Vascular Surgery Board Review

Audible Bleeding

2022-01-23

Contents

Chapter 1

About

The content was developed here by the Audible Bleeding team to accompany our board review podcast episodes.

1.1 Usage

This is not a comprehensive guide but instead an outline of the most high yield information to help guide board preparation.`{r include=FALSE} # automatically create a bib database for R packages knitr::write_bib(c( .packages(), 'bookdown', 'knitr', 'rmarkdown' ), 'packages.bib')`

Chapter 2

Cerebrovascular

2.1 Available Guidelines

Updated Society for Vascular Surgery guidelines for management of extracranial carotid disease

2.2 PRESENTATION AND DIAGNOSIS

What is the definition of crescendo TIAs Frequent repetitive neurologic attacks without complete resolution of the deficit between the episodes, producing the same deficit but no progressive deterioration in neurologic function If a progressive deterioration then it is a stroke in evolution Who needs to be screened? Only 15% of stroke victims have a warning TIA before a stroke so waiting until symptoms occur is not ideal. The purpose of carotid bifurcation imaging is to detect "stroke-prone" carotid bifurcation plaque and identify a high-risk patient likely to benefit from therapy designed to reduce stroke risk The absence of a neck bruit does not exclude the possibility of a significant carotid bifurcation lesion - focal ipsilateral carotid bruits in symptomatic patients has a sensitivity of 63% and a specificity of 61% for high-grade carotid stenosis (range, 70%-99%). Screening of the general population is not indicated. Screening should be considered for patients with: Evidence of clinically significant peripheral vascular disease regardless of age Patients aged >65 years with a history of one or more of the following atherosclerotic risk factors: CAD Smoking Hypercholesterolemia. In general, the more risk factors present, the higher the yield of screening should be expected. US findings that confirm disease 50-69% stenosis of ICA - Low sensitivity for 50-69% stenosis - a negative ultrasound in symptomatic patients necessitates additional imaging PSV 125-229 cm/sec EDV 40-100 Internal/Common Carotid PSV Ratio 2-4 70-99% stenosis of ICA PSV >/= 230 cm/sec EDV >100 (EDV > 140 cm/sec most sensitive for stenosis

>80%) Internal/Common Carotid PSV Ratio > 4 Velocity-based estimation of carotid artery stenosis may need to be adjusted in certain circumstances Higher velocities in women than in men Higher velocities in the presence of contralateral carotid artery occlusion. High carotid bifurcation, severe arterial tortuosity, extensive vascular calcification, and obesity may also reduce the accuracy of DUS imaging Other Imaging Modalities CTA Pro - fast, submillimeter spatial resolution, visualize surrounding structures Con - cost, contrast exposure MRA Pro - no contrast administered; analyze plaque morphology Con - Does not visualize calcium in plaque; overestimates the degree of stenosis (False positive for 50-69% to be read as >70%) Catheter-based digital subtraction imaging (DSA) Still considered by many the gold-standard imaging modality Reserved for individuals with conflicting less-invasive imaging or those considered for CAS Con - cost and risk of stroke

2.3   MANAGEMENT

Optimal medical therapy Hypertension Lowering blood pressure to a target <140/90 mmHg by lifestyle interventions and antihypertensive treatment is recommended in individuals who have hypertension with asymptomatic carotid atherosclerosis or those with TIA or stroke after the hyperacute period. Each 10-mm Hg reduction in blood pressure amongst hypertensive patients decreases the risk for stroke by 33%. Diabetes - Glucose control to nearly normoglycemic levels (target hemoglobin A1C <7%) is recommended among diabetic patients to reduce microvascular complications and, with lesser certainty, macrovascular complications other than stroke. Lipid abnormalities Risk of stroke decreased by >15% for every 10% reduction in serum LDL in patients with known coronary or other atherosclerosis Statin agents are recommended targeting LDL of 100 mg/ dL, for those with coronary heart disease or symptomatic atherosclerotic disease, and LDL of 70 mg/dL for very high-risk persons with multiple risk factors Smoking - Physician counseling is an important and effective intervention that reduces smoking in patients by 10% to 20% Antithrombotic therapy - There is no evidence to suggest that antiplatelet agents other than aspirin have improved benefit in asymptomatic patients with carotid atherosclerosis Carotid endarterectomy general principles

2.4   TIMING

Recommendations on when to operate after a stroke Acute stroke with a fixed neurologic deficit of >6h duration: When the patient is medically stable, less than or equal to 2 weeks after the stroke is preferable to a longer delay Consider urgent intervention in a medically stable patient with mild-moderate neurologic deficit, if there is a significant area of ischemic penumbra at risk for progression Stroke in evolution (fluctuating / evolving neuro deficit) or crescendo TIA (repetitive transient ischemia w improvement between events): If neuro status is not

stabilized by medical intervention consider urgent CEA CEA is preferred to CAS based on an increased embolic potential of carotid lesions that present in this fashion What is the only emergent indication for CEA Crescendo TIAs or a stroke in evolution with a surgically correctable lesion that is identified INTRA-OP TECHNIQUES General concepts Patch angioplasty or eversion endarterectomy are recommended rather than primary closure to reduce the early and late complications of CEA (GRADE 1, Level of Evidence A). Neuromonitoring/Shunting options during a carotid endarterectomy Local anesthesia with direct neuro monitoring - the patient is awake and moving to command throughout the case. Though improved neuromonitoring has not been shown to reduce MI rate with CEA Stump pressure Clamp the inflow and place butterfly attached to a-line tubing into the internal carotid If stump pressure is > 40 mmHg can proceed, if < 40 place shunt EEG Neuromonitoring - EEG tech places neuromonitoring, monitored by intraop tech and neurologist remotely, generally clamp ICA for 3 minutes before proceeding, if any deficits unclamp, await normalization of EEG then proceed Non-selective shunting - shunt all carotids Techniques to reach internal carotid lesions that are high? Nasotracheal intubation will help extend the neck to reach higher lesions Divide posterior belly of digastric to reach high lesions with care to watch for glossopharyngeal Styloidectomy Mandible subluxation with assistance from ENT if previous techniques fail. What is the best technique for a patient with a kinked internal carotid artery? Eversion carotid endarterectomy will allow you to reduce the redundancy Otherwise, no advantage has been shown between eversion or patch, both can be shunted Discuss nerve injuries – where you would encounter these and what deficit would be seen Hypoglossal Just above the bifurcation of the carotid artery Will see tongue deviation to the side of injury Glossopharyngeal High dissections under digastric Difficulty swallowing, aspiration risk, can be devastating Vagus Adjacent and lateral to carotid, injury occurs with carotid clamping, Hoarseness is noted as RLN is a branch off of vagus Marginal Mandibular (Off of facial nerve) Retraction at the angle of the jaw for high dissections Leads to the corner of lip drooping, can be confused with a neuro deficit following the case

2.5 POST-OP COMPLICATIONS

What to do if neuro deficits following your carotid endarterectomy If in OR – perform duplex, if normal open wound and shoot cerebral angiogram If in PACU or on the floor – many would consider CTA first vs duplex to look for thrombosis Risk factors and how to manage hyperperfusion syndrome Defined as an ipsilateral headache, hypertension, seizures, and focal neurological deficits can present 2-3 days out from surgery Pts with uncontrolled hypertension are at risk for hyperperfusion syndrome, clinical practice guidelines by SVS recommend strict BP control following CEA, maintain a pressure less than 140/80

2.6   LONG TERM COMPLICATIONS AND FOLLOW UP

Recommend f/u US at $</=$30 days. $>/= 50\%$ stenosis requires further imaging. Contralateral stenosis The risk of progression for moderate stenosis at the initial surveillance to severe stenosis can be as high as five times Requires post-operative surveillance. Carotid Artery Stenting In patients aged >70 undergoing CAS the risk of stroke was the highest, presumably due to calcific disease in the arch Lesion-specific characteristics are thought to increase the risk of cerebral vascular events after CAS and include a "soft" lipid-rich plaque identified on noninvasive imaging, extensive (15 mm or more) disease, a pre-occlusive lesion, and circumferential heavy calcification This can be reduced, but not eliminated, by using flow-reversal embolic protection rather than distal filter protection Limited data on CAS in asymptomatic patients - currently is not supported by guidelines or considered reimbursable Consider CAS in symptomatic patients with $>50\%$ stenosis who are poor candidates for CEA due to severe uncorrectable medical comorbidities and/or anatomic considerations (h/o ipsilateral neck dissection or XRT, contralateral vocal cord paralysis, lesions that extend proximally to the clavicle or distal to C2) Transfemoral Approach vs Transcarotid approach ROADSTER Trial - single arm study with flow reversal for cerebral protection. Suggest lower rates of post-op stroke Post-op follow up - Dual-platelet therapy should be continued for 1 month after the procedure, and aspirin should be continued indefinitely Management of uncommon disease presentations Occluded Carotid What to do for occluded carotid? Leave it alone What if occluded carotid is still causing TIAs External carotid endarterectomy and ligation of internal The addition of oral anticoagulation is likely to reduce the rate of recurrent CVA What if the patient has severe vertebrobasilar insufficiency and carotid artery disease? Should undergo carotid revascularization first to improve flow What about tandem lesions in the carotid in a symptomatic patient, carotid bulb and carotid siphon lesion (high ICA)? How should you treat this? Treat carotid bulb first, likely the embolic source Carotid artery dissection Patients with carotid dissection should be initially treated with antithrombotic therapy (antiplatelet agents or anticoagulation) (GRADE 1, Level of Evidence C). Patients who remain symptomatic on medical therapy may be considered for intervention. Although data are insufficient to make firm recommendations, the committee unanimously agreed that balloon angioplasty and stenting is currently preferred over open surgery after failed medical management (GRADE 2, Level of Evidence C) Simultaneous coronary and carotid disease Patients with symptomatic carotid stenosis will benefit from CEA before or concomitant with CABG. The timing of the intervention depends on the clinical presentation and institutional experience (GRADE 1, Level of Evidence B). Patients with severe bilateral asymptomatic carotid stenosis, including stenosis and contralateral occlusion, should be considered for CEA before or concomitant with CABG (GRADE 2, Level of Evidence B) Prospective Trials - MUST READS Asymptomatic Carotid Atherosclerosis Study (ACAS) Compared medical man-

agement with CEA in asymptomatic patients with $> 60\%$ stenosis 5-year stroke and death rate was 5.1% vs 11% In women, the benefit of CEA was not as certain as 5y stroke and death rates were 7.3% vs. 8.7% This was pre statin and Plavix era North American Symptomatic Carotid Endarterectomy Trial (NASCET) Compared medical management vs CEA for symptomatic patients with moderate (50-69%) and severe stenosis ($>$70%) Only moderate impact for patients with moderate stenosis (50-69%) Symptomatic patients with $>$70 % stenosis benefited from CEA, at 18 months 7% major stroke in surgical arm, and a 24% stroke rate in medical arm. 29% reduction in 5-year risk of stroke or death Patients with severe $>$70% stenosis had such a dramatic effect the trial was stopped early for this subset and all referred for endarterectomy No benefit is shown in symptomatic patients with $< 50\%$ stenosis European studies have shown similar results ACST = ACAS ECST = NASCET. Carotid Revascularization Endarterectomy versus Stenting Trial (CREST) Compared CEA vs. CAS in both symptomatic and asymptomatic patients. Composite endpoint of 30-day stroke, MI, death equivalent between CEA and CAS CAS had a significantly higher incidence of stroke and death than CEA and CEA higher incidence of MI Subanalyses identified that older patients ($>$70y) had better outcomes after CEA than CAS, the QOL impact of stroke was more significant than that of MI, and anatomic characteristics of carotid lesions (longer, sequential, remote) were predictive of increased stroke and death after CAS Unfortunately, this study provides a benchmark to strive for, but no other large trials have achieved these results. ROADSTER Single arm feasibility trial of transcarotid carotid stenting The results of the ROADSTER trial demonstrate that the use of the ENROUTE Transcarotid NPS is safe and effective at preventing stroke during CAS. The overall stroke rate of 1.4% is the lowest reported to date for any prospective, multicenter clinical trial of CAS. Trials to look out for in the next few years CREST-2 - multicenter, randomized controlled trial is underway that is evaluating revascularization against modern intensive medical management ACT-1 and ACST-2- the role of intervention in asymptomatic patients, designed to compare the early and long-term results of CEA vs CAS and best medical management ROADSTER-2 - TCAR

Chapter 3

Cross-references

Cross-references make it easier for your readers to find and link to elements in your book.

3.1 Chapters and sub-chapters

There are two steps to cross-reference any heading:

1. Label the heading: `# Hello world {#nice-label}`.
   - Leave the label off if you like the automated heading generated based on your heading title: for example, `# Hello world = # Hello world {#hello-world}`.
   - To label an un-numbered heading, use: `# Hello world {-#nice-label}` or `{# Hello world .unnumbered}`.
2. Next, reference the labeled heading anywhere in the text using `\@ref(nice-label)`; for example, please see Chapter 3.
   - If you prefer text as the link instead of a numbered reference use: any text you want can go here.

3.2 Captioned figures and tables

Figures and tables *with captions* can also be cross-referenced from elsewhere in your book using `\@ref(fig:chunk-label)` and `\@ref(tab:chunk-label)`, respectively.

See Figure 3.1.

```r
par(mar = c(4, 4, .1, .1))
plot(pressure, type = 'b', pch = 19)
```
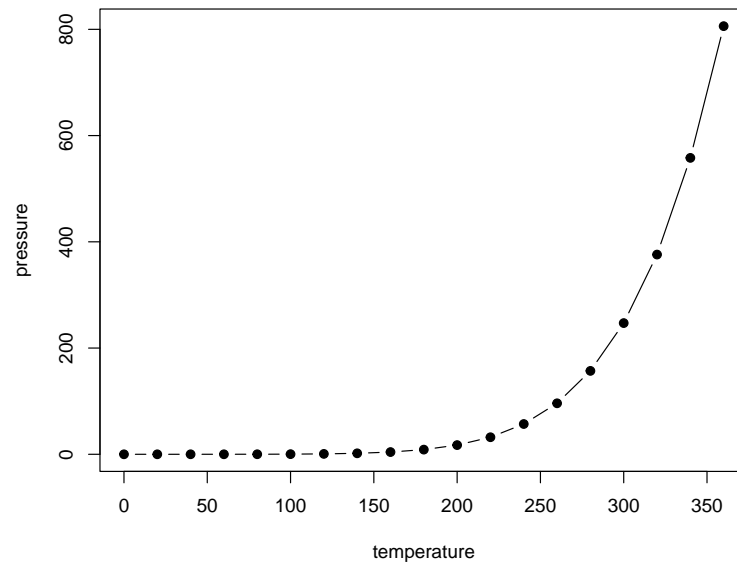
Don't miss Table 3.1.

13

Figure 3.1: Here is a nice figure!

```
knitr::kable(
  head(pressure, 10), caption = 'Here is a nice table!',
  booktabs = TRUE
)
```

Table 3.1: Here is a nice table!

temperature	pressure
0	0.0002
20	0.0012
40	0.0060
60	0.0300
80	0.0900
100	0.2700
120	0.7500
140	1.8500
160	4.2000
180	8.8000

Chapter 4

Parts

You can add parts to organize one or more book chapters together. Parts can be inserted at the top of an .Rmd file, before the first-level chapter heading in that same file.

Add a numbered part: `# (PART) Act one {-}` (followed by `# A chapter`)

Add an unnumbered part: `# (PART\*) Act one {-}` (followed by `# A chapter`)

Add an appendix as a special kind of un-numbered part: `# (APPENDIX) Other stuff {-}` (followed by `# A chapter`). Chapters in an appendix are prepended with letters instead of numbers.

Chapter 5

Footnotes and citations

5.1 Footnotes

Footnotes are put inside the square brackets after a caret `^[]`. Like this one [1].

5.2 Citations

Reference items in your bibliography file(s) using `@key`.

For example, we are using the **bookdown** package [**?**] (check out the last code chunk in index.Rmd to see how this citation key was added) in this sample book, which was built on top of R Markdown and **knitr** [**?**] (this citation was added manually in an external file book.bib). Note that the `.bib` files need to be listed in the index.Rmd with the YAML `bibliography` key.

The RStudio Visual Markdown Editor can also make it easier to insert citations: https://rstudio.github.io/visual-markdown-editing/#/citations

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[1]This is a footnote.

Chapter 6

Blocks

6.1 Equations

Here is an equation.

$$f(k) = \binom{n}{k} p^k (1-p)^{n-k} \tag{6.1}$$

You may refer to using `\@ref(eq:binom)`, like see Equation (6.1).

6.2 Theorems and proofs

Labeled theorems can be referenced in text using `\@ref(thm:tri)`, for example, check out this smart theorem 6.1.

Theorem 6.1. *For a right triangle, if c denotes the* length *of the hypotenuse and a and b denote the lengths of the **other** two sides, we have*

$$a^2 + b^2 = c^2$$

Read more here https://bookdown.org/yihui/bookdown/markdown-extensions-by-bookdown.html.

6.3 Callout blocks

The R Markdown Cookbook provides more help on how to use custom blocks to design your own callouts: https://bookdown.org/yihui/rmarkdown-cookbook/custom-blocks.html

Chapter 7

Sharing your book

7.1 Publishing

HTML books can be published online, see: https://bookdown.org/yihui/bookdown/publishing.html

7.2 404 pages

By default, users will be directed to a 404 page if they try to access a webpage that cannot be found. If you'd like to customize your 404 page instead of using the default, you may add either a `_404.Rmd` or `_404.md` file to your project root and use code and/or Markdown syntax.

7.3 Metadata for sharing

Bookdown HTML books will provide HTML metadata for social sharing on platforms like Twitter, Facebook, and LinkedIn, using information you provide in the `index.Rmd` YAML. To setup, set the `url` for your book and the path to your `cover-image` file. Your book's `title` and `description` are also used.

This `gitbook` uses the same social sharing data across all chapters in your book-all links shared will look the same.

Specify your book's source repository on GitHub using the `edit` key under the configuration options in the `_output.yml` file, which allows users to suggest an edit by linking to a chapter's source file.

Read more about the features of this output format here:

https://pkgs.rstudio.com/bookdown/reference/gitbook.html

Or use:

```
?bookdown::gitbook
```