Intra-Aortic Balloon Pump Refresher

Hello all – here’s the latest topic FAQ. As usual, please remember that these documents are not meant to replace reference texts, and they are certainly not meant to be the last word on anything! The idea here is to present information that passes on the experience of a preceptor to the newer ICU nurse, gathered over “too many” years of ICU experience at the “trenches” level. I do try to “fill in the gaps” with reference sources, usually from the web, and I'll list them at the end.

I’ve tried to organize the questions so that different topics are clearly separated, so that people can quickly find the answers that they need. As usual, please feel free to write all over this document, point out mistakes (there are probably lots), and add questions, criticisms, etc. Some of the questions have not been answered yet – I need to run them by the balloon tech folks. Please keep the un-answered questions in mind, and if you get the answer to one of them, please let me know so we can add it in. Thanks!

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**Intra-aortic Balloon Pump Refresher FAQ**

1- **What is an intra-aortic balloon pump?**

An intra-aortic balloon pump is a device that basically does two good things for a heart in trouble. These two effects correspond to the two movements that the balloon makes, namely inflation and deflation. The balloon itself looks like a wire coat-hanger with a transparent plastic hotdog on the end, which inflates and deflates in careful timing with certain parts of the cardiac cycle of systole and diastole. The balloon is inserted into the femoral artery, threaded up, and the tip is placed so that it sits just below the aortic arch – this is usually done in the cath lab under fluoro, but can be done at the bedside in an emergency.

2- **Why is an IABP inserted?**

The first reason to insert a balloon is to help perfuse the coronary arteries when they are nearly closed by tight lesions. If you try to visualize the cardiac cycle, think of the heart during diastole: the chamber walls open up, and on the left side of the heart, the valve leading from the LV to the aorta – the aortic valve – flips shut. The aorta has just been filled by the previous systolic contraction, and now with the aortic valve closed, it rebounds a little, like a garden hose with a pulse of water going through it – the walls stretch a bit with each systole, and then spring back a bit, creating a small backwards pressure towards the heart. The openings leading to the coronary arteries are actually in the wall of the aorta, just above the aortic valve, and the arteries fill passively during diastole. The balloon is timed to inflate at the end of diastole, creating a forcible pressure backwards along the aortic arch, pushing blood actively through the coronary arteries.

**Inflation:** perfusing tight lesions, treating ischemia that won’t go away.

2-1 **What is diastolic augmentation?**

Because this occurs during the diastolic part of the cycle, and because it “augments” the normal coronary blood flow, this is called “diastolic augmentation”.

2-2 **How much volume does the balloon hold?**

The balloon itself can hold different volumes, but usually is set to an inflation volume of 40cc.

2-3 **Why do they use helium?**

“The advantage of helium is its lower density and therefore a better rapid diffusion coefficient.” What I think this means is that helium, being very light, and not very dense, is easier to push and pull in and out of the balloon through the line tubing. I’m not sure what happens if the helium gets into the patient – I remember being told that it’s physiologically inert – maybe the patient talks funny?

NB: Balloon Tech Gary says that the “rapid diffusion coefficient” means that the helium will dissolve very quickly in the blood if the balloon were to leak some into the circulation. But not a
whole lot of helium: if the balloon were to rupture, a bolus of helium would act just like any other
gas/air embolus in the circulation – for any sign of balloon rupture (like blood in the balloon line),
the console must be shut down immediately, and the balloon removed.

2-4 What are tight lesions?

Tight lesions are the narrow spots along the lumens of the coronary arteries that make for all the
trouble – if they’re nearly closed, say >95%, then the patient may develop spontaneous angina
(“unstable angina”).

2-5 What is stable angina? Unstable angina?

Stable angina is the chest pain that a patient gets early in the development of their coronary
lesions – they get the pain under stable, predictable conditions, like climbing a flight of stairs.
Unstable angina is the pain the patients get as the coronary lesions get tighter. This angina can
strike spontaneously, without any exertion, and represents worsening CAD.

2-6 What is LMNOP? What if LMNOP doesn’t work?

LMNOP are the initials that some people use to remember the maneuvers to make for cardiac
ischemia: Lasix (assuming they’re “wet”), Morphine, Nitrates, Oxygen, and Position (sit them up if
they’re short of breath – unless they’re hypotensive!). If LMNOP doesn’t work, then you have to
think about putting in a balloon pump to forcibly perfuse the coronaries.

2-7 How do I know if the balloon is working?

You know that the balloon is working if the patient’s chest pain goes away! You also want to look
at their EKG to see if their ischemic changes, if any, have resolved – remember, some diabetic
patients, and we see lots of them - don’t have chest pain with ischemia, so you have to be
careful.

2-8 What if the balloon goes in, and they’re still having symptoms?

If the ischemia isn’t controlled with IABP insertion, they probably need to go for an emergent
CABG or stent procedure, since something is probably about to infarct.

2-9 What are V-waves? Why do they come and go?

V-waves are a sign of ischemia – they can show up as part of a PCW waveform, and in this
context it means that the patient has developed “ischemic MR” – mitral regurgitation. The idea is
that the ischemia has affected the papillary muscles that control the mitral valve. They have
stopped working properly, and the valve starts leaking. You can use the presence of V-waves as
an indicator that the patient is still in ischemic trouble – sometimes this is useful if a patient is
intubated and can’t tell you they’re having pain, or in people who don’t have pain, like diabetics
with neuropathy sometimes. The goal would be the same as treating someone with ischemic
changes on their 12-lead – you want to see the v-waves go away. Look for the oxygenation to
worsen with v-waves, since the valve is letting blood flow backwards towards the lungs – look for
it to improve once the valve is working again.
Deflation: treating cardiogenic shock:

2-10 What is cardiogenic shock?
“Cardiogenic” means that the shock state is being caused by heart failure: the pump isn’t pumping. Remember that there are three parts of a blood pressure, and the common kinds of shock are caused by bad things happening to one of those: pump, volume, and arterial squeeze.

2-11 What is afterload?
Afterload is the resistance that the heart is looking at as it tries to pump blood out into the arterial system. (Preload is the volume arriving in the LV, measured as the wedge pressure.) If the arterial squeeze is high, then the heart has a harder time pushing blood into the tight vessels – looser is better! Afterload corresponds to the SVR number – normal is around 1000, septic would be low, and cardiogenic would be high. Remember – high is tight, low is loose.

2-12 What is afterload reduction?
Since a high afterload makes it harder for the LV to empty itself, it adds to the work that the heart is trying to do – bad! So the goal is to lower the afterload – to lower the SVR. You can do this with drugs, like NTG or nipride, but if the patient has a systolic pressure of 90 – probably not a good idea! The balloon, deflating just at the beginning of systole, creates an area of lower pressure in the aorta – which helps the LV empty itself, and takes a lot of the workload off it – mechanical afterload reduction. Almost everyone with cardiogenic shock died of it before the IABP came along for this purpose.

2-13 Why can’t we just use pressors?
Well – you could, and sometimes you have to, even with the balloon pump working. But do you really want to add a pressor to failing heart muscle? Probably not – you want to avoid things that make the heart work harder. Dobutamine - the beta pressor - would be the drug of choice. Remember, the alpha receptors are in the arteries, and pressor-izing the arteries in this situation would be bad – it increases afterload resistance, and those arteries are probably already quite tightened up – that’s the reflex response the body uses to try to maintain blood pressure if cardiac output fails. These people already have bad peripheral perfusion – add an alpha pressor and they might lose their fingers!

2-14 How can I tell if the balloon is working?
Simple: if the balloon goes in for chest pain/ischemia, you look for the patient’s pain and EKG changes to go away. Those nasty v-waves should go away too, if they were there before, and MR going away should improve oxygenation quickly. If the balloon goes in for cardiogenic shock, then blood pressure should improve as the cardiac output comes up. The SVR should come down, and you should be able to wean some on the dobutamine.
2-15 What should happen to the urine output, and the wedge pressure?

The PCW should go down for two reasons – the balloon should improve the blood supply to a
hurting LV and help it pump better – empty itself better. Afterload reduction from deflation should
help PCW go down because of the mechanical advantage the balloon gives to the LV. With
better cardiac output, urine output should improve – remember that somebody needs to check the
X-ray to make sure the tip of the balloon is in the right position – too low and it can obstruct
the renal arteries, which tends to be bad for the kidneys.

2-16 How do I know if the patient is balloon dependent?

“Balloon dependent” describes a patient who is cardiogenic, and whose heart depends on the
mechanical assistance from the IABP to keep blood pressure up. Pause the IABP – their BP falls.
This patient is obviously not ready to wean from the balloon yet.

2-17 What is the “chemical balloon”?

The phrase “chemical balloon” refers to using a combination of vasoactive drugs to mimic the
effect of the IABP – usually this is tried in an outside hospital to stabilize a patient before they can
be moved somewhere that a balloon can be placed. Dobutamine is used to increase cardiac
output, and IV NTG or sometimes nipride is very carefully added to decrease afterload resistance
– remember that nipride dilates the arterial bed, and dobutamine can too! This is a very tricky
road to go down, and is obviously dangerous, since the dobutamine can produce
tachyarrhythmias, and the nipride can produce really stupendous hypotension. Never forget to
take ridiculous care using nipride, running it alone, never flushing the line, etc.

3- How is a balloon inserted? Who does the procedure?

An IABP is inserted by a cardiologist, usually in the cath lab under fluoroscopy, using much the
same technique as any central line placement. Careful placement is needed to avoid placing the
balloon too high or low, and the patient must have an x-ray to confirm proper placement of the
balloon tip. This can be read by the balloon techs, but should be confirmed by a knowledgeable
doc.

4- What is balloon timing?

Timing is everything in life, and the IABP is no exception. If you think about it even for a moment,
you’ll realize that if the balloon is still inflated in the aorta, when the heart is trying to pump blood
into that aorta – well, that would be a bad thing. So the timing of both inflation and deflation must
be carefully looked after. This is the responsibility of the nurse caring for the patient. You
can not avoid this – you can not rely on the timing set by the balloon techs, because timing needs
can change frequently. If you feel uncomfortable with timing, that’s probably a good thing,
because that means you care! I’ll try to cover this as best I can – and we may be getting a
simulator into the unit that we can connect to a console. Then I’ll run the staff by it on the night
shift until everyone is more comfortable with this. Meanwhile, you should feel free to call the
balloon techs at night, or call the RNs in the CCU or the cardiothoracic ICU for advice.

One more word about timing before going into the details: remember that there are “safe”
positions for each timing knob. Turning the knobs inwards, towards the center of the console,
puts them in a position where the timing can not hurt the patient. It won’t help them either, but at
least no damage will be done. When I trained on the old console, they taught us to remember
that it’s like during a storm: “safe inside”, and “dangerous outside” – the old consoles had two timing sliders instead of knobs, but the idea was the same: moving the sliders inwards was always safe if you were worried, and moving the sliders outwards was moving first into treatment, and then if you went too far, danger. So if you’re not sure where you are with the timing, turn the knobs inwards – left knob towards the right, clockwise – right knob towards the left, counterclockwise, always towards the center of the console. Then work the left knob carefully back towards the dicrotic notch to set inflation, and then work the right knob to the right to set deflation.

**Timing Basics**

Right! Finally got a scanner. (All strips come from documentation by the Datascope Corporation, and are used with permission). Okay, here’s a nice strip of a balloon that’s just about perfectly timed, with the console set at a ratio of 1:2 – meaning, it’s “ballooning” every other beat. Let’s see if I can remember how to do arrows…

![Graph](https://www.datascope.com/ca/pdf/preinservice_self_study_guide.pdf) Used by permission.

Okay, what have we got here? First off, see the groups of three? Three peaks? Look for the groups to help you orient yourself. Now - everybody see the first arrow on the top left, pointing at “PSP”? Number 1? That’s the patient’s peak systolic blood pressure. Now look at the next arrow down, “APSP”, number 3. See how the peak that it’s pointing to is lower than the first one? You can see the same thing happening clearly in the beats that follow – this is important – see how the second arterial peak is lower than the first one? (The really high waveform in the middle, number 2, is the balloon doing its thing, but we’ll get to that in a minute.) The first waveform, the PSP is the “patient’s systolic pressure”, and number 3, after the balloon wave, is the “assisted patient’s systolic pressure”, which reflects unloading.

Why is this such a good thing? Let’s remember that in cardiogenic shock, the heart is trying to pump against a really tight arterial system – it tightens up to try to maintain blood pressure when the heart loses pumping power. Is this a good thing? It ought to be – it’s the only thing the body can do in this situation. But does a weakened LV enjoy pumping against a really tight set of arterial vessels? No it does not! This is what “afterload” means – the resistance that the LV is facing as it tries to pump blood out into the arteries. Anybody know what number we use to measure afterload? Who said SVR? Very good! Higher is tighter, lower is looser, and if your patient’s heart is failing, looser is better. So the first goal of proper timing is to make sure that the assisted systole is lower than the patient’s own systole.
This is where the difference in arterial pressures comes in – the balloon, by deflating, lowers the arterial pressure in the aorta – that’s part of the “assist”. The other part of the assist is that the deflation helps the LV empty itself – more on that below.

After the dicrotic notch – this is the point at which the balloon inflates – see the waveform shoot upwards? Number 2? This is the pressure generated in the aorta as the balloon inflates, and since this inflation is happening during – which phase of contraction? – diastole – this really high part of the wave is called the “augmented diastolic” pressure. (On the diagram it says “PDP” – I have no idea what they mean.) Since this is the highest pressure generated in your patient’s arteries, your transducer setup is going to display this number as the patient’s own systolic – which it ain’t. We follow the MAP in this situation anyhow. But it is perfusion pressure – that inflation pressure does help perfuse tissues, so maybe it doesn’t matter so much, as long as you know the difference. I usually write “augmented diastolic” over my hourly BP checks on the flow sheet to indicate what the transduced systolic number really means.

Now look at the place where the pressure in the aorta is lowest, at the end of balloon deflation – this is called the BAEDP: the “Ballooned Aortic End-Diastolic Pressure”. Say that three times fast. This point should always be lower than the patient’s own diastolic pressure – which on the diagram is the bottom arrow on the left. See how the one is lower than the other? This is the second goal of proper timing – to lower the diastolic resistance in the arteries. Both pressure components are lowered, decreasing the SVR.

Now take a look at the group of three peaks on the right side of the diagram. This should be the pattern you want to get with proper timing. With the machine set at a ratio of 1:2, you should see the assisted systole lower than the patient’s, and the BAEDP lower than the patient’s diastolic. See the pattern? Systolic peaks lower, diastolic bottoms lower. You’ll see people standing, scrutinizing the monitor, saying, “Okay, this should be lower than that, and this should be lower than that.”

**Inflation Timing**

**4-1 Why does the balloon inflate at the dicrotic notch?**

The balloon is supposed to inflate towards the end of diastole. So - the walls of the heart open up, the chambers fill, and the aortic valve flips shut. It turns out that the anatomical openings - the ostea - leading to the coronary arteries are in the wall of the aorta, just above the valve, and at the end of diastole the aorta rebounds a little bit, and the coronaries perfuse – passively. Now, if your ischemic patient needed more than just passive perfusion – what could you do? - inflate the balloon. How do you know when to inflate? It turns out that the dicrotic notch, coming at the end of diastole, indicates exactly the event we want – the closure of the aortic valve. Once the valve is closed, the balloon inflates, and blood is forcibly pushed backwards along the aortic arch, and into the coronary arteries under pressure, improving perfusion.

**4-2 Why do we use the arterial wave for timing?**

Simple: we use the arterial wave to look for the dicrotic notch, to use as the marker for inflating the balloon. Use the inflation knob to move the inflation wave leftwards, until it meets the dicrotic notch.
Arrows again. This time, the arrows from above are pointing to the dicrotic notches. The arrows from below are pointing to the inflation waves of the balloon. (The inflation wave is a lot smaller in this picture than it usually is. Bad diastolic augmentation…) Is it anywhere near where it ought to be? No – it needs to be moved leftwards. Move it to the left with the inflation knob, turning away from the center of the console. If you do it slowly, you’ll see the inflation wave actually move over until it intersects with the dicrotic notch. Don’t go too far! Bingo! Can you see how the arrows coming later in the strip point to the same things? The augmentation should improve as you fix the inflation timing.

4-3 But there’s also the “balloon pressure waveform”. What’s that for?

The arterial wave comes from the patient, so it doesn’t tell you anything about the balloon itself. The balloon pressure wave tells you if the balloon is inflating or deflating properly. Usually in my experience if the balloon is timing well and producing a good-looking waveform, then the balloon waveform is taking care of itself. You are still responsible for knowing what the wave is supposed to look like, and you should keep a copy of the IABP waveform card to check. Here’s an example of a properly timed waveform:

4-4 What is a dicrotic notch, and why do they call it dicrotic?

The notch indicates closure of the aortic valve, and comes at the end of diastole, as the pressure falls. Why is it called dicrotic?
4-5 What is diastolic augmentation?

Remember that the balloon inflates at the end of diastole, just after the aortic valve closes – the rapid inflation is what augments the perfusion of the coronary arteries through the ostia. This rapid inflation can produce a pressure wave that’s actually higher than the patient’s systolic pressure, and that high pressure wave is referred to as diastolic augmentation.

4-6 How does inflation help?

Inflation helps by forcibly perfusing the coronary arteries, instead of letting them be perfused passively. Look at the “PDP” point in the diagram below – that’s the pressure perfusing the coronaries generated by the inflation of the balloon. A lot of pressure! This is often enough to control angina/ischemia along with ischemic symptoms, and can stabilize an ischemic patient until they can go to either cath lab or OR.

4-7 What are all those initials pointing to the different parts of the timing waveforms?

Everybody has their own system for labelling the important points on a balloon timing waveform, but they refer to the same events. Starting at the left:

- **PSP**: meaning the “patient’s systolic pressure”.
- Next is **IP** – here I think they mean “inflation point”, which of course is also what? - correct, the dicrotic notch.
- Next? What do they mean by **PDP**? I have no idea. I would call this the “augmented diastolic peak”.  
- After that? **BAEDP** – that’s what I call it as well.  
- Then – **APSP**: this I think means “assisted patient systolic pressure”. Close enough – I call this “assisted systole”.  
- **DN** – okay, this one they call the dicrotic notch.  
- **PAEDP**: probably “patient’s aortic end-diastolic pressure”. Which is to say, the patient’s diastolic, unassisted.
4-7 How do I make sure my inflation timing is right?

The safe position for the control knobs is always inwards towards the center – the inflation knob is the left-hand one on the console, and turning it to the left, counterclockwise – outwards from the center – will move the inflation wave to the left (earlier) as you watch on the arterial line trace. The inflation wave should coincide with the dicrotic notch. See the arrow?

As a note: you want the angle there where the inflation wave goes up from the notch to be nice and sharp. "Crisp", I think is the word they use.

Deflation Timing

4-8 What is the "point of isovolumic contraction"?

This refers to the point in the cardiac cycle when the chambers have filled with blood at the end of diastole – the chamber walls are building up pressure to start systolic contraction, and this is the point at which the heart is working the hardest.

4-10 What is "myocardial stroke work"?

Myocardial stroke work is the effort that the heart puts out with each systolic contraction. In cardiogenic shock, the pump is having a hard time pumping – so stroke work is something you want to try to reduce – which is exactly what balloon deflation does.

4-11 How does deflation help?

Rapid deflation of the balloon creates an area of lowered pressure in the aorta just ahead of the emptying left ventricle. Sort of like suction. The suction helps empty the ventricle with each beat, and takes some of the workload off of the cardiogenic heart. Almost everyone with cardiogenic shock died before the invention of the IABP because there was no way to assist the failing LV – now the survival numbers are pretty good.
4-11 How do I make sure my deflation timing is right?

The deflation knob is the right-hand one on the console. Turning the knob clockwise, to the right, moves the deflation wave to the right (later). Move the knob to the right until the BAEDP looks sharpened, and lower than the patients’ diastolic, but not so far that it begins to rise – check the diagram to help you remember which points are supposed to be lower than which.

See how the second diastolic (the assisted one) is lower than the first one (the patient’s)? Like the inflation point, the point at the BAEDP (the point of the arrow on the right) should be nice and sharp. If this point begins to rise, you need to reset the timing to correct it.

4-12 Which way do I turn the knobs on the console?

This is worth repeating – the safe positions of the knobs are turned “inwards” towards the center of the console. You time inflation by moving the left-hand knob counterclockwise, or to the left, away from the center. Deflation is timed with the right-knob, again, starting from the center, towards the right, away from the center.

Timing Problems

4-14 I know that there are two big bad timing errors – what are they, why are they so bad, and how do I make sure I don’t make them?

The two big bad timing errors are early inflation and late deflation.

They both come from moving the timing knobs too far away from center.

4-15 What is early inflation?

Early inflation is just that – the inflation knob is turned too far to the left, and the inflation wave actually comes before the dicrotic notch. This means that the balloon is inflating before the aortic valve closes, pumping backwards into the LV, which is already having a hard time emptying itself...
More arrows. Here they’re pointing to the inflation wave, which is way out ahead of where it ought to be. (IP I guess stands for “inflation point”.) See where it says DN? That’s where the inflation wave should be. (Why?) Ack! I have to say, just looking at this wave is enough to give me chest tightness…

**4-16 What is late deflation?**

Late deflation is when the balloon remains inflated too long – the heart is trying now to pump against an inflated balloon. Bad! The deflation knob has been turned too far to the right – move it back towards the center, make sure the BAEDP is lower than the patient’s diastolic pressure on the waveform, and start over.

See the BAEDP all the way up there? The patient’s end-diastolic pressure is that PAEDP that you see down lower – this is also a certified Big Bad timing error – don’t let this happen.

**4-17 Are there “good” timing errors?**

Sure - if the knobs are too far inwards, then the balloon is safely inflating and deflating – it’s just not really helping much. Here’s the opposite of early inflation: what can it be but “late inflation”? Duh. See the inflation point? Which way will you turn the inflation knob to fix this? How does the deflation look?
Here’s the other one. This is the opposite of late deflation – has to be “early deflation”. Won’t hurt the patient, but doesn’t help either. How would you fix this one? How does the inflation look?

4-18 Can the EKG be used for timing?

Yes – there are timing markers that you can use to time by EKG, and the Transact console that we use does this automatically. Actually in practice, we never do this, because we never, ever, balloon people in our ICU without an arterial wave – if only because we transduce the “root line” that’s built into the balloon to give us one.

4-19 What if the patient is being paced?

In practice – yes, you can balloon a paced patient. I haven’t done this myself in a while, but I remember that there used to be a “pacer reject” mode on the older IABP consoles – we should put this question to the balloon techs for a better answer.

Balloon Tech Gary says: If the patient is A-pacing, use the R-wave trigger mode, and decrease the gain to make the QRS smaller – that way the balloon will trigger off of the A-spike. With V-pacing, use the same R-wave trigger mode, and the balloon will trigger off the V-spike.

4-20 What if the patient is having ectopy? Or a-fib?

Balloon pump consoles really don’t like irregular rhythms. There are lots of claims by companies that make the consoles that their machines track a-fib with good timing – I haven’t seen it. Likewise ectopy – balloons become unhappy with FLBs (funny looking beats) of any kind – seriously consider having the team try to abolish ventricular ectopy in the patient if they’re balloon dependent. Likewise it might be a good idea to try to convert a person from a-fib to sinus rhythm, for the same reason.
4-21 What is “triggering”?

The console needs some way to know where it should start — we can adjust the timing from there, but the machine needs to see some signal from the patient to tell it when to start inflation and deflation.

4-22 What is “trigger mode”?

The console can use several ways to recognize trigger signals — the most commonly used is “R-wave”. The balloon techs will work with you to figure out which mode to use. On the Transact console, sometimes “peaks” mode works well — I don’t know enough about this. There are pacemaker trigger modes too — we need to look into this.

4-23 How often do I need to check my balloon timing?

You certainly want to check the balloon timing as soon as you get into the patient’s room. I usually take a quick look at the patient, the monitor, and then the console. I set the IABP ratio to 1:2, and I make sure that the timing is as good as I can get it. Then I print a timing strip and stick it on the back of the flow sheet. The timing may change as the patient’s condition does: changes in heart rate, blood pressure, arrhythmias (obviously) — all can make differences in the way the timing will need to be set. Be alert!

5 What “bad things” do I have to watch out for when caring for a patient with a balloon?

5-1 What if they bleed at the insertion site?

IABP patients always have to be anticoagulated. The balloon itself is a very convenient place for clots to form, which of course would tend to break off and float downstream to unhappy places, producing infarcts. This certainly qualifies as a “bad thing”. With anticoagulation, whether with heparin or one of the newer anti-platelet aggregation meds, comes the risk of bleeding, and since the balloon is inserted into a large, pressurized artery, some bleeding at the insertion site is common. I wouldn’t worry about having to change the site dressing once or twice in a shift, as long as I knew that the PTT was in range and not too high. Obviously, big bleeding would mean a call to the interventional people to come and look.

There’s also some risk, as always with femoral sticks, of bleeding out the back of the vessel, retroperitoneally. Watch for hematomas forming on the patient’s back, or flank, starting on the same side that the IABP is on, and follow the hematocrits carefully. Try to think ahead, be vigilant for signs that things like this might even possibly be coming. The fewer surprises, the better.

5-2 What about platelets?

Balloon pumps eat platelets — these patients often show falling platelet counts. I haven’t actually seen anyone need platelet transfusion, but you definitely see drops in the counts. Anybody know why this is?

Balloon Tech Gary: “the platelet count drops because the balloon physically injures them as it operates.”
Travelling Dawn points out: “make sure that this heparinized patient doesn’t have HIT!” Excellent point. The patient might need Argatroban instead of heparin.

5-3 Why do we use two sets of monitoring wires?

The balloon console needs an EKG trigger – see above: 4-21

If the console can’t see the EKG, then it won’t run – in a patient who is balloon dependent, this can be very bad unless you have a backup system in place – which we always do. One set of skin electrode wires goes as usual to the monitor, and a cable goes from there to the balloon console, which triggers off the R-waves it sees. The second set of wires goes from the patient’s skin using another set of 3 electrodes in a lead II pattern straight to the console without going through the bedside monitor – these are called the “skin wires” – and you’ll see the choice shown on the console: “monitor” and “skin”. If you lose one, switch right away to the other.

5-4 What do I do if the patient rips off all the wires?

A neat thing about the Transact console is that if you lose all your wires altogether, you can still trigger and time off the patient’s arterial waveform – there’s a button to select it. Patients on balloon pumps are famous for becoming confused – as I’m sure I would be if someone stuck a harpoon in my groin and didn’t let me out of bed for a couple of weeks! Again, this definitely comes under the heading of “things to anticipate” – try to have a plan ready with the team if the patient should even start becoming disoriented. Remember that if this patient sits up straight, the IABP can migrate inwards, upwards, and literally poke up through the aortic arch. (“Bad thing”.)

5-5 What if the patient codes?

There used to be an mode called “internal 80” built into most of the consoles that you were supposed to activate in case of a code – this was supposed to inflate and deflate the balloon “blind” at a rate of 80 bpm, and possibly generate some blood pressure. More recent material I’ve found on the web suggests switching to “pressure triggering” – which makes sense, since the balloon would inflate and deflate in sync with compressions. We need to follow up with the balloon techs on this question.

5-6 What if I have to shock the patient?

The documentation says that the Transact console is safely grounded to allow the patient to be shocked.

5-7 What if I find the patient standing at the bedside?

Actually, there was a famous story about a patient, years ago, who apparently managed to get out of bed and tried to take off down the hall with the IABP still in place. I don’t know if the story is true, but if it was true I don’t think he would’ve gotten too far. This would actually be an awful scenario, since even sitting up too far in the bed can make the stiff balloon catheter migrate inwards to the point where it can poke a hole in the aortic arch. The nurse that let this happen would probably have to claim to have been temporarily comatose. The point of course is to stay very alert to the fact that ballooned patients get very confused, very frequently, sometimes to the point of requiring intubation so that they can be kept safely sedated until the balloon can come out. Other people do just fine on the balloon. Be vigilant.
5-8 With the balloon still in?

Don’t let this happen! If it did happen: you would try to physically secure the patient. Get lots of help, alert every physician concerned, call in the interventional doctors, get stat films to check the position of the balloon tip, assess the patient continuously for signs that the aorta might be perforated: chest pain, hematocrit drops, widening mediastinum on chest x-ray, awful hemodynamic instability... Follow up closely – would the patient need to return immediately to the cath lab to have the IABP inspected, removed, or changed under fluoro?, follow hematocrits, blood gases, PT/PTT, chemistries – the lot.

5-9 Holding his balloon in his hand?

Don’t let this one happen either, although this might actually be preferable to number 5-8. Maybe not. The point is that the IABP is about as invasive a device as there is, and it is your responsibility to keep the patient safe – you need to stay way ahead of events, and be ready to head off surprises. Work with the team, and with your peers, and have a plan ready if the patient should become agitated – don’t wait until it happens!

5-10 What if they’re bleeding at the insertion site?

Remember that IABP patients have to be anticoagulated, because the balloon itself is very thrombogenic – that is, clots will form on it, and get shot downstream to unpleasant places causing the death of, say, a kidney, or a foot. So since the insertion site connects to the anticoagulated femoral artery, some small leakage is common, and easily dealt with by changing dressings. More than minor bleeding obviously should be seen by the docs – is the patient bleeding into the tissue around the site? Has the back of the artery been poked during insertion – could there be retroperitoneal bleeding there? Sometimes there’ll be bleeding at the little suture sites more than where the catheter goes in – holding pressure usually works, and then some gelfoam.

5-11 Should they be transfused?

Transfusion goes in and out of fashion, but in general it seems that keeping a hematocrit greater than 30 is the rule in cardiac patients, to keep up oxygen delivery to myocardium that’s at risk.

5-12 What if the balloon gets pulled out just a little bit (or a lot)?

Not good. The tip of the balloon is supposed to sit in the aorta just below the left subclavian artery. If the balloon gets pulled downwards, it could obstruct flow from the main aortic lumen into the renal arteries. Any time a ballooned patient suddenly loses urine output volume, along with everything else you want to check and see if the balloon itself has come loose or taken a yank downwards. Nowadays the balloon is stitched to the skin – along with that it’s a good idea to magic-mark the skin next to the stitches, or flag the balloon with a bit of red tape at the stitch site – anything to make it clear that the balloon has changed position.

5-13 What if the balloon gets pushed in just a little bit (or a lot)?

Also not good. Obviously, and as can’t be mentioned too often, the balloon can poke upwards through the aortic arch.
5-14 What is balloon rupture, and how can I tell if it happens?

Balloons break sometimes – I’ve never seen it myself. Sometimes patients have severely calcified aortas, and the roughened surfaces rub against the balloon with every inflation until finally a hole gets worn into it. The clues are loss of inflation volume – normally set at 40cc, sometimes 30cc, or blood in the balloon line.

5-15 What do I do for a balloon rupture?

Shut the console down. This balloon needs to come out promptly – notify the appropriate people immediately. At this point of course, if the patient is balloon dependent, you may have real trouble. Think about what to do to support them in the period of time until the balloon can be replaced – the combination of dobutamine and nipride (the “chemical balloon”) might be something to think about.

5-16 Why can’t the patient sit up?

Because the stiff IABP line will migrate inwards, and upwards.

5-17 Can the head of the bed be raised at all?

Usually to about 25-30 degrees, no more.

5-18 Why can’t they bend the leg that has the balloon?

The balloon will migrate inwards if the leg flexes too sharply, and the balloon won’t work properly if it bent or kinked, which usually happens just inside the insertion site. Keep a soft restraint on the affected ankle to help the patient remember not to flex the leg.

5-19 What about the left radial pulse?

If the balloon moves upwards, the patient may lose perfusion to the left arm, because the left subclavian artery will be occluded. **This means that the tip of the balloon is moving towards the aortic arch!** Check this once in a while, even if you’re sure nothing is wrong with the balloon’s position.

5-20 What about obstructing the renal arteries?

Same problem but in the opposite direction – if the balloon is too low, the renal arteries can be occluded – urine output will fall dramatically, and the patient will be at risk for kidney injury.

5-21 What should the x-ray of the balloon tip show?

“The balloon is threaded over the guide wire into the descending aorta just below the left subclavian artery.”
5-22 What about the distal pulses?

Definitely a critical point to watch. Any time that an artery is “hardware-ized”, you want to be very careful that there’s still good perfusion downstream from that artery – the easiest check for this is the pulse. You also want to monitor all those good perfusion things: temperature of the affected leg/foot compared to the other, CSM, etc.

5-23 Should I document the pulses in both legs/feet?

Yes. Check both the DP’s and the PT’s. Mark them with magic marker. The policy when I learned it was to check the distal pulses hourly.

5-24 How should I document the pulses?

What I do is to make two columns on the flow sheet using the “stat meds/treatments” column – left and right, each marked DP/PT. Under that I note “palp”, or “dop”, or (hopefully rarely) “absent”. On the sides of the columns I write “warm” or “cool”. Be sure to notify the team of any significant change.

5-25 What if the leg/foot goes cold?

Bad thing. Let the team know right away. Document the change carefully. This is obviously not something to sit on until the morning! (The preceptor is a night nurse.) The balloon may have to come out, sooner rather than later.

5-26 What if I can’t even doppler the pulses any more?

Big bad thing. Same procedures as above. Sometimes vascular surgery is paged to come and assess the limb. Balloon probably should come out in a short period of time – I’ve seen times when another one was immediately put in on the other side.

5-27 What is an embolectomy?

Surgical removal of a clot plugging an artery. Did your patient throw a clot from the balloon? Is your patient properly anticoagulated? Very very important. Follow your labs without fail.

5-28 What is a PVR machine? Do we have one? Where do I get one? How do I use it?

PVR stands for pulse volume recorder – this is basically a blood pressure cuff that prints a visual graph of the pulse in a limb. Any time that you can’t easily palpate or doppler all four pulses distally, or any time there’s a change in pulses or the temperature/perfusion of a leg or foot, you need to get the machine from the CCU – I believe the vascular floors have one, the SICU may have one too. The OA’s can get it for you, and the other units are used to us asking for it. You need to get someone to show you how to work it – it’s not really hard, but it can be tricky.

Basically what you’re doing is putting a blood pressure cuff around the affected limb, usually at mid-thigh or calf, and inflating to about 80mm. Leaving the cuff inflated, you turn on the recorder, which looks like one of the old single-channel EKG printers, and you record the upward blips on the paper. The blips should match the heart rate, and the higher they blip on the paper, the better the perfusion. If the signal is weak, you can increase the “gain” to make the machine more...
sensitive, but then you'll have to use the pen control to chase the printer line up and down on the paper - get someone to help you out with this the first couple of times.

Print a strip for each leg to document the difference – the vascular people will be very interested in these, and will probably want to do a set for themselves. I tape the strips to the back of the flow sheet.

Bear in mind that a change in pulses may be the early signal of something threatening the foot, or the leg. Any significant change, say from palpable pulse to dopplerable pulse should start you thinking, and communicating with the team. Some people think that all IABP patients should have baseline and followup PVRs – I think that a patient with a warm extremity, and with stable pulses probably doesn’t need them, since they only tell you what you already know. It’s the pulses that you can’t feel that should worry you. Any time you think you need a PVR, get one.

5-29 What about retroperitoneal bleeding?

Any time the femoral artery gets stuck there’s a risk of bleeding internally, towards the back as the patient is lying in the bed – especially when they’re anticoagulated.

5-30 How can I tell if my patient is having a retroperitoneal bleed?

Watch for crit drops, watch for bleeding or ecchymosis at the site, or elsewhere, check the patient’s back and flanks for hematomas that can signal a retroperitoneal bleed. (That’s Somebody’s Sign – I don’t know who…) In other situations the patient could have an abdominal CT scan - but travelling with a balloon, while possible, is a hairy proposition, and only done once in a while. Sometimes this kind of bleeding means that the patient will need a vascular repair at the site, along with having the balloon removed.

Here are some numbers from a study we found on the subject of IABP complications. Of 580 patients, here are some of the things that went wrong:

- Vascular complications (ischemia, mostly) happened in about 12% of the patients (72).
- Of these, 21 got better by having the balloon removed.
- Another 21 had to have an embolectomy.
- 13 had to have vascular repair.
- 2 had a fasciotomy (that doesn’t sound so good – compartment syndrome in the leg? Yow.)
- 4 required amputation (I’ve never seen either this or fasciotomy happen).
- There were three aortic perforations. All were fatal. Do not let these patients sit up!

5-31 What if the patient becomes confused, or agitated?

Watch carefully for any change in alertness or orientation. Patients on balloon pumps very often get very confused, probably as the natural result of being restrained, kept flat, and not allowed to move around much for a long period of time. The goal is to keep the patient safe. Provide appropriate reassurance and re-orientation, but sedation may be necessary – try to have a plan in place ahead of time. I find it’s always best to bring the team into the room and have them observe the patient themselves, rather than trying to describe their mental state. Haldol is often useful – it depresses respiration the least, but can have bad cardiac effects by lengthening the QT interval and producing arrhythmias. Don’t be afraid to pester the team if you think the patient isn’t safe.
Restraints may have to be used – remember to document why, how, how much, how long, and when you got them ordered.

I’ve think myself that the confusion often comes from lack of sleep and being uncomfortable all the time, day after day. These patients often get very sore in the back – sometimes an order for a Percocet every 4 hours can get them enough comfort and sleep to keep them oriented. Sometimes not.

5-32 What if the nurse becomes confused or agitated?

Very common! (But can you tell if you’re confused, when you’re confused?) Seriously, sometimes life in the ICU can really get a newer nurse’s head in a whirl, or even an experienced nurse’s head in a whirl. The point is, don’t let yourself get lost or isolated enough in your assignment that you feel like you’re having to deal with frustrations alone. Likewise, don’t get caught up in the feeling that you “have to prove to yourself” – or anyone else – that you really can do this job, that you really are up to the task of taking care of this or that person who’s probably the sickest person in the state right now, all by yourself. ICU care is by its’ nature a team effort. This is not philosophy – it’s reality. A doctor couldn’t do what you do – and you couldn’t place an IABP or a pacemaker. You can’t change ventilator modes, and respiratory can’t shoot cardiac outputs. If you are feeling stressed, or isolated, or frustrated – extremely common and natural feelings for staff in the ICU at every level – reach out and get help. This is not optional. It is a critical part of your ability to work in the unit. Swallow your pride, make humility your goal, and team up.

5-33 What is “hardware sepsis”?  

This is what happens when bad germs get into your patient along the routes created by the devices stuck into him: the balloon pump, PA line, or whatever. It’s the same as any other septic picture: the patient gets hot, tachy, dilated, hypotensive, and it’s treated like any other septic situation: fill the tank, squeeze the tank, kill the bugs. It’s also a good idea to try to remove the piece of equipment that’s causing the problem: swan, IABP – sometimes it can be hard to tell where the problem is coming from, so you’ll see the team go in and pull every line the patient has, and replace them. Just make sure that you have pressor access if you need it, which may mean that a new central line will have to go in before the old ones come out. It can be helpful to remind the team that a femoral line can be placed and used quickly, without an x-ray – even though they’re considered the “dirtiest” of the central lines, they can save a situation from going from “mildly stressful” to “call a code”. Ensuring that the patient has the right kind of IV access is your job.

5-34 What are prophylactic antibiotics?

Nowadays they’ll start ballooned patients on Ancef as soon as they come back from the cath lab. Come to think of it, I don’t think I’ve seen IABP hardware sepsis in a while.

5-35 Why do the ballooned patients have to be anticoagulated?

The balloon itself is very thrombogenic – clots like to form on it – and remember, clots in the arterial circulation float downstream and can plug any vessel that they wind up in – whatever tissue is beyond the plug, infarcts. “Bad thing”. Keeping patients therapeutic on heparin prevents this pretty well, but not always, so you have to stay alert and monitor the perfusion to the leg downstream from the balloon.
5-36 What about heparin, or reopro (abciximab), or integrilin (eptifibatide)?

Heparin is the traditional drug that we use to anticoagulate cardiac patients with – we have a lot of experience with it, and we know how to use it pretty well. But it turns out that it’s the formation of clots out of platelets that causes the trouble inside the coronary arteries. A new group of drugs, like reopro and integrilin has been developed that specifically works on platelet-clumping, and apparently they work very well. Sometimes you’ll see patients run on both for a while.

5-37 What are the new platelet drugs all about?

Stopping the platelets from clumping up and forming clots apparently is incredibly helpful in preventing thrombosis, which you really don’t want to happen in your brand new stents! Apparently the new drugs are so helpful in this regard that they stopped the studies and released the data early.

5-38 What is Plavix?

Plavix is a platelet-aggregation inhibitor that comes in pill form.

5-39 What are stents?

Stents look like the little springs that come inside ballpoint pens. They are metal mesh tubes that are put into place in the cath lab – they are placed inside the coronary artery, and then clicked open, so that they hold the lumen of the artery open wide just where the tight spots are. Easier than bypass surgery. I don’t know how long they last, but I do know that patients with them need to take something like Plavix, because platelets love to stick to things like stents – anything irregular – and they’d clot off as a result.

6- Which balloon console do we use?

We use the Bard company’s Transact IABP console. The console drives and controls the balloon: it holds the helium tank, which nowadays is a little gold thing the size of your fist. It has a pretty good computerized brain that helps you with timing – in fact it will try to time the balloon all by itself, and sometimes can do a good job. The control panel is divided into fairly obvious groups:

Power (AC or battery – the balloon will work for a time on battery – a couple of hours? – but we only do this when we’re transporting to and from the cath lab or the OR, and the balloon techs usually handle this.)

Choice of either skin wires, monitor signal, or arterial wave for trigger signal. The two wire systems back each other up – the console needs some way to see what they patient’s rhythm is. The neat thing about the Transact is that if the patient loses all her wires, you can time the machine off of the arterial line waveform – you always have one of these because there’s one built into the balloon itself.

Choice of triggers: R-wave, peaks, pacer – there’s lots of choices. Consult with the balloon techs about this – about 90% of the time we run on R-wave trigger.

Controls to stop and start the balloon: off, standby, purge, run, automatic. Bear in mind that the balloon will run in non-automatic mode, but the gas alarms will be off – meaning that if the line kinks, or leaks, or for any reason the balloon loses volume or gas you won’t know it. Be careful.
Weaning controls: to set the ratio of ballooned beats to the patient's own beats: 1 to 1, 2 to 1, 4 or 8 to 1. Remember that timing is always checked with the balloon set to a ratio of 2 to 1. You'll see the balloon techs time the console at 1 to 1 – I don't know how they do this, but hey, it's much more their thing than mine – I don't argue with the pros.

Monitor screen – this can be set to see the patient's arterial waveform or the waveform that sees the balloon itself inflating and deflating. You have to know what both are supposed to look like. More on these later on. You can set the monitor to either waveform, change the scale, freeze the screen, all those things. There's a printer as well – I print a strip of the patient's arterial waveform with the ratio set at 2 to 1, to show how well the balloon is working, and stick it on the back of the flow sheet. It can be hard to see the waves clearly on the console monitor, so for timing what I do sometimes is set the scale on the bedside monitor so that the art-line waveform is really enormous and clear, and then do my timing.

6-1 What is the purpose of the “balloon pressure waveform”?

Remember that all these waveforms are coming from transducers, that are hooked up to lines, that are connected to and "looking at" something – either a vessel or chamber in the patient, or in this case the balloon that's going into the patient. This is the waveform coming from a transducer built into the console – it looks at how the balloon is working as it inflates and deflates, and the wave is supposed to look a certain way. Changes in the waveform can tell you different things – I'll try to get a supply of reference cards to keep in the unit so we can look at them when needed. Of course, our main problem is that we don't get enough balloons in our unit, and lots of people go to the class and then don't see one for 4 months. Stressful. Hopefully soon we may be able to get a simulator that will stay on the unit, hooked up to a console, and we'll play with it to the point where everyone will be more comfortable.

6-2 How often should I check it?

Certainly switch back and forth from both waveforms on the console at the beginning of the shift and every hour or so after that.

6-3 Can I assume that the balloon pressure waveform is okay if my arterial-line timing waveforms are okay too?

My experience is that if the patients' arterial waveforms are clear and correct, that means that the balloon is working the way it ought to be, and that the balloon waveform will be okay as well.

6-4 When do I have to worry?

I always worry.

6-5 What should I do if something seems wrong with the balloon pressure waveform?

Check this over at the beginning of the shift with the nurse you're following – get some idea of what things look like at the start of your shift. Likewise, check with the balloon techs when they bring the patient to you. There are times when the balloon just won't run right – maybe it's kinked inside the patient, or the balloon can't be inflated to it's full volume for some reason. The balloon may need to be purged, because it may have lost some helium – not into the patient, but through the machine somewhere. If you notice a change during the shift that looks significant in any way,
you can call the balloon techs to look, or page them at home at night. Check the reference card for hints – is the line kinked outside the patient, is there a gas leak along the line somewhere? I’ve had to run the length of the pump tubing through an emesis basin of water looking for a leak sometimes. Don’t hesitate to call for help.

6-6 How is the entire setup connected to the patient and the bedside monitor?

There’s a cable that jacks out of our monitor that plugs into the balloon console – that’s how the balloon sees the patient’s rhythm one way. Then there are the skin wires – second way. Then a transducer is hooked up to an arterial line that runs along the whole length of the balloon inside the patient, opening at the tip-end. (This is the ‘root line’) – that’s one arterial wave. Hopefully, but not always, there’s a radial art-line – second arterial wave. Sometimes there’s an arterial arm to the sheaths that stay in the patient after cath lab procedures – that needs to be hooked up too – that’s three arterial waves. Lot of waves! Important: any pressurized line that goes into a patient needs to be connected to the monitor, if only so you’ll know if it comes disconnected. Once you have a chance to work with the machine a couple of times, the setup will make more sense – expect to be confused at first.

6-7 What is the “root line”?

The root line is the arterial line built into the balloon. It runs along the length of the device, opens up at the end, and reads the pressure in the aorta where the balloon tip is.

6-8 Why does the root line transducer need to be air-filtered?

We go to a lot of trouble to make sure that air doesn’t get into the patient’s arterial circulation. (Venous too.) If a pressurized bag began for some dumb reason to pump air into a patient’s aorta, the result would be an air embolus – just as bad as any other embolus, like a clot, travelling along in the artery, eventually causing an infarct somewhere.

6-9 Why do we mark the root line “No Fast Flush”?

Again, to prevent air in the line from going into the patient. If for any reason you need to aspirate or flush the root line, you don’t want to hit the flusher and push several inches of air that might happen to be in the tubing along into the patient. The idea is that you’re supposed to do all these moves manually, using a ten cc syringe, watching for air the whole time.

6-10- Why can’t I draw bloods from the root line?

What if it became clotted? And you had no radial line? Could you time the balloon without an arterial wave? Not properly, anyhow.

6-11- Can I ever?

You really should not. If you’re in a near-code situation, you do what you have to, but it’s not a good idea. Insist on a radial line if you think the patient needs one.

6-12 There seem to be eight arterial blood pressure waves coming from this patient. Which one do I believe?
People argue about this one. I usually believe the highest pressure I see. Remember though that the highest pressure that the monitor sees is usually not the patient’s systolic pressure – it’s the augmented diastolic pressure, which is often higher than the patient’s when the balloon is working right. MAPs are usually a better guide.

6-13 Why do I need to transduce all of them?

If a pressurized arterial line were to come disconnected, the alarms would let you know. Remember to set and check alarm limits for everything.

6-14 How do I check the helium level? How do I change the helium tank?

There’s a gauge on the side of the console – the helium tank for the transact console is supposed to last a very long time – months? I’ve never had to change one, but there’s always a spare in the equipment bags that some with the machine, and I’ll make sure that we have some manuals available.

6-15 What is purging? Should I purge the balloon?

The balloon and the long clear tubing that connects it to the console are only supposed to contain helium, which is lots lighter than air, and therefore lots easier to pump in and out of the balloon. If air were to get into the line or the balloon, it wouldn’t work properly – purging empties the balloon and refills it from the helium tank. I learned that usually the only time you need to purge the balloon is if you drain water from the line – sometimes water condenses in the clear balloon line and needs to be drained out. In that case air would get into the system, and it would need to be purged. Once in a while an unclear root tracing will clear up with a purge.

6-16 What do I do if the console quits?

I’ve never seen it happen, but it’s always good to have a plan. The CCU, and possibly the cardiothoracic ICU are supposed to have an extra console on hand – send for it right away.

Meantime, here’s what one online hospital reference suggested:

- Get another console immediately. (Uh, I think we knew that one.)
- Manually inflate and deflate the balloon if the console is going to be down for more than 15 minutes. Use a big catheter-tip syringe (we call these “GU guns” for some reason), and use about 10cc less than the balloon’s volume, inflating about 10 times a minute.
- Don’t ever put air into the root line.
- The idea is to prevent the formation of clots on the balloon – don’t worry about trying to time it to the patient. (That would be a neat trick! “Hey guys, watch this!”)
- Tell the cardiology people what’s going on right away.

6-17 Why can’t I run the console with the gas alarms off?

You can, but it’s not a good idea because it’s not really safe. The gas alarms are what tell you if something has changed about the inflation or deflation of the balloon – if the line is kinked, you won’t know, if the line leaks, you won’t know, and so on. There are times when you do have to
run with the gas alarms off – recently I took care of a man whose balloon was kinked just inside the insertion site – the decision had been made to leave it in place, so we ran it with lots of advice from the balloon techs, who agreed that it might only run that way if the gas alarms were left off.

6-18 How do I reset the console if it alarms?

It depends on why it alarmed. If the patient rolled over and kinked the line, then resetting the machine won’t work. The console actually is pretty good at telling you what’s wrong – read the messages at the top of the screen. Make sure the line is clear, then hit standby, then auto – that will restart at 1 to 1, with gas alarms on.

6-19 What do I do if the console says “gas leak”?

Make sure the clear balloon line is tightly connected at both ends to the patient and the console, then restart the console. If you get the message again, you might have to run the length of the tubing through a pan of water to see if there’s a pinhole leak. Or you can listen along the length of the line with a stethoscope. Most of the time there’s no detectable leak, and the machine does make message mistakes sometimes. Be alert to the possibility of balloon rupture though – inspect the line for blood. If you see any at all, the console must be shut off, and the balloon has to come out.

6-20 Or “no trigger”?

This means that the console can’t see the patient – either the skin wires or the monitor wires have come off. Try switching to the other system from whatever it is you’re using, and see if the console will work. If neither wire system works, change to the arterial trigger – there’s a button for it, and the machine will time pretty well off of the root line waveform until you get electrodes and wires re-connected to the patient.

6-21 What if I have to travel with the patient?

The only travelling that you’ll do with a ballooned patient is either to or from the cath lab, or rarely to the CT scanner. If the patient goes to the OR, they’ll be moved by anesthesia and a balloon tech. Either way, if you have to go anywhere, call in the balloon tech to go with you. The console has a set of inputs on one side for running when the patient is connected to a bedside monitor – on the other side is a set of inputs for travel cables. The equipment bag has an ECG cable for triggering, and an arterial cable for the root line.

6-22 What if there’s a lot of water in the balloon line?

If there’s a lot of condensate in the line it can make the console unhappy. I was taught that we were supposed to stop the console (standby), disconnect the tubing from the console and drain it downwards towards the floor onto a chux or something, reconnect, purge, and then restart. I’ve seen very little condensate with the newer console – we should check with the balloon techs about this.

Balloon Tech Gary: the machine purges itself every 3-4 hours, and removes any water in the line when it does.
6-23  Should I ever turn the console off?

The only time that I’d shut the console off would be if I thought that there was a balloon rupture, with blood in the balloon line. To stop the console temporarily, push the standby button. Sometimes house officers will ask you to do this so they can assess heart sounds, or bowel sounds. This is okay very briefly, but remember that a balloon-dependent patient may not handle this well.

6-24  When should I call the balloon tech for help?

Any time you think you need it. Most problems can be solved by a little group thinking among the nurses in the unit, and a call to the nurses in the CCU might be useful, but if you think you have a problem you can’t fix – that’s why the techs are there.

6-25  How do I page the balloon tech?

During the day they carry in-house pagers that you can call through the regular page operators. At night they have a different paging number – if the page operator doesn’t have it, the CCU or the SICU will. Sometimes the techs do stay in-house overnight if there are a lot of consoles running, or if there are unstable patients in the units.

6-26  How do I know if the helium is getting low? How do I change the helium tank?

There’s a pressure gauge on the right side of the console that shows the current pressure in the tank – if it gets too low, a message will flash on the screen that the tank will need changing soon. Changing the tank turns out to be pretty easy – according to the balloon tech who talked us through it on the phone one night:

a- leave the console running
b- find the big black lever on the right side of the console, and pull it outwards, away from the machine until it stops
c- grasp the helium tank (a rubber glove will help, because it’s a little hard to grab), and unscrew it
d- screw in the new tank firmly
e- push the black lever back down, which spikes the new tank
f- the gauge should show a nice high pressure.

7-  What about documentation?

Do it carefully.

7-1 Which pressures do we document?

In the space on the flow sheet where we put the blood pressure, we still write the systolic and diastolic numbers from the monitor, but you have to remember that the higher number will be the highest pressure peak that the transducer sees – which is usually the augmented diastolic when we’re ballooning.
7-2 How do I document pulses?

I make two columns marked left and right, and mark “palp”, or “dop”, or “absent” for each DP and PT. On each side I write “cool” or “warm”, underlined if there’s been a change.

7-3 Should I paste in the PVR strips?

Definitely. I sometimes take one of the sticky sheets that we use for blood product slips and stick them on that – that stays with the flow sheet so that people can find them quickly.

7-4 What about the weaning ratio?

We use a split column to mark the ratio every hour, and to document that we’ve observed the waveform: ratio on top, like 1:1, and a check mark below.

7-5 What goes on the flow sheet, and what goes in my note?

I try to cover the basics in my note and leave the details to the sheet. For example, I might say: Pt. in stable sinus rhythm s ectopy, Lido at 1, NTG at 200, heparin titrated to scale with am result 68.8. No c/o SSCP or SOB. IABP fx well at 1:1, site dressing changed x1 for sm amt sang drainage, site clean. See timing strips on flow sheet for details. Distal pulses: L (IABP) DP and PT doppelerable only, foot cool but CMS intact; R DP and PT palpable, foot warm. PVRs taped to flow sheet, showing good waveforms for both legs.

8- What is balloon weaning?

The balloon does have to come out of the patient at some point. Weaning is the process of changing the ratio so that the balloon supports at first every other beat (1:2), and then every fourth, or every beat, and observing how well the patient tolerates the wean.

8-1 Is there a weaning protocol?

Yes. What you’re trying to do is to see if the patient gets into trouble if you try to wean the balloon. So the first thing is to get a baseline EKG with the balloon at 1 to 1, along with a set of numbers: CVP, PCW, output, index, SVR, SV, all that good stuff. Then you set the IABP at 2 to 1, and go for two hours, at the end of which you do another EKG, and shoot the numbers again, looking for ischemic changes on the EKG, and anything that might indicate that the patient isn’t tolerating the wean, like a rising wedge pressure, dropping output, rising SVR. If nothing bad occurs, you try two hours at 1 to 4, again followed by EKG and numbers, and finally 1 to 8 with EKG, etc., followed by a return to 1 to 1 when the weaning is done.

8-2 When should we start weaning the balloon?

It depends on why the balloon went in. Remember that there are two main reasons for an IABP – to help keep tight lesions open in the coronary arteries (inflation), or to help a failing LV in cardiogenic shock (deflation). The first reasons includes ballooning a patient for just a day or two after stent placement, after which hopefully they’d tolerate a rapid wean and removal. In that situation, anticoagulation is really of critical importance – do you want to be the one that let the patient clot off their brand new stents?
The second situation is more difficult, but hopefully somewhat predictable. The idea is that the heart that's been hit by cardiogenic shock will need a certain amount of time to recover. What is there to recover? It turns out that around the area of infarct (you don't have cardiogenic shock without a big infarct) is an area that is still alive, still ready to pump, but dazed, or as they say "stunned". This area of "stunned myocardium" will eventually come back to work, but not for a given period of time, usually about a week. So the person who may have an EF of 12% right after an enormous MI may have a much better EF a week later, after the stunned areas come back and start to work. The goal of ballooning this patient is to get them through that period of time, with the balloon functioning as an LVAD – a left-ventricular assist-device.

8-3 How do I know if the patient is tolerating the balloon wean?

The patient will remain stable according to all the things you're following: EKGS, cardiac output, central pressures will all stay stable.

8-4 How do I know if they're not?

They become symptomatic. Chest pain, ischemia on EKG, blood pressure drops, wedge pressure rises, oxygenation gets worse. (Think about sending blood gases any time you think the patient's condition may be changing.)

8-5 Should I stop weaning if the patient is having trouble?

Absolutely stop the wean. Go to the house officers and show them your numbers, your EKGS, and your blood gases. The game plan may have to be changed. In the case of cardiogenic shock, you may have to briefly try a wean for several days in a row until the stunned part of the heart starts working again.

8-6 How long can a balloon stay in?

It's variable. I've heard of patients being ballooned for longer than a month when they're waiting for transplant. Ten days is the usual rough limit.

8-7 Who pulls the balloon?

The interventional fellow comes to the unit and pulls the balloon. Update: as of May '03, the techs are pulling balloons.

8-8 When should I turn off the heparin before a balloon gets pulled?

The medical team should speak with the interventional people to determine this, or sometimes the fellow will call you in the unit to plan things. You should try to get a specific time, and be very clear. One source said that heparin can be stopped four hours before the balloon comes out, with the console running at 1:1.

8-9 What should I worry about after the balloon gets pulled?

Your concern is the site and the perfusion to the leg. Provide site care as it's ordered – cardiology still likes sandbags, although it seems that angiography doesn't. Check the site for drainage,
ecchymosis, swelling, anything that might mean that there was bleeding into the tissue around the site. Check the pulses in the affected leg, and compare with previously – is the leg and foot warmer now? Are the pulses stronger? Document properly. Keep the patient flat for the ordered amount of time. Get clear orders about when, or if, the patient is to be re-anticoagulated, or started on oral anticoagulation, or not anticoagulated at all.

Some sources:

www.rxlist.com (a very useful site for finding pharmaceutical info)

http://critcare.lhsc.on.ca – the website of the London (Ontario) Health Sciences Centre, Critical Care Division

www.corr.com – the makers of integrilin


www.cardio-info.com/_disc6/0000007e.htm the Johns Hopkins protocol cited in the CV Talk Educators and Professionals Discussion Group

www.datascope.com/ca/abstract_1.html "Vascular Complications from Intraaortic Balloons: Risk Analysis"