Treatment with intraaortic balloon pump (IABP) is the most common form of mechanical support for the failing heart.
The first clinical application of a successful treatment with IABP was reported in 1967. Intra aortic balloon pumping was advocated successfully in a 45 year old female who had sustained a myocardial infarction and was hypotensive, comatose and anuric in severe cardiogenic shock.
Since then the IABP had been convincingly promised to be helpful in acute low cardiac output state following left ventricular failure. Despite the paucity of evidence-based recommendations concerning its use, IABP remains the most commonly used assisting device in cardiac surgery with more than 80,000 pumps inserted each year worldwide.

What are the indications for the use of IABP in ICU?

The classical indications for the use of IABP support include acute myocardial infarction with cardiogenic shock, as an adjunct to high-risk percutaneous coronary intervention, preoperative stabilization prior to coronary artery bypass surgery, and for continued support in the postoperative period. Less conventional indications include stabilization of left main disease, and as a bridge to cardiac transplantation. It may also be effective in the management of mechanical complications of myocardial infarction, such as acute mitral regurgitation and ventricular septal defect. Patients with intractable arrhythmia and heart failure refractory to medical therapy may also benefit.

What's the physiologic rationale of using IABP as a therapeutic vs prophylactic measure in cardiac patients?

The IABP is a double-lumen, balloon-tipped catheter, usually inserted through a sheath placed in the femoral artery. A sheathless technique is preferred in patients with peripheral vascular disease. The catheter tip is positioned in the descending thoracic aorta immediately distal to the left subclavian artery. One lumen is connected to the balloon, allowing back and forth movement of helium gas, while the other lumen is used for flushing the catheter and transduce aortic pressure. The balloon inflates during diastole leading to augmentation of aortic root and coronary artery pressures, thus improving coronary perfusion; it rapidly deflates in systole enabling reduction of afterload with a decrease in systolic pressures. The inflation-deflation sequence is timed with the arterial waveform or the EKG trace to synchronize with the cardiac cycle. Besides improving coronary blood flow and oxygen supply to the myocardium, IABP support results in a reduction of the left ventricular wall stress and afterload with a decrease in the myocardial oxygen consumption. The stroke volume and cardiac output increase, with an improvement in organ perfusion.

Few key characteristics -
Balloon position: The closer to the Aortic valve the greater the diastolic pressure elevation. 2) Balloon Volume: When the balloon volume is equal to the stroke volume the diastolic augmentation is maximized. 3) Balloon diameter and occlusivity: The greatest augmentation occurs with complete aortic occlusion. 4) Stroke volume: If stroke volume is less than 25 ml little diastolic augmentation can be expected.

What are the contraindications for the use of IABP?

IABP is generally contraindicated in the presence of aortic regurgitation as it may increase retrograde flow during balloon inflation through a leaky valve. It is also contraindicated in aortic dissection or aneurysm and in the presence of severe coagulopathy. In patients with severe peripheral vascular disease, it may lead to ischemia of the limb.

Also, one should be mindful of the complications -
most frequently they are vascular in origin, including aortic perforation, aortic dissection, femoral artery thrombosis, femoral artery pseudoaneurysm, lower extremity ischemia, visceral ischemia, and peripheral embolization. Hematologic complications such as hemolysis, thrombocytopenia, and hemorrhage also may occur. Mechanical complications include balloon perforation, incorrect positioning, gas embolization, and inadvertent removal

What's the evidence out there either in favour of or against the routine use of IABP in Cardiac patients admitted to intensive care?

The IABP-SHOCK II is the only large RCT addressing the efficacy of IABP in patients with acute myocardial infarction and cardiogenic shock who undergo early revascularization.[3] In this multicentric German study, 600 patients who were planned to undergo early PCI or emergency coronary artery bypass surgery were randomized to receive IABP support either before or immediately following the intervention, based on physician judgment. More than 95% of patients in both groups underwent PCI; about 3% of patients underwent emergency coronary artery bypass surgery. No significant difference was observed in the 30-d all-cause mortality, the primary outcome. The study had several limitations, including the selection of patients with relatively mild shock, and exclusion of patients with mechanical complications of myocardial infarction. IABP was inserted after revascularization in the majority (87%) of patients, which failed to evaluate the possible benefit of early hemodynamic stabilization in cardiogenic shock. A relatively large number of patients in the control group (10%) crossed over and underwent IABP insertion, which may have masked a possible benefit from IABP support on intention-to-treat analysis. The question of IABP efficacy in more severe forms of cardiogenic shock after acute myocardial infarction remains unanswered.
Recent meta-analysis, including the SHOCK II trial suggest a significantly lower among patients who received thrombolysis combined with IABP. In contrast, patients who received PCI and IABP support had significantly increased mortality.
In acute myocardial infarction without cardiogenic shock, IABP use has not been associated with a reduction in infarct size, assessed by cardiac MRI scans.
The efficacy of IABP in patients undergoing high risk PCI was evaluated in a multicentric UK study. High risk patients include those with left ventricular ejection fraction of less than 30% and extensive coronary artery disease. IABP was inserted before PCI in the intervention group. The primary endpoint of major cardiac and cardiovascular events (MACCE) including death, acute myocardial infarction, cerebrovascular event, or requirement for repeat revascularization at hospital discharge was not significantly different between groups. The 6 m all-cause mortality was similar in both groups.
The IABP is most commonly used in the perioperative period in patients who undergo coronary artery bypass surgery. Balloon counterpulsation may have a crucial role in the

stabilization of high-risk patients prior to coronary artery bypass surgery and continued support in the postoperative period. Preoperative IABP insertion may reduce mortality in patients with severe left ventricular dysfunction who undergo off-pump coronary artery. Meta-analyses also suggest that preoperative stabilization may improve outcomes in high-risk patients undergoing coronary artery bypass surgery.

Long term follow up of IABP-Shock published in 2018 in Circulation f/b an editorial which says it's Final nail in the Coffin
in this study, long-term follow-up was performed 6.2 years (interquartile range 5.6–6.7) after initial randomization. Follow-up was completed for 591 of 600 patients (98.5%). Mortality was not different between the IABP and the control group (66.3% versus 67.0%; relative risk, 0.99; 95% CI, 0.88–1.11; P=0.98). There were also no differences in recurrent myocardial infarction, stroke, repeat revascularization, or rehospitalization for cardiac reasons (all P>0.05). Survivors' quality of life as assessed by the EuroQol 5D questionnaire and the New York Heart Association class did not differ between groups.
Mortality is still very high, with two thirds of patients with cardiogenic shock dying despite contemporary treatment with revascularization therapy.

Hypothesis behind these results-
First, balloon counterpulsation provides only a small augmentation of cardiac output in the setting of shock, and the device requires intrinsic left ventricular contractility for optimal benefit. Furthermore, balloon counterpulsation does not directly support right ventricular function, which may contribute to shock in some patients. In this context, IABP use may simply provide insufficient circulatory support to ensure end-organ perfusion. Once irreversible end-organ damage has occurred, outcomes are uniformly poor. Second, although 80% of participants in IABP-SHOCK II had multi-vessel coronary artery disease (CAD), nearly all underwent percutaneous coronary intervention for coronary revascularization. only 3.5% of trial participants underwent coronary artery bypass graft (CABG). Thus, complete revascularization with CABG is a promising path forward.

Interestingly, there is one camp of clinicians is "IABP believers" while the other camp is "IABP Haters". The majority of physicians, however, are in the middle, finding themselves"between a rock and a hard place". These physicians are overwhelmed by the fear of not adhering to guidelines more than being really convinced of the lack of benefit of IABP use [4, 5]. The net result of this"hurricane" is that, in clinical practice in Europe and the United States, the utilization rate of the IABP has been decreasing over the last few years

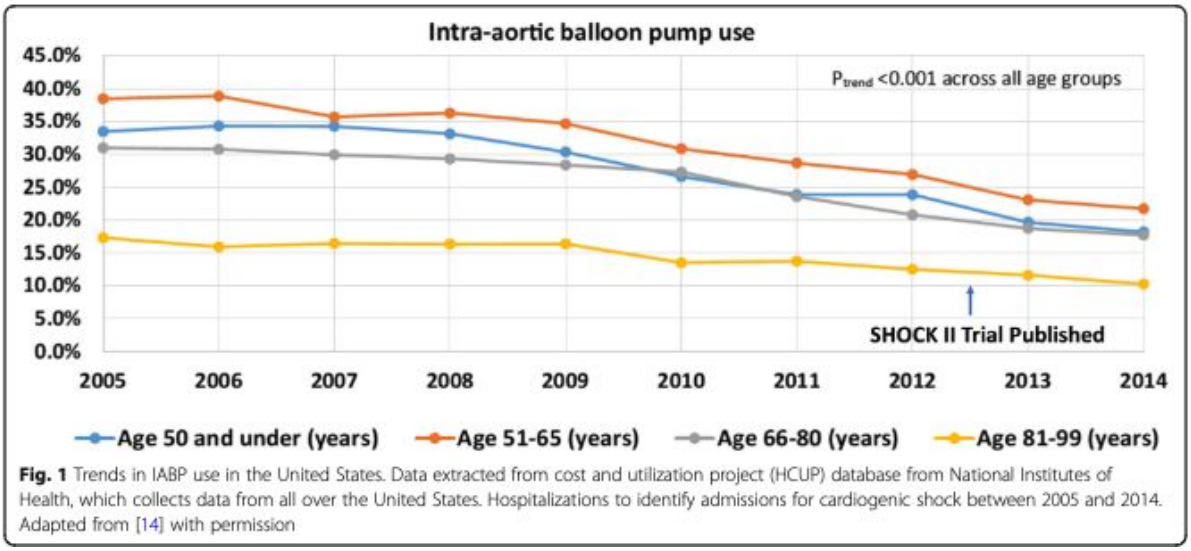

Fig. 1 Trends in IABP use in the United States. Data extracted from cost and utilization project (HCUP) database from National Institutes of Health, which collects data from all over the United States. Hospitalizations to identify admissions for cardiogenic shock between 2005 and 2014. Adapted from [14] with permission

Its relatively affordability and ease of insertion has cemented its position as the first line of treatment for hemodynamic support in cardiogenic shock. Accordingly, the current ACC/AHA recommendations maintain a Class 2A for the use of IABP in shock. However, a review of the current literature suggests that the evidence supporting the American College of Cardiology and American Heart Association (ACC/AHA) guidelines are equivocal. Alternative uses for IABP such as perioperative support during high-risk cardiac surgery, treatment of left ventricular distention on extracorporeal membrane oxygenation, and as a bridge to transplant have been proposed. The effectiveness of the IABP in these clinical situations remains largely unproven, due to the paucity of available data.

however, a recent meta-analysis, for example, included 9212 patients and investigated the utility of the IABP when implanted preoperatively in patients undergoing coronary bypass graft surgery [6]. The results of this analysis strongly indicate that there is benefit in using the IABP under these conditions, with the relative risk reduction of mortality being more than 4%. Furthermore, the risk of MI and renal failure were reduced when IABP treatment was instigated and both intensive care and total hospital stays were reduced, also indicating a possible economic benefit, as well as health benefits, of using the IABP [6].
a recent study by Yang et al. [7], carried out in 416 patients with LV dysfunction undergoing off-pump coronary bypass grafting, showed that a preoperative IABP was linked with a lower 30-day mortality.

Iqbal et al. [8] recently carried out an observational analysis of 174 patients (with 55 patients receiving IABP) successfully resuscitated following an out-of-hospital cardiac arrest. In this study, the use of IABP therapy in the postresuscitation period was associated with improved functional recovery and outcomes, although the mortality rate was not different between the IABP and non-IABP groups.

so there is some interesting data in favour of IABP in select subset of population.

What's your current practice?

We use balloon counterpulsation extensively for pre and postoperative support of patients with a low ejection fraction who undergo coronary artery surgery. In fact, this is the most

common indication for IABP use in our set up. Patients with acute myocardial infarction with cardiogenic shock, also undergo balloon counterpulsation routinely. Our cardiologists generally do not use balloon counterpulsation prior to PCI in patients without cardiogenic shock. We have occasionally used balloon counterpulsation in patients with viral myocarditis and cardiogenic shock, and toxin related myocardial depression (beta blockers and calcium channel blockers). The usefulness of IABP in this situation is uncertain, considering the fact that the problem in this situation and decreased coronary perfusion due to coronary occlusion.

I guess we need to continue this debate on appropriate use of the IABP and needs to involve multiple specialties including cardiologists, intensivists, anesthesiologists and cardiac surgeons. These specialties need to work together to actively contribute to a rigorous and objective data collection/examination/analysis in order to decide which patients will benefit from IABP and which patients won't.