

Exceptions to the Rules: Abdominal and Thoracic Aneurysms

Jason Bayne MD, FRCSC

Vascular Surgery

Jewish General Hospital

Assistant Professor, Program Director

McGill University

Objectives

- Risk factors for aneurysms, and their affect on screening
- Clinical and imaging factors affecting the management of abdominal aortic aneurysms
- Modern techniques for aneurysm repair

Disclosures

- Paid proctor and consultant for Cook Medical
- Proctor for Medtronic Inc.
- Received speaking honoraria from Boston Scientific, Cook Medical, Gore Medical

History

- Used to just be:
 - Imaging once a year until we got to 5cm
 - At that point the rupture risk (~5%) estimated to approach the operative risk (~5% 30 day mortality), so we operate
- Things have changed:
 - UK – Small Aneurysm Trial
 - Endovascular repair
 - Screening Guidelines
 - Surveillance Guidelines

Screening

- Multiple different screening recommendations developed around the world, Sweden, UK, USA, Canada and others
- USA (Society for Vascular Surgery – Medicare):
 - Screen for AAA in 1st degree relatives of AAA patients when they are 65-75 years old, or >75 years in good health
 - Screen for AAA in men or women >75 years with a smoking history
 - Screening should be a one time u/s. If no aneurysm, could be repeated in those 2.5-3.0cm in 10 years

Screening

- Canada:
 - Initial CSVS Guidelines:
 - All men aged 65 – 75
 - Selective screening for those high risk for AAA
 - Women >65 with smoking, cerebrovascular disease, or family history
 - Men <65 with family history
 - Canadian Task Force on Preventative Health Care:
 - One-time screening with ultrasound for abdominal aortic aneurysm for men aged 65 to 80. (Weak recommendation; moderate quality of evidence)
 - Not screening men older than 80 years of age for abdominal aortic aneurysm. (Weak recommendation; low quality of evidence)
 - Not screening women for abdominal aortic aneurysm. (Strong recommendation; very low quality of evidence)

Screening

- Canada
 - 2018 CSVS AAA Screening Working Group:
 - Men and women 65-80
 - Selective patients >80 depending on life expectancy
 - First degree relatives >55
 - Repeat after 10 years in those 2.5 – 3.0cm

Risk Factors?

- Risk factors for developing AAA different than they are for rupture:
 - Incidence:
 - Age
 - Cigarettes
 - Male Gender
 - Family History
 - Coronary, peripheral, carotid arterial disease
 - Cholesterol, HTN
 - Increased BMI
 - Collagen – Vascular Connective tissue disorders

Risk Factors:

Table II. Risk factors for the development of an abdominal aortic aneurysm (AAA)

Variable	Estimate	P	OR	95% CI	Score
Male (vs female)	1.74	<.0001	5.71	5.57-5.85	18
Age, years (vs <55 years)					
55-59	1.01	<.0001	2.76	2.55-3.00	11
60-64	1.68	<.0001	5.35	4.97-5.76	17
65-69	2.24	<.0001	9.41	8.76-10.12	23
70-74	2.67	<.0001	14.46	13.45-15.55	28
75-79	3.02	<.0001	20.43	18.99-21.99	31
80-84	3.35	<.0001	28.37	26.31-30.59	35
Race/ethnicity (vs white)					
Hispanic	-0.37	<.0001	0.69	0.62-0.77	-4
African American	-0.33	<.0001	0.72	0.66-0.78	-3
Asian	-0.41	<.0001	0.72	0.59-0.75	-4
High blood pressure	0.22	<.0001	1.25	1.21-1.28	2
Coronary artery disease	0.54	<.0001	1.72	1.69-1.76	6
Family history of AAA	1.34	<.0001	3.80	3.66-3.95	14
High cholesterol	0.29	<.0001	1.34	1.31-1.37	3
Diabetes	-0.29	<.0001	0.75	0.73-0.77	-3
Peripheral arterial disease	0.47	<.0001	1.59	1.54-1.65	5
Carotid disease	0.41	<.0001	1.51	1.46-1.56	4
Cerebrovascular history	0.16	<.0001	1.18	1.14-1.21	2

Risk Factors:

Variable	Estimate	P	OR	95% CI	Score
Smoking, packs/day					
≤10 years					
<0.5	0.96	<.0001	2.61	2.47-2.74	10
0.5-1	1.16	<.0001	3.19	2.93-3.46	12
>1	1.16	<.0001	3.20	2.88-3.56	12
11-20 years					
<0.5	1.58	<.0001	4.87	4.63-5.12	16
0.5-1	1.76	<.0001	5.79	5.48-6.12	18
>1	1.79	<.0001	6.00	5.66-6.35	19
21-35 years					
<0.5	1.99	<.0001	7.29	6.97-7.64	21
0.5-1	2.08	<.0001	7.99	7.62-8.38	22
>1	2.13	<.0001	8.41	8.57-9.36	22
>35 years					
<0.5	2.19	<.0001	8.96	8.57-9.36	23
0.5-1	2.42	<.0001	11.19	10.76-11.64	25
>1	2.50	<.0001	12.13	11.66-12.61	26
Quit smoking					
<5 years ago	-0.14	<.0001	0.87	0.84-0.912	-1
5-10 years ago	-0.39	<.0001	0.68	0.65-0.71	-4
> 10 years ago	-0.87	<.0001	0.42	0.41-0.43	-9

Risk Factors:

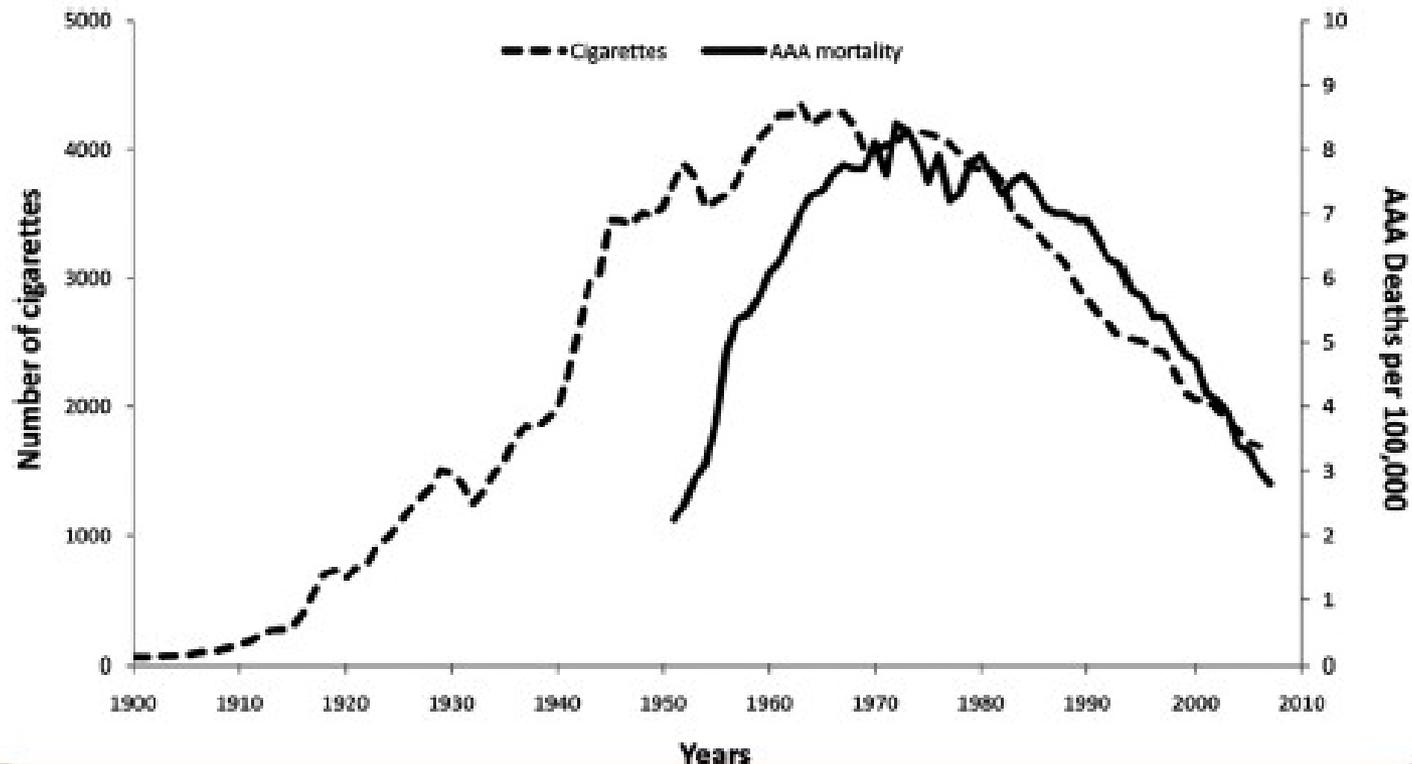


Fig 1. The annual adult per capita cigarette consumption and age-adjusted abdominal aortic aneurysm (AAA) deaths per 100,000 white men by year in the United States. (From Lederle FA. The rise and fall of abdominal aortic aneurysm. *Circulation* 2011;124:1097-9.)

Risk Factors:

- Thoracic Aortic Aneurysm:
 - Incidence:
 - Much lower incidence than AAA, though not well known ? 0.01% (10 out of 100,000)
 - Average age may be younger (65 as opposed to 75), but increases with age
 - Less predominantly a disease of males
 - Sequelae of dissection in 20% - Related to HTN
 - More significant genetic component, over 20% have a first degree relative with aneurysm - TAAD
 - Connective tissue disorders, and vasculitis

Risk Factors:

- Ruptured AAA:
 - Female Gender
 - Larger Aneurysm Diameter
 - Low FEV1 / COPD
 - HTN
 - Family History
 - Immunomodulators after organ transplant

- ? Expansion, symptoms (pain), infection, trauma, collagen vascular disease
- Ruptured TAA:
 - Diameter
 - Older age
 - COPD
 - Pain
 - Dissection
 - CRF

How to Interpret Screening Recommendations?

- Multiple conflicting recommendations
 - Some very restrictive – men 65 – 80 only
 - Others present multiple exception situations
- Should we do it at all?
 - Yes!
 - Despite low population incidence even in men of 1 – 2%,
 - RCT supported evidence with NNS of 311 – better than breast cancer and FOB for colon cancer programs
- Should we do it in first degree relatives?
 - Yes!
 - Incidence is 10-15%!!
 - Occur at younger ages, and more likely to rupture in many non-screening studies
 - Probably should for thoracic aneurysms too, but this has never been recommended (lack of evidence)

How to Interpret Screening Recommendations?

- Should we do it in women?
 - Probably
 - Again, evidence is limited only because only one trial even enrolled women, and was underpowered in their subset, not because they showed no benefit
 - Women make up 20 – 25% of all AAA's treated
 - Women with >20 pack year history of smoking are nearly TWICE as likely to develop AAA as men in with the same smoking history, though when they quit, their risk dropped faster
 - Though incidence in women overall is lower decreasing value of screening, rupture rate is higher which increases value

How to Interpret Screening Recommendations?

- Should we do it in the elderly?
 - Probably
 - The incidence is much higher
 - Our population is aging
 - We are increasingly using EVAR to treat patients in this age category – if their “estimated” life expectancy would support EVAR, then we should
 - Evidence supporting this is limited, mostly because trials of screening limited enrollment to not include this age group, not because they showed no benefit

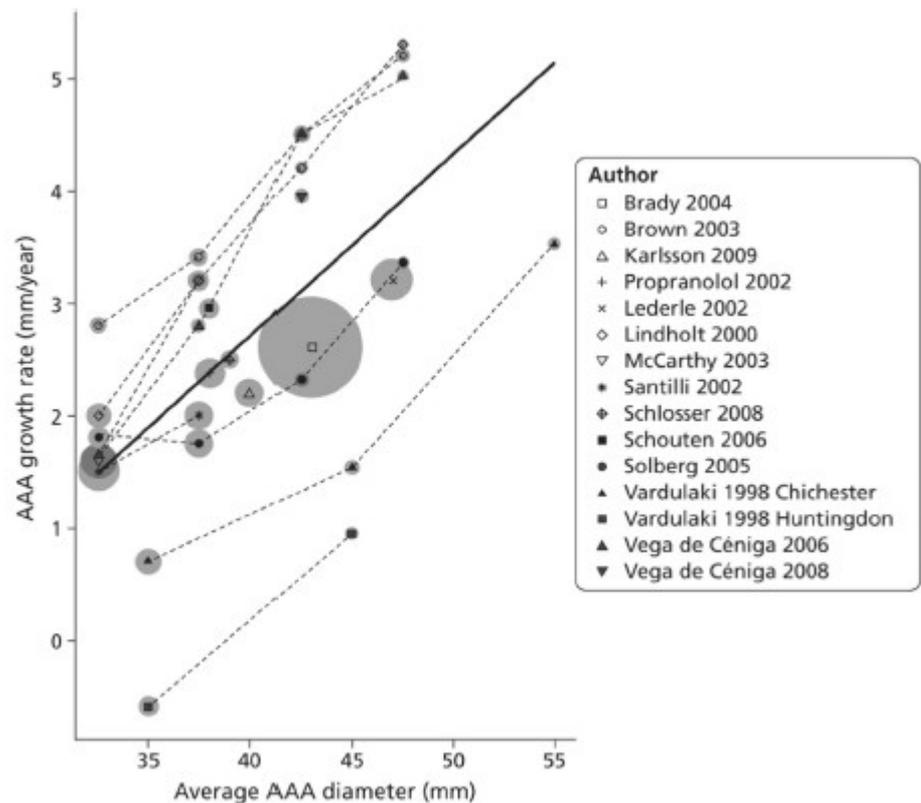
We found one! Now what?

- Wait until 5cm and then repair! (?)
 - UK Small Aneurysm Trial
 - Showed that in aneurysms 4 – 5.5cm, waiting with u/s surveillance until 5.5cm was better than early operation
 - Didn't really show that 5.5cm was a better threshold than 5.0cm
 - Didn't look at EVAR
 - Had a quite high operative mortality rate
 - Despite concerns, 5.5cm has become the standard threshold for men
 - Women had 3 times the rupture rate, so 5.0cm was kept for women
 - u/s was done every 6 months until 5cm, then every 3 months and stopped if symptoms, or growth >1cm in a year

More Ultrasound

- Led to excessive amounts of u/s given the need to mimic the trial's protocol if want to reproduce trial's results

- Thompson et al did a meta-regression analysis in 2013 of expected growth rates
- Calculated a 10% risk of progressing to a diameter of 5.5cm
- Integrated cost-effectiveness data
- Came up with surveillance interval recommendations
- Adopted in SVS guidelines



More Guidelines

We suggest surveillance imaging at 3-year intervals for patients with an AAA between 3.0 and 3.9 cm.

Level of recommendation 2 (Weak)

Quality of evidence C (Low)

We suggest surveillance imaging at 12-month intervals for patients with an AAA of 4.0 to 4.9 cm in diameter.

Level of recommendation 2 (Weak)

Quality of evidence C (Low)

We suggest surveillance imaging at 6-month intervals for patients with an AAA between 5.0 and 5.4 cm in diameter.

Level of recommendation 2 (Weak)

Quality of evidence C (Low)

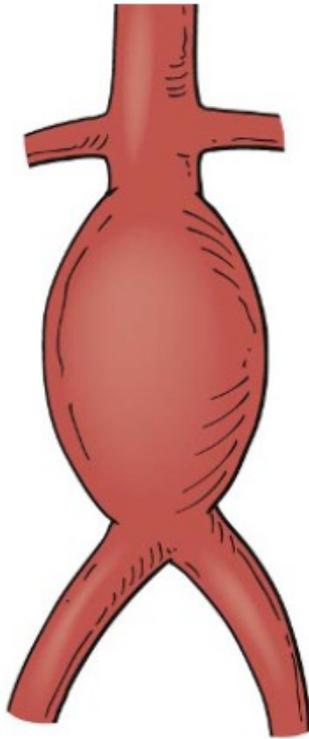
Exceptions?

- Guidelines did not consider:
 - Women
 - Smoker subgroup
 - Diabetes – protective
- May be wise to consider switching to q6mo u/s in women at 4.5cm, and perhaps even yearly at 3.5cm especially since we have a different size threshold for intervention
- Less clear for smokers

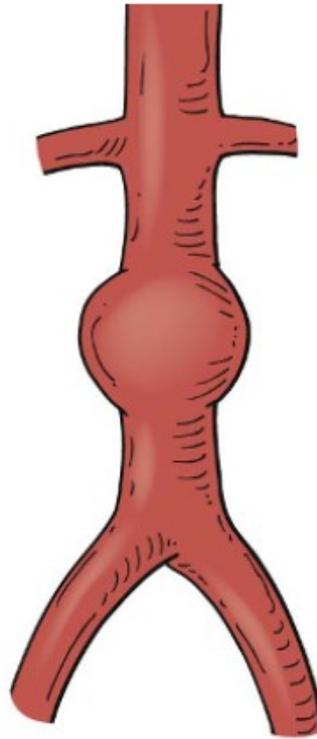
Exceptions to Treatment Threshold?

- May also be wise to consider intervening at other points than standard 5.5cm cut off
 - Consider smaller diameters if rupture risk may be higher
 - Consider larger diameter if operative risk may be higher
- Higher rupture risk:
 - Female gender – 5.0cm
 - Growth > 1cm in a year
 - Pain
 - Saccular aneurysm (or reason to suspect nonstandard etiology)
 - Impending need for chemotherapy or solid organ transplantation – though overall prognosis and surgical risk likely higher – need to individualize
 - Combination of other risk factors for rupture? – FmHx, smoker, COPD, relative growth, vague or unclear symptoms

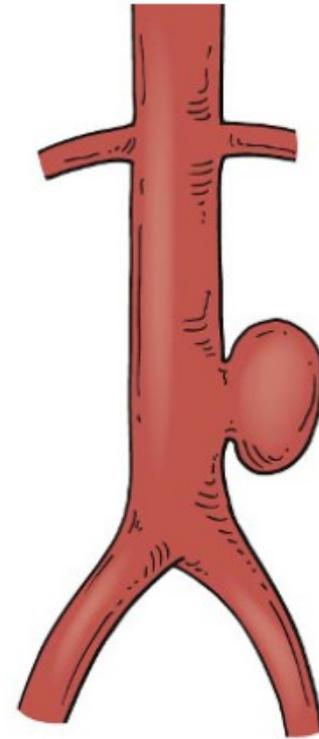
Saccular



A Fusiform



B Concentric saccular



C Eccentric saccular

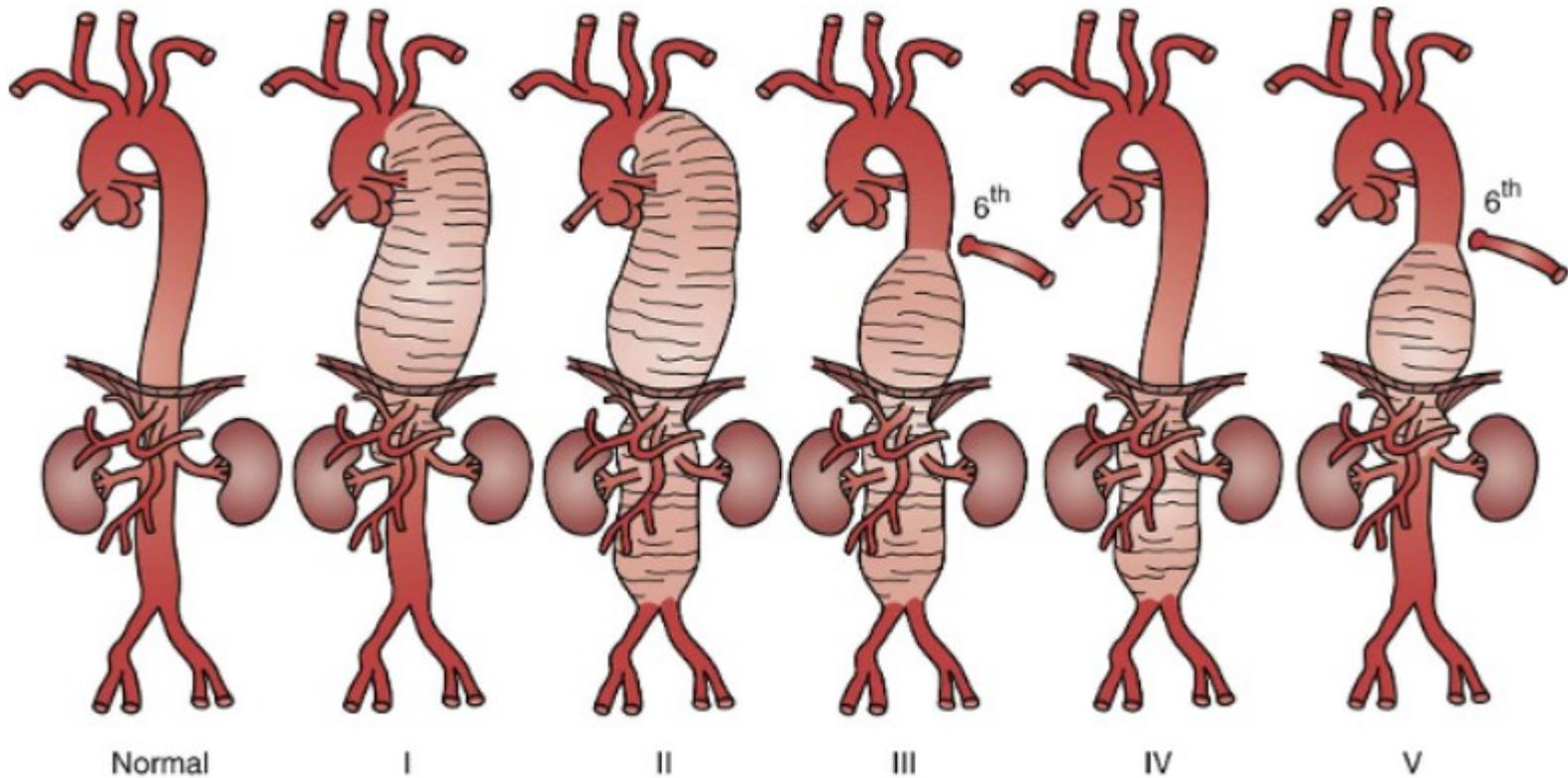
Exceptions to Treatment Threshold

- Higher operative risk:
 - Concomitant severe comorbidities, coronary, pulmonary, renal
 - Frail, advanced age
 - Need for more extensive repair (involving renals or other visceral branches)
 - Need for open repair and known hostile abdomen?
 - Open vs Endovascular Repair?
 - PIVOTAL and CAESAR showed no benefit to early repair with EVAR

Treatment Threshold Thoracic?

- Historically thoracic aneurysms had much higher operative risk, started off at a larger normal native diameter:
 - Treatment threshold of 6cm was suggested
 - Variety of investigators have suggested various sizes for various reasons ranging from 5 – 7cm!
 - Many thoracic aneurysms are dissections, rupture at smaller diameters (in 13% less than 6cm)
 - Dissections also have higher morbidity and mortality with repair so some argue to wait until larger
 - Same two issues also occur with connective tissue disease, and worse, outcomes with stent grafts are poor
 - For more extensive repairs such as type I and II thoracoabdominal higher morbidity, whereas type IV might be less

Aneurysm Extent



Modern Treatment Options

- Endovascular vs Open
- Large paradigm shift
- Initial huge benefits for 30 day mortality with EVAR
- Longer term mortality benefits less clear especially for all cause mortality, but also to aneurysm related mortality
 - Endoleak
 - Thrombosis
 - Component migration
 - Late rupture

Modern Treatment Options

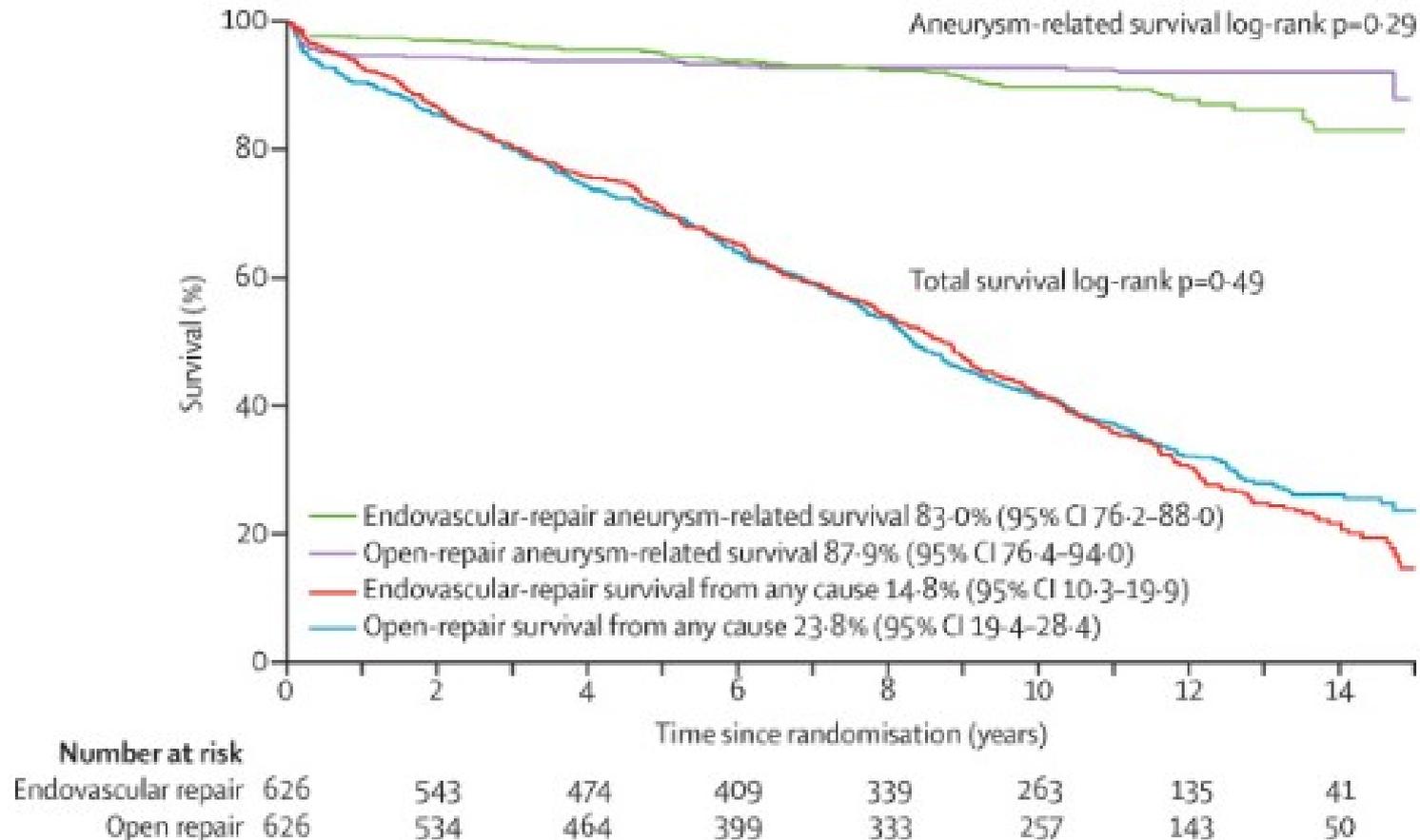


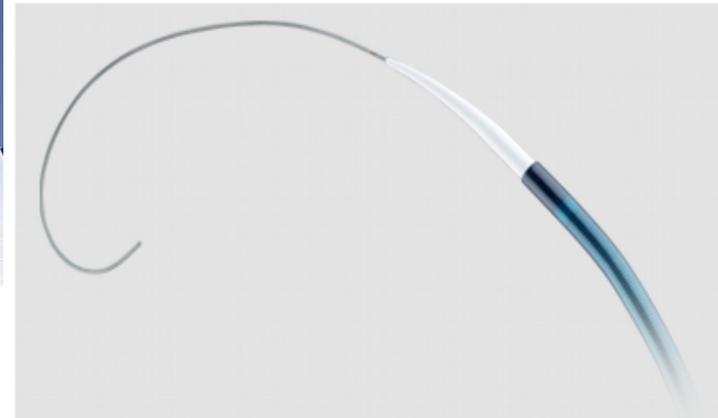
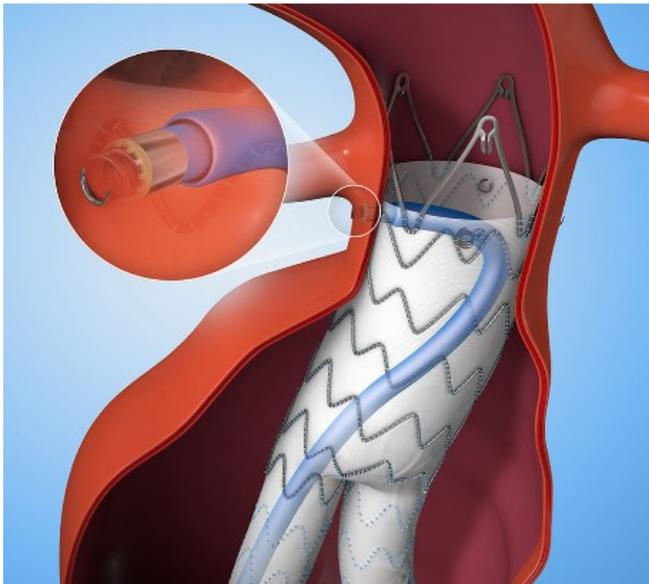
Figure 2 Kaplan-Meier estimates for total survival and aneurysm-related survival up to 15 years of follow-up

Modern Treatment Options

- As devices improve, and knowledge develops of when and how to employ the most appropriate devices, we expect the outcomes have improved from the early EVAR-1 trial
- Further EVAR-1 looked at very few long term complications of open surgery, and when considered, possibly more equivilancy in the long term
- Potential catch-up bias, since the remaining EVAR group after the 30 day mortality advantage still contained many patients who were more frail and unwell that would have died off in the open group
- Even so, if long term results are very similar, most would prefer the upfront advantages of EVAR

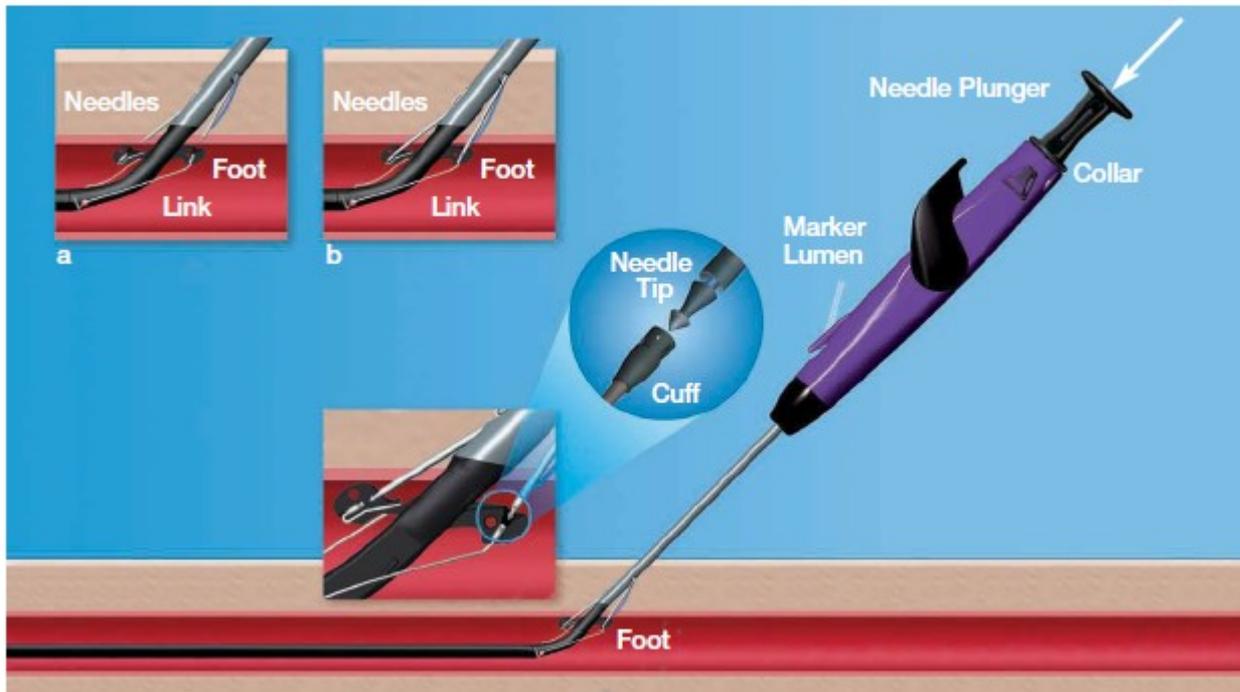
Advancing EVAR

- Main limitations of initial devices:
 - Neck length, diameter, angulation, conical nature
 - Access tortuosity, diameter



Advancing EVAR

- Percutaneous
 - Facilitated by more reliable closure devices
 - Facilitated by smaller profile aortic devices (14F)



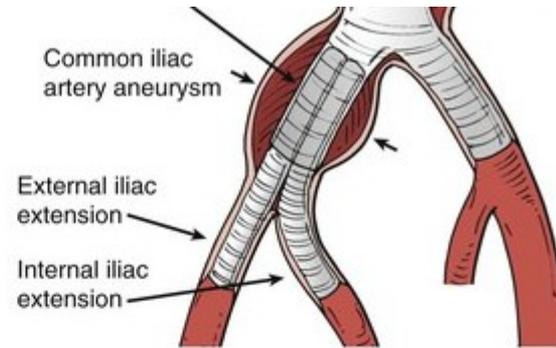
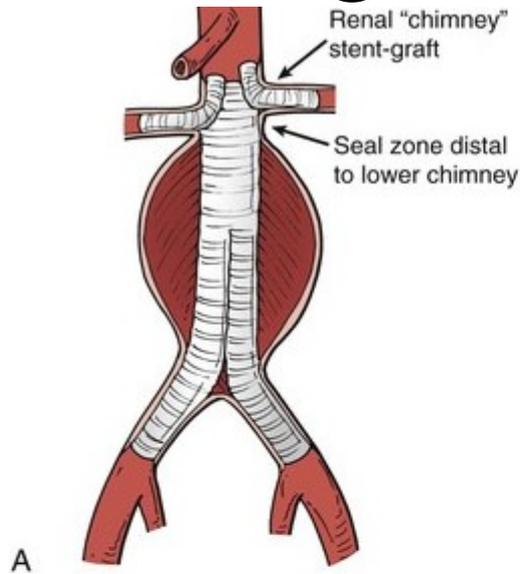
Advancing EVAR

- Same day discharge
 - With percutaneous procedures done awake under local
 - With EVAR morbidity and mortality already quite low
 - Our own group showed:
 - Up to 60% of EVARs could be planned as outpatient,
 - 80% success actually discharging same day
 - No difference in complications (11 vs 9%)
 - No difference in readmission (2 vs 4%)
 - No difference in reintervention (4 vs 4%)
 - No difference in mortality (1 vs 1%)
 - Increased ED usage in same day discharged patients (15 vs 6%)

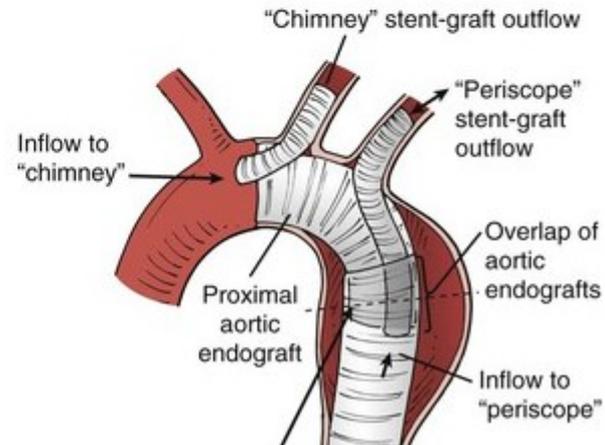
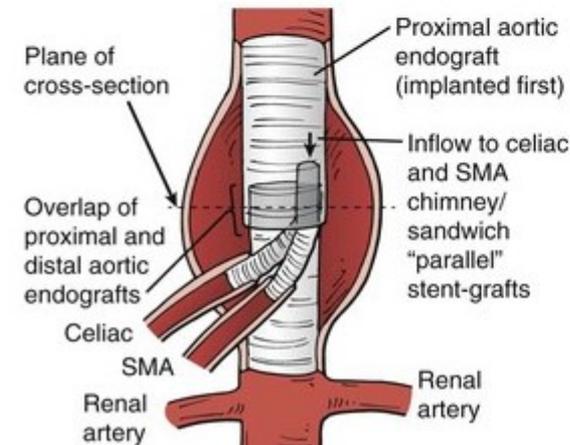
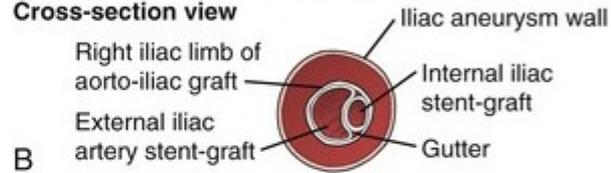
Advancing EVAR

- With increasing options boundaries are continuing to be pushed:
 - Off label uses:
 - Parallel graft techniques
 - Outside IFU use:
 - Short necks
 - Custom made graft designs
 - Branches and fenestrations

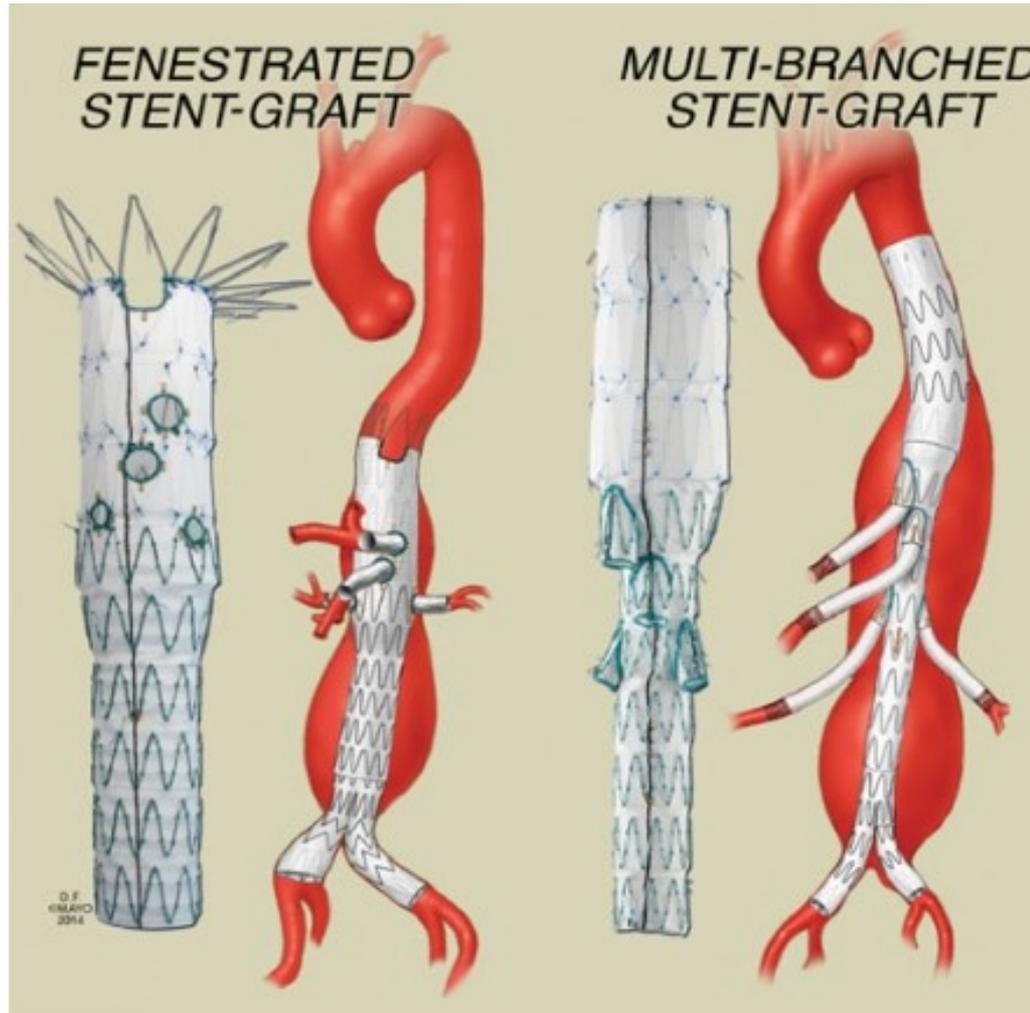
Advancing EVAR



Cross-section view



Advancing Open



Mayo Clinic
G. Oderich

Advancing EVAR

- Moving outside IFU in particular is a potential problem, especially when applying standard off the shelf designs to anatomy they were not intended for
- Our own group looked at this and has published midterm, and now submitted long term data:
 - Any IFU nonadherence predicts device failure
 - IFU nonadherence affects long term survival

Take Home Points

- We still use 5.5cm as a cutoff for men, and 5.0cm for women, (?6.0cm for thoracic)
- We recommend screening for AAA
- We recommend surveillance for discovered AAA (possibly at reduced intervals from previous)
- There are multiple techniques to repair an aneurysm, regardless of complexity
- Many situations may be considered an “exception”
 - Older patients, smokers, first degree relatives, and even women should be considered for screening
 - Early intervention may be considered in patients with growth, symptoms, saccular shape, female gender, COPD, smoking, family history
 - Delayed intervention may be considered in the advanced elderly, frail, higher risk pathologies and anatomies

Take Home Points

- You don't HAVE to follow guidelines – you are a doctor
- Each situation is unique and requires consideration on its own
- We do have a responsibility as well to protect our patients and our health care system from excessive investigations and interventions

Merci!