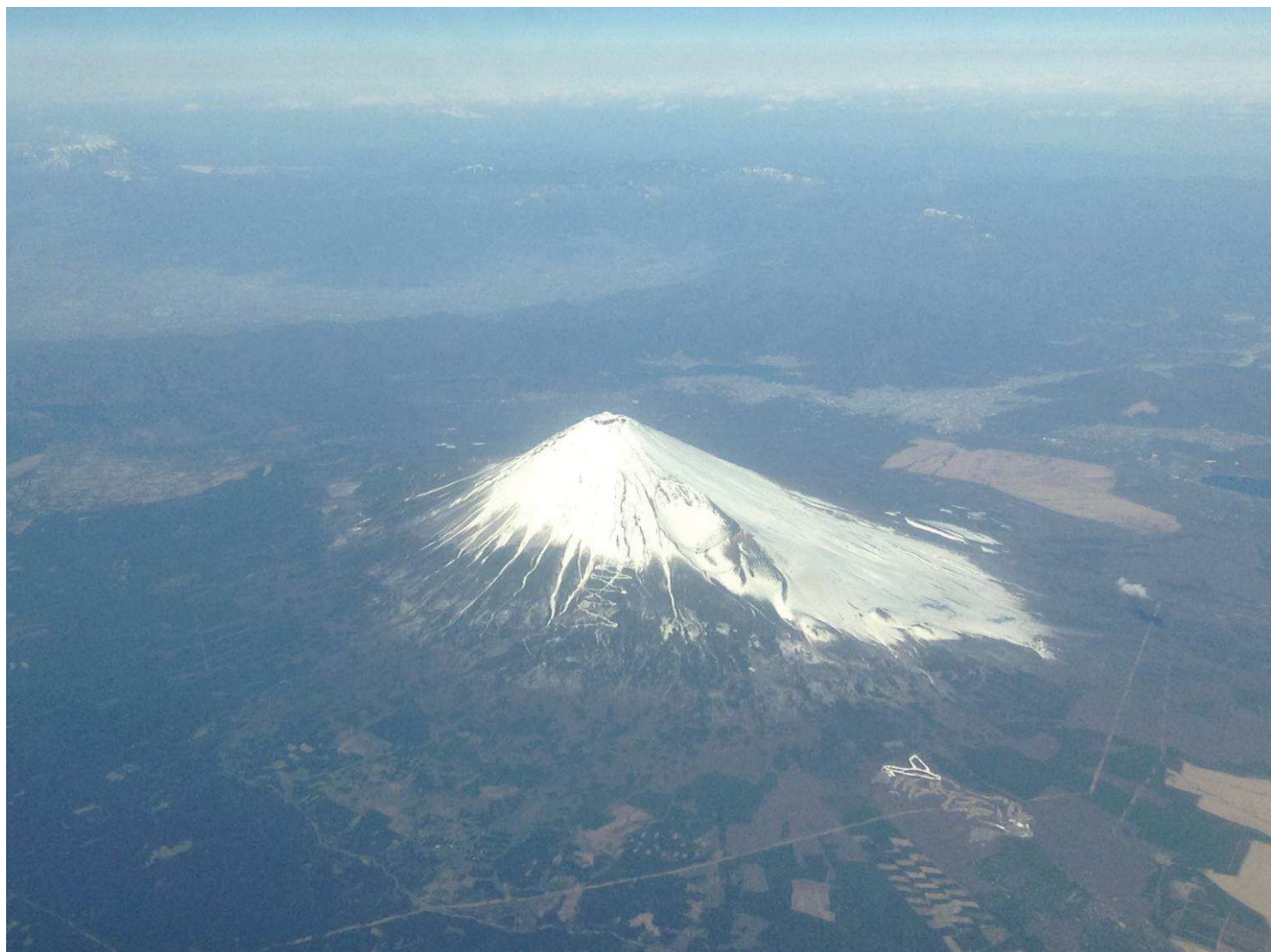
AS indicates aortic stenosis; AVR, aortic valve replacement; COR, Class of Recommendation; LOE, Level of Evidence; N/A, not applicable; and TAVR, transcatheter aortic valve replacement.



# Decision making of Patient selection



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# Agenda

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6. 弁膜症治療の今後

## Starting the TAVI program,.....



TCT2011







Complimentary  
Registration  
for Fellows

## Learning Objectives

By the end of this course, participants should be able to:

- Describe the basics of angiography and the use of guidewires, guide catheters, and angioplasty equipment
- Recognize the terminology and results of percutaneous cardiovascular intervention and the complementary vs. alternative roles of angioplasty and surgery
- Explain the current status of emerging catheter-based techniques in the fields of coronary, endovascular, and structural heart disease, including transcatheter valve therapy and aortic stent grafting



## TRANSCATHETER CARDIOVASCULAR THERAPEUTICS FOR SURGEONS

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Emerging Directions for the Cardiothoracic and Vascular Surgeon

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# Hybrid surgeon

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- Optimal skill set in TAVI, endovascular interventions and new catheter-based technology
- Least biased decision maker
- Still needs intensive collaboration with other surgical and interventional experts.



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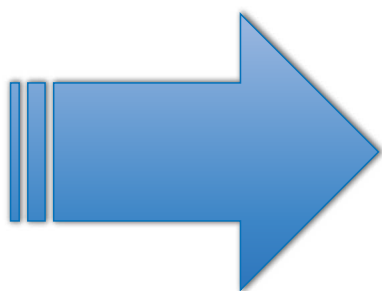
Hybrid skill is  
optional.

Hybrid thinking is  
essential.



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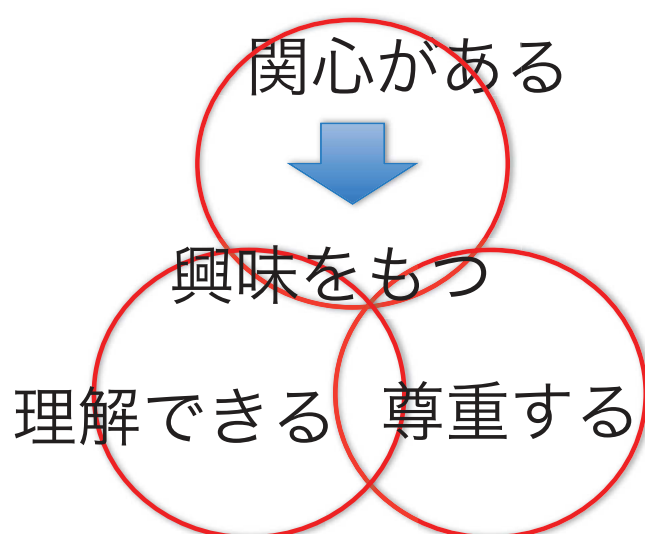


# Cross Training



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Cross Training って？



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**Thank you!!**

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