

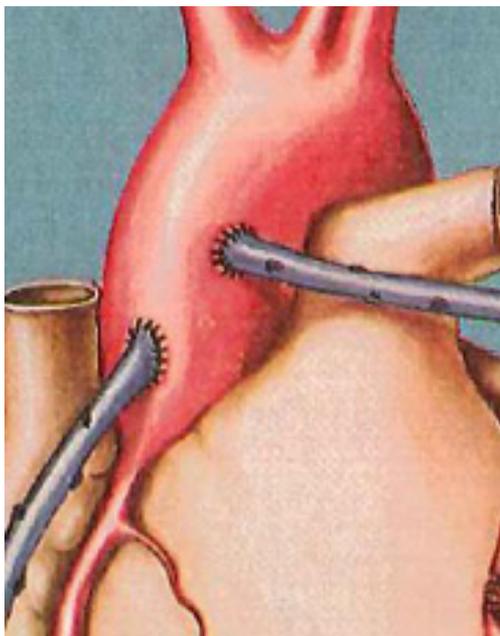
## Sewing Proximals on the Ascending Aorta during CABG Operations

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*There is more evidence—and there is more good evidence—that bypass surgery prolongs life than there is for any other procedure in the history of medicine or surgery.*

—Bruce W. Lytle, MD [Lytle, 2021]

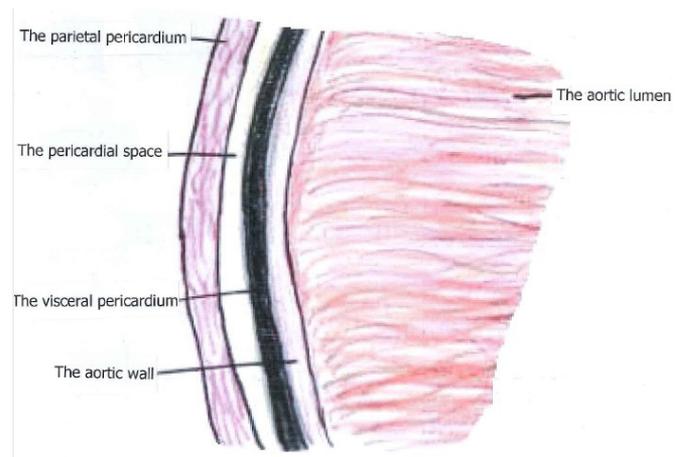


### EVERYTHING MATTERS. NOTHING IS NEUTRAL.

To have coronary bypass surgery deliver on the claim made by Dr. Lytle in his Gibbon Lecture at the 2020 meeting of the American College of Surgeons, surgeons doing these operations must pay attention to every detail of the procedures. While a lot of attention is, appropriately, focused on sewing the distal anastomoses in coronary artery bypass operations [Tribble, 2018], there is often comparatively less attention placed on creating the proximal anastomoses for coronary

artery bypass grafts. [Favaloro, 1970]. A lack of attention to these anastomoses can lead to significant problems for patients undergoing coronary artery bypass surgery. This article will address the common issues to be considered in creating proximal vein graft anastomoses in a standard coronary artery bypass operation. Let's get started.....

### THE PROXIMALS FOR CORONARY ARTERY BYPASS GRAFTS WILL BE ATTACHED TO THE ASCENDING AORTA. WHAT IS THE ANATOMY OF THE ASCENDING AORTA RELEVANT TO CREATING THESE ANASTOMOSES?



The Anatomy of the Ascending Aorta

After opening the parietal pericardium to expose the heart and the aorta, you need to understand the anatomy of the ascending aorta in order to deal properly with sewing proximal grafts to it. The visible surface of the aorta inside the pericardium will be the visceral pericardium, which lies external to the adventitia of the wall of the aorta. This visceral pericardium sometimes has a bit of fat in it. However, this visceral pericardium is important to preserve, as it will add strength, and, perhaps, a bit of hemostasis to the anastomoses of the grafts that you will suture to the aorta. Occasionally, you will need to trim away some of the fat contained in this visceral pericardium in order to create the aortotomy necessary for your proximal graft sites. However, you should remove as little of this nearby tissue as feasible, as it can act as an autogenous pledget when you are placing the sutures

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for your grafts. An especially egregious error that you may be lured into, especially in reoperations, is to dissect more deeply on the aorta, which may result in the removal of the sturdy adventitia, exposing the media of the aorta, which has little to no strength. [Tribble, Reoperative Cardiac Surgery I, 2018]

### IS THE ASCENDING AORTA SUITABLE FOR PROXIMALS?

One of the first issues to consider in a patient being referred for coronary bypass surgery is whether the proximal ascending aorta is suitable for proximal anastomoses. The assessment of the 'health' or quality of the ascending aorta starts with the preoperative evaluation. We developed a checklist for thinking about the possibility that the ascending aorta might be abnormal in a patient being considered for coronary artery bypass grafting (CABG), with either calcification or with 'soft' atheromatous debris being of concern, either of which can be quite problematic when contemplating any cardiac surgery, especially coronary artery bypass operations.

There are pertinent issues in the history that should make you suspicious of proximal aortic disease including a history of smoking, diabetes, renal failure, diffuse peripheral vascular disease, female gender, or aortic branch vessel disease (such as obstructive disease in the origins of the arch vessels, the mesenteric vessels, the renal arteries, or, especially, orifice disease in the left or right main coronary arteries). Calcium visible in the aorta (sometimes called 'an eggshell aorta') on a chest X-ray or a CT scan is quite worrisome, as well. In recent years, we, and others, have more and more frequently opted to obtain a CT scan on most patients being considered for cardiac surgery, especially reoperative cardiac surgery. [LaPar 2011, and Tribble, Reoperative Cardiac Surgery, Part I, 2018]



A CT scan showing calcium in the ascending aorta

The evaluation of the aorta should continue, once you have entered the chest, by palpation of the aorta or by

intraoperative ultrasound evaluation of the aorta. Early in my career, I learned a neat trick from Noel Mills, a very experienced and innovative cardiac surgeon who spent most of his career at the Ochsner Clinic. Dr. Mills told me that he would routinely perform an inflow occlusion maneuver, in which he would briefly clamp the superior or inferior vena cava, causing the patient's blood pressure to fall transiently and allowing him to gently squeeze the aorta, which allowed assessment not only of calcium in the aortic wall but also of soft plaque inside the aorta, if either of these conditions were present. And, of course, if these types of abnormalities were found, a change in the operative plan would be required.

If there is any suspicion of a diseased aorta based on these preoperative or intraoperative findings, the next step would be to perform an intraoperative ultrasound (or echo) evaluation of the ascending aorta. If it turns out that the aorta is affected by either calcium (hard plaque) or soft atheromatous material (which is even more ominous than calcium), you'll have some important strategic decisions to make, including considering alternate cannulation sites such as the innominate artery (if it seems to be unaffected), the axillary artery, or a femoral artery. You may also need to find alternative sites for the proximal ends of the coronary grafts. These alternative sites include the innominate artery, one of the carotids (either in the chest or in the neck), or even one of the internal mammary arteries (IMA), all of which I have used, at one time or another, as the proximal sites for coronary grafts. To be more specific about the use of an IMA as an inflow site for coronary grafts, you can consider freeing up the right internal mammary (assuming you are using the left IMA to graft one of the coronaries, usually the left anterior descending coronary artery) and using it as an inflow site. If this maneuver is used, the right internal mammary artery can be left in continuity after dissecting enough of it from the chest wall to access it easily, in order to attach a graft or grafts. Another option is to replace the ascending aorta with a prosthetic tube graft, which is sometimes a reasonable option, though this approach is more attractive if an aortic valve replacement is part of the planned operation. [Reece, 2007]

### WILL YOU DO THE PROXIMALS WITH A SINGLE CROSS CLAMP OR WILL YOU USE A PARTIAL OCCLUSION CLAMP?



A Partial Occlusion Aortic Clamp

There are a number of issues to consider in contemplating this question, including:

- Partial occlusion clamps have been shown to increase cerebral emboli, and, therefore, should virtually never be used if the ascending aorta is abnormal in any way.
- These clamps are also associated with some risk of a dissection (which I have seen happen a number of times).
- You can supply the heart with plenty of blood while the regular X-clamp is on and while the proximals are being done, thus lessening the attraction of using a partial occlusion clamp (more on this strategy below).
- It is technically easier to perform these proximal anastomoses with the aorta in its normal configuration than when it is 'squeezed' by a partial occlusion clamp.
- In spite of these considerations, some surgeons do like to use a partial occlusion clamp, at least partly focusing on shortening the X-clamp time, though, as noted above, if some perfusion of the heart is maintained while the X-clamp is on, is of less relevance.

### WILL THERE BE ADEQUATE SPACE ON THE AORTA FOR PROXIMALS?

The ascending aorta is 'expensive real estate,' as an old saying goes. That is, you will need to consider the following issues:

- The need to work around an aortotomy for an aortic valve replacement (AVR), if an AVR is part of the current operation
- Discerning how distal on the aorta you are able to place the aortic cannula
- Taking into account where the X-clamp is or will be
- Deciding where you plan to place your cardioplegia cannula

### WHERE WILL THE PROXIMALS BE LOCATED ON THE AORTA?

Next, you will need to think about where the various grafts will need to be sewn to the ascending aorta:

- The left anterior descending (LAD) & diagonal grafts will usually need to be located on the left side of the aorta (noting that the LAD will usually be grafted with the left internal mammary artery, ie, the LIMA)
- Grafts to the ramus intermedius (RI) & high obtuse marginal (OM) vessels can be attached to either side of the aorta (more on this issue below).
- Grafts to the more lateral OM's can usually be attached to the left side of the aorta
- Grafts to the right coronary artery or its branches (the posterior descending or posterolateral coronary arteries) should, usually, be attached to the right side of the aorta.

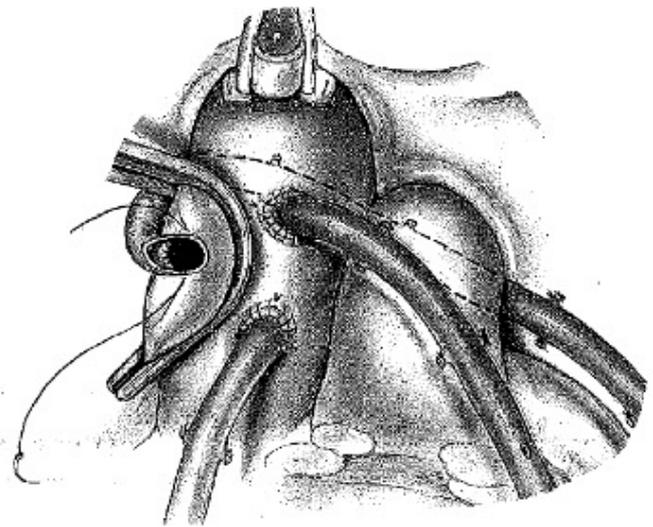
### AT WHAT POINT IN THE CASE WILL THE PROXIMAL ANASTOMOSES BE DONE?

Most surgeons will perform the distals first and the proximals second, in contrast to the strategy I was taught as a resident (which I never, ever liked and which I abandoned the day I finished my residency). This strategy allows the surgeon to judge the optimal length and position of each graft.

### WHERE WILL THE BYPASS GRAFTS 'RUN,' FROM AORTA TO CORONARY ARTERY?

Another set of decisions involves where the various vein or radial artery grafts will 'run' from the aorta to their target vessels. The priorities include:

- Most grafts should lie against the posterior or lateral pericardium
- That is, they should NOT run over the right ventricle or over the pulmonary artery, mainly because it is hard to gauge the length of these grafts when neither the RV nor the PA are full while on cardiopulmonary bypass (CPB), even when you retard the venous return to fill those structures in an effort to gauge graft length.
- Grafts to the ramus intermedius or the obtuse marginal coronaries can be led through the transverse sinus, under the pulmonary artery and aorta, and sewn to the right side of the aorta.



A vein graft passing through the transverse sinus, with anastomosis on the right side of the aorta. (Note the dashed lines demonstrating the route of this graft, running posterior to the pulmonary artery & aorta.)

- Positioning a graft in the transverse sinus is an attractive option for several reasons, including:
  - i- Those grafts will not be affected by the pulmonary artery, which can sometimes cause

- stretching or kinking of these grafts, depending on its degree of distention
- ii- Those grafts running in the transverse sinus will be less vulnerable during a reoperation (and you should consider all patients at risk for needing another operation, sooner or later).
- iii- The graft or grafts to the right coronary artery or its branches can be placed slightly higher (more distal) on the ascending aorta, so there will be space for all of these proximal anastomoses (both left and right sided grafts)
- Grafts to the posterior descending or posterolateral branches of the RCA can run under the inferior vena cava (IVC), which, though not commonly done, does create a 'beautiful lie' for those grafts, and grafts routed in this way cannot be kinked by the vicissitudes of an RV that is changing in size, as hemodynamics vary. All that is required to pass a graft under the IVC is to encircle the IVC with finger and thumb and to touch the pericardial reflection below the IVC with the electrocautery to create a pinpoint hole in the pericardial reflection that can then be dilated with a clamp. These right sided grafts can be sewn to the aorta a bit more distal than other grafts, which is handy if you have routed a left sided graft through the transverse sinus and anastomosed it to the more proximal portion on the right side of the aorta
- Radial grafts are positioned like vein grafts
- If a free IMA graft is needed, it is usually sewn to the hood of a vein graft and will usually be routed from aorta to the LAD across the RV outflow tract

### WHAT ABOUT THE TIMING OF CREATING THE PROXIMALS DURING THE OPERATION?

You should consider doing them last (after doing the distals). Here's why:

- It is much easier to get the length of the grafts right if distals are done first.
- The patient can be gently warmed up when proximals are being done.
- It doesn't matter if the heart is fibrillating during this time. (More on this issue below)
- You know at that point what you've grafted, of course (in contrast to doing the proximals first, as you might find a distal isn't graftable).
- You'll be ready to come off cardiopulmonary bypass (CBP) soon after the last proximal is done.

### HOW CAN YOU MAINTAIN CARDIAC PROTECTION DURING THE CONSTRUCTION OF THE PROXIMALS?

You can provide luxuriant blood flow to the non-working heart with the cross clamp still on by running warm blood in

as many ways as possible during the time needed to attach the proximal ends of your grafts to the aorta (while remembering that an empty beating heart consumes only about 10% of the oxygen as does a working heart) including by:

- Keeping the retrograde catheter perfusing during this time [Derryberry, In Through the Out Door, 2018 ]
- Perfusing all veins with the octopus attached to the cardioplegia line (until each, in turn, is sewn to the aorta)



The multihead octopus catheter for cardioplegia delivery

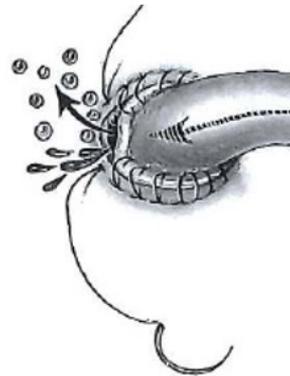
- Taking the bulldog off the IMA and letting the IMA perfuse its target coronary artery during this time
- Note: The heart, being perfused as described above, will often spontaneously defibrillate during this time. So, you may have to manage blood that might be ejected at this point. (See next section for managing blood in the heart or in the aorta while sewing the proximals.)

### HOW CAN YOU VENT (THE HEART, AND, ESPECIALLY, THE AORTA) WHILE SEWING PROXIMALS?

- The primary venting of the aorta will be via the DLP cardioplegia and venting cannula, which should be left in place in the aorta while sewing the proximal anastomoses. (Interestingly, 'DLP' comes from the names of the children of the inventors of this cannula, who were named David, Lynda, and Philip.)
- You could place an LV, LA, or PA vent to aid with venting, though these strategies are rarely needed in this setting.
- You can use a small tipped plastic sucker placed through a punched proximal site, prior to sewing a vein to it, which will keep the aorta relatively empty.
- However, you should try to keep the native coronary orifices covered by blood in the proximal aorta

to minimize air getting into them (though the blood being run through the retrograde catheter, the vein grafts, and the IMA will usually keep them deaired fairly well). A strategy that can aid in keeping the native coronary orifices covered is to raise the head of the bed a click, while sewing the proximal anastomoses.

- Regardless of the venting strategies used, you should make sure everyone on the team is aware that blood can be ejected while creating the proximal anastomoses, if heart is beating (which is unusual, but does happen sometimes, prior to completing all of the proximal anastomoses).



The final deairing of a vein graft prior to tying the suture.

### WHAT'S THE OPTIMAL ORDER OF ATTACHING THE PROXIMAL ENDS OF THE GRAFTS TO THE AORTA?

- Generally, you should do the proximal anastomosis of the RCA graft last, as blood running through the retrograde cardioplegia catheter and the IMA will perfuse rest of heart fairly well during this time and keeping the blood running through the RCA graft as long as feasible, prior to anastomosing it to the aorta, complements the blood from the retrograde catheter (since retrograde perfusion tends to supply the left side of the heart a bit better than the right side).
- If the IMA to LAD graft is open, do the proximals for vein grafts for nearby territories early, as their zones will get collateral flow from that IMA to LAD graft.
- In summary, it is best to do the proximals for the lateral wall grafts first and the proximal for the RCA graft last.

### HOW CAN YOU DEAIR THE GRAFTS?

- First of all, you do not want air in any part of the arterial circulation. Air can stay in the capillary bed for quite some time (potentially for many hours after the operation).
- Keep a saline filled syringe on the graft after disconnecting it from the octopus, which will also help keep air out of the graft and will allow you to discern the proper graft length, after which a bulldog clamp is placed on the vein, prior to cutting it to the appropriate length.
- It's best to avoid sticking the graft with a needle to deair it, though doing so is preferable to letting a big air bubble go down the graft (since the needles can injure the vein, at least to some degree).
- One way to aid in deairing the grafts is to have cut the valves of the vein after the vein is harvested, which I and some other surgeons do routinely. [Mills, 1976] If you have cut the valves in the vein grafts and if you have warm blood running through other grafts and through the retrograde cardioplegia cannula, the grafts will virtually always be deaired by blood flowing retrograde out of the graft.

### HOW DO YOU MEASURE GRAFT LENGTH?

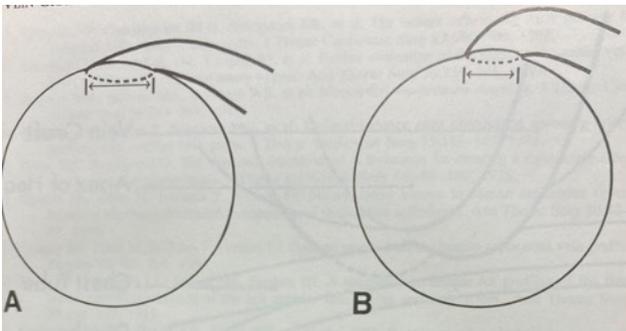
- Distend the vein you plan to anastomose to the aorta next with a saline filled syringe.
- Take this opportunity to look, again, for leaks at the distal anastomosis and to make sure that there are no twists in the graft.
- Consider distending the heart (by transiently impairing venous return to the cardiopulmonary bypass circuit) to be sure that you know how the heart, when full, will affect the route and length of the graft.
- Mark the vein, with dots from a marking pen, to ensure that the graft stays straight. (Some do this early in the case, though it's probably best to mark them at this point so that the marks are always on 'the top' of the vein.)
- Remember that left sided vein (or radial) grafts should be routed underneath the IMA graft used to graft the LAD.
- Don't punch the proximal hole in the aorta until the graft is measured and 'situated' where you think it will lie when the proximal is finished (as you may want to consider an alternative site on the aorta once you see how the graft is likely to lie).
- Do only one graft at a time. That is, avoid punching more than one hole in the aorta at a time, as that will keep the field 'drier' and since you may change the plan for the location of the proximal anastomosis as you see how each graft, in turn, seems to lie optimally.

### HOW DO YOU PUNCH THE HOLES IN THE AORTA FOR THE PROXIMALS?



A standard aortic punch used for proximal grafts sites.

- The site for a proximal should be just a bit off the top of the aorta, because if the hole is on the very top of the aorta, the vein hood may be flattened. And, the site for the proximal anastomosis shouldn't be too far down (posterior) on the side of the aorta, either, as the graft may end up having a kink in it, right at the spot the vein is attached to the aorta.
- After selecting the site for the proximal anastomosis, clear away a bit of the visceral pericardium, with the Bovie, to minimize bleeding
- However, don't clear too much, because catching the edge of this visceral pericardium with your anastomotic stitches can aid in hemostasis.
- With an 11 scalpel blade (that is, with a blade with a sharp point), cut an X in the middle of the cleared site. (Remember that you should NOT put the point of that blade in the middle of the site, as if you do, the cut won't be in the middle of the site you've chosen for the proximal. In other words, picture what, exactly, you want the punched hole to look like.)
- Avoid making these two cuts too long, as you MUST cut away the aortic tissue incised with the 11 blade with the punch. (Otherwise you may have to deal with an incision in the aorta that extends beyond the punched hole, which could bleed, or you may leave a slit that could be a site where a dissection could start).
- Don't make the punched hole too big, because a large hole will flatten out the hood of the vein. A 4.5mm punch is optimal for most vein grafts, while a 4.8mm punch is often too big. If a 4.0mm punch is used, you may have to punch repeatedly, which will create an irregular hole and make suturing a bit more difficult. (A 4.0mm punch actually is a good size for a radial graft or a small saphenous vein, however.)



A: The hole in the aorta is too large for the vein, flattening the hood.  
B: The hole in the aorta is appropriate for the vein graft's size.

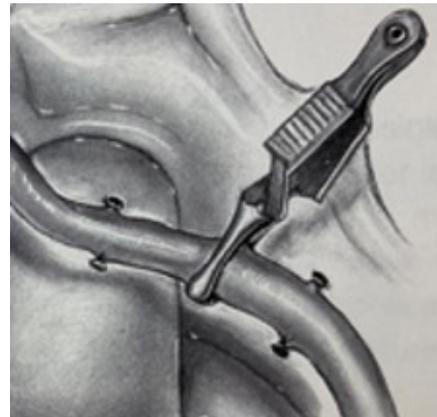
- If the punched hole is a bit oval, try to make the long axis of the oval be in line with the graft to be sewn to it, so that the hood of the graft won't be flattened out.
- Watch carefully to be sure that no piece of the punched aorta falls into the aorta. To avoid this issue, be sure that the punch is cleaned after each bite of the aorta is taken. Also, if you are running blood through your retrograde catheter during this time (and you should be),

that blood will usually flush out any particles created during the use of the aortic punch.

- Again, avoid punching all the proximal graft sites at first. Usually, it's best to do them one at a time, though it is a good idea to mark the sites you intend to use with a marking pen, to ensure that you have room and to judge carefully when each proximal graft should be attached.
- If the punch does not 'release' from the aorta, that is usually due to extra adventitial tissue that is still attached to the aorta. It is important to never forcefully remove the punch from the aorta, as doing so might result in an aortic dissection. If the punch does not separate easily from the aorta, release the plunger carefully, so that punched tissue does not fall into the aorta and then grasp the uncut tissue and sharply excise it.

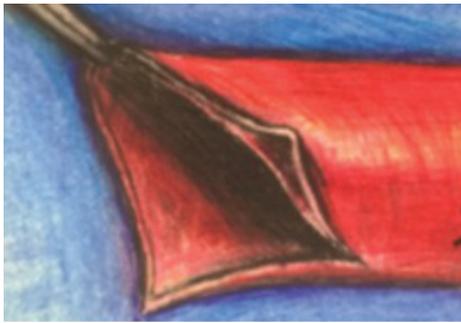
#### WHAT DO YOU NEED TO DO BEFORE STARTING TO SEW THE PROXIMAL?

- Check the graft length and orientation again, to be sure that the intended cut site on the vein is still appropriate once the aortotomy has been created, while invoking the old adage of 'measure twice, cut once.'
- With the vein distended gently with the saline filled syringe, put a bulldog on the vein. Place it far enough back that the suture won't get caught on it as you sew. This bulldog clamp will prevent blood from flowing out of the vein while you are constructing the proximal anastomosis and will help keep air out of the vein.



A bulldog clamp placed on vein graft while creating the proximal anastomosis (note that it should be to the side to avoid twisting).

- If a circular graft marker is used, put it on the vein after the bulldog is placed, which will keep it from slipping distally on the vein.
- Using sharp arterial scissors, cut the vein with just a bit of a bevel. Then 'back cut it' a bit by cutting the vein a few millimeters in the heel. This back cut should not be as long as one would usually use for a distal anastomosis.



The proper tailoring of the proximal end of a vein graft.

### HOW DO YOU SEW THE PROXIMAL ANASTOMOSES?

- Round up the gear that you'll need to create the anastomosis, including a long (36") 5-0 Prolene suture with a C-1 needle, DeBakey vascular forceps (perhaps a bit 'heavier' than those used for the distal anastomoses), your needle driver of choice (most use Castro-Viejo drivers while Ryders are preferred by some surgeons), and a pair of forceps to 'spout' the vein with (blunt, narrow tipped Gerald forceps work well for this purpose).

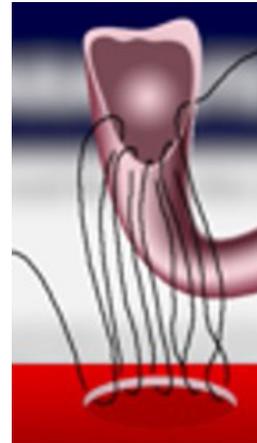


Gerald Forceps

- Create the proper 'work space' by placing white towels around the sternotomy incision to keep the sutures from getting caught on the retractor or the cannulas. (Why use blue towels when the suture is blue?? White towels are better because you can see the blue suture optimally.)
- Make sure that the towels are folded on the edge toward the operative field, as a folded towel will be less likely to 'catch' on the suture as you're sewing.
- The first step of every vascular anastomosis is to properly position the rubber shod clamp, which controls the non-working end of the suture and keeps that portion of the suture from getting in your way.
- However, you should never put a stitch in a vascular structure until you have positioned the non-working end of the suture in an appropriate place.
- Most of the time, you'll want to have your assistant

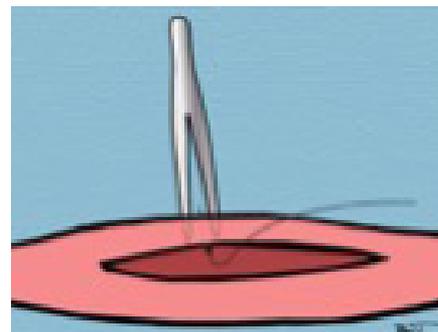
'spout the vein' gently with a pair of small, blunt tipped vascular forceps (like Gerald's).

- Start sewing where you want to finish. (Ordinarily, you want to be putting the final stitches in forehand, as your visualization of the aortic edges is best at the beginning and worst at the end of the anastomosis.
- You're going to sew the heel first, as in all vascular anastomoses.



Sutures placed in an open manner in the heel of a vein graft.

- Do NOT take large bites of the vein, especially in the heel of smaller grafts, as doing so may narrow the vein at that point.
- And, you will sew 'outside in' on the vein, inside out on the aorta, at least most of the time.
- Always keep control of the needle (keeping 'metal on metal,' which means the needle should either be in the needle driver or controlled by your forceps).
- Focus on rotating the needle to get enough of the needle out of the aorta so that you don't have to touch

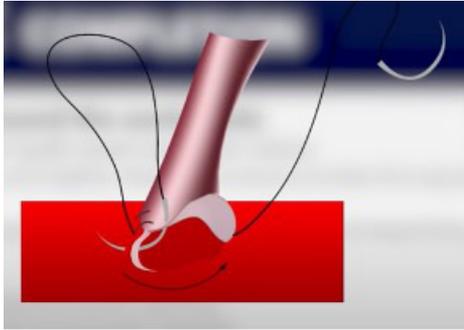


Stabilizing the needle as it exits by grabbing the sides of it

the tip of the needle (to prevent burring of the tip).

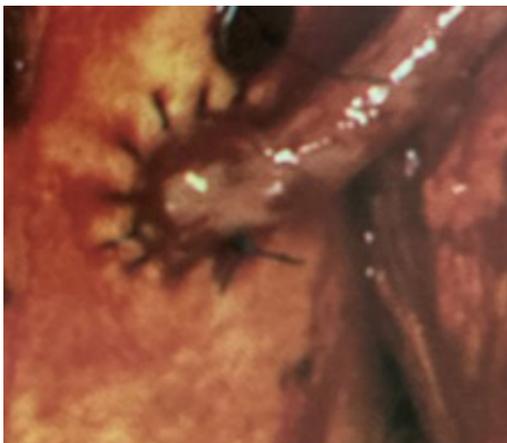
- Remember to control the needle as it exits the aorta and remember that it is okay to catch a bit of the surrounding tissue with the needle to stabilize it. (Some call this maneuver 'the best trick ever.')
- [Tribble, String Music, 2018]

- Take plenty of stitches in these anastomoses to prevent leaks. (As you become adept at handling the needles with forceps and needle driver, you should be able to ‘fly along’ with these proximal anastomoses, so you shouldn’t feel too pressed to get them done.)
- The stitches **MUST** be full thickness on the aorta. (Partial thickness bites are weak and may lead to bleeding or even dissection. Remember that proximal graft sites are thought to be one of the origins of dissections that can occur after cardiac surgery.) It is surprisingly easy to fail to get a full thickness bite, so both surgeon and assistant must watch each stitch carefully to ensure that the needle never enters the media of the aorta. The best way to avoid a partial thickness bite is to aim the needle towards the floor initially and to then rotate it up and out of the aorta.



After pulling down the initial stitches in the heel, continue around the rest of the anastomosis.

- Let the needle exit the aorta wherever it ‘wants’ to come out. It doesn’t matter how the stitch pattern looks, only how it works.
- Use smaller bites on the aorta so that the sutures won’t get in the way of another desirable site for a proximal. This is especially important if the aorta is ‘crowded’ as when there are multiple proximals to be done or if the space on the proximal aorta is limited.



The completed proximal anastomosis of a vein graft.

- Avoid using the DLP (the cardioplegia needle) site for a proximal, as it is generally useful to keep it in place for deairing after the proximals are all done.
- Consider using the anastomotic suture to tie down whatever graft marker you are using (if one is used). This maneuver is usually done after tying the anastomotic suture securely. (More on graft markers below.)

### WHAT SHOULD YOU DO AFTER COMPLETING THE PROXIMALS?

- Look for air in the veins and vent the vein with a tiny needle (27 gauge) if necessary, prior to removing the bulldog clamp.
- Take the bulldogs off and always ask the scrub nurse if ‘all the dogs are back in the doghouse’. (You will lose some ‘serious style points’ if you have left a bulldog on a graft when you’re trying to come off bypass!)
- Consider, at this point, with the cross clamp on and with the heart still decompressed, placing the posterior pericardial chest tube, as it is often easier to position it under these conditions than it is to place the tube with the heart full and beating. And, remember that you also want to ensure that this tube is not touching a vein graft (which may require a loose stitch in the posterior pericardium to hold the tube away from a graft).
- And, on a similar note, you might also consider placing the ventricular pacing wires after placing the posterior tube and while the left ventricle is not yet full and beating vigorously, since doing so won’t increase the cross clamp time significantly (remembering that you should still be running warm blood through your IMA graft(s) and through your retrograde cannula).

### SHOULD YOU CONSIDER PLACING SOME KIND OF MARKERS NEAR EACH PROXIMAL SITE?

You can (or, perhaps, should) consider using graft markers around or near your proximal graft sites, as they can potentially benefit three groups, including:

- Cardiologists, as virtually all CABG patients will be cathed at some point in the future, and most cardiologists like graft markers, as these markers can shorten the time required to do a cath at any point after the operation.



A catheter engaging the origin of a graft, guided by a graft marker during a postoperative cath (the red circle is added for emphasis).

- Patients, as graft markers make catheters safer:
  - There will be fewer strokes (noting the ~ 1% stroke risk with a cath, with that % being higher after an operation, especially after a recent one)
  - Less dye may be required, which is good for the patient's kidneys, and less dye is needed if the precise site of the proximal anastomoses are known.
- Surgeons, as most surgeons will want to know if one of their grafts is really out (and not declared occluded just because the cardiologist doing the cath could not find the proximal site)
- Cardiologists & surgeons who might be placing a transcatheter aortic valve (TAVR) at a later time, since markers on proximal grafts can help in planning for and implanting these valves. [Pingpoh, 2017]

### WHAT KINDS OF MARKERS CAN BE USED TO MARK PROXIMAL GRAFT SITES?



Types of graft markers that are commercially available.

There are a variety of types of radiopaque graft markers, including:

- Those available from medical suppliers, such as
  - Stainless steel rings
  - Flexible rings of radio-opaque material
  - Small metal circles with a hole in middle (which are tied into the anastomotic suture knot, so that they are adjacent to, but not encircling the graft)
- Or, you can use 'homemade' markers, such as:
  - Radiopaque markers from surgical sponges, as suggested by Dr. John Ochsner [Mills & Ochsner, 1978]
  - Vascular clips, as suggested by Dr. Frank Selke [Selke, 2018]

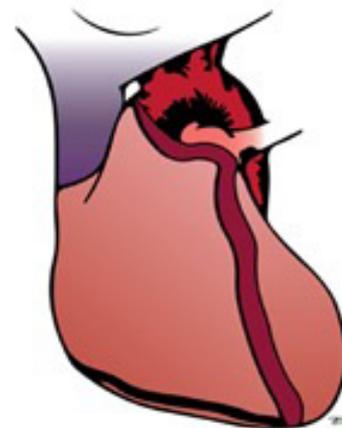
### HOW (AND WHEN) WILL YOU DEFIBRILLATE THE HEART?

- It's only rarely necessary to defibrillate the heart, if warm blood is running while creating the proximals, as the heart will commonly resume beating in a normal rhythm under these conditions
- While defibrillating the heart causes only minimal harm, it has been shown to cause enzyme leaks
- Therefore, spontaneous defibrillation 'has to be a good thing'
- If you could 'dial it in,' you'd like the heart not to beat until you're about done with the proximals, so that blood won't be ejected, possibly onto a team member.

But, you can usually prevent blood from being ejected at this point, even if the heart does begin beating.

- Still, defibrillation is sometimes necessary, and it is easy to do, with very low power, when the heart is still relatively empty, after completing the proximals and after adequate perfusion has been delivered through the newly constructed grafts.

### SHOULD YOU CLOSE THE PERICARDIUM?



The pericardial incision used to create a Flege Flap.

There are many reasons to consider covering the heart with some combination of pericardium, pleural fat, or even prosthetic material. We have covered the issues and techniques elsewhere. [Flege, 1987, Tribble, Reoperative Cardiac Surgery, 2018, & Ego, 2022] Simply put, the sternum should never, ever be left in contact with the heart, the grafts, or the aorta.

### POST OP NOTES

As the old saying goes, no job is finished until the paperwork is done.

When dictating your op note, include a description of how you created your proximal grafts. A small 'techniques note' on creating op notes is that you can (and probably should) have a template that you use for these notes saved on your computer that you can edit appropriately and then cut and paste it into the EMR. Using such a template not only saves time, but it also can prompt you to include all the details you would like to have in your note.

If time permits, you should always write a few notes of reflection in your techniques notebook, at some point shortly after the operation. If you adopt this habit, you will be amazed at how often you have more reflections on what you have done during an operation than you would have thought. [Tribble & Merrill, 2016]

## FINALLY, A NOTE ON TEACHING CARDIAC SURGERY



Teaching a cardiac surgery resident

Sewing a straightforward proximal anastomosis of a vein graft is, or should be, well within the skill set of even fairly inexperienced surgical residents. [Yount, 2017] If they understand the principles outlined here and if you, the teaching surgeon, have just a modicum of patience, almost any surgical resident can ‘get quickly up to speed’ on these anastomoses. And, you can be sure that a younger resident will be forever grateful for the opportunity to do one or more of these anastomoses.

### SUMMARY

Creating the proximal anastomoses during a coronary artery bypass operation involves a surprising number of nuances, most of which are fairly important, and these details are only rarely described in techniques articles and books.

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