Sir,

Mitral stenosis (MS) is commonly seen in patients after an acute rheumatic fever and is associated with the fusion of the mitral valve leaflets at the level of commissures. If the valve condition is adequate, balloon mitral valvuloplasty (BMV) can serve as a viable alternative to surgical replacement of valve in patients with MS. However, BMV is associated with certain complications as well. Among them, the occurrence of hemopericardium with cardiac tamponade is one of the most serious complications of percutaneous BMV. In most studies, mortality related to BMV ranges between 0% and 3%, and the major causes of death are cardiac tamponade, mitral regurgitation (MR), and deterioration of the patient's general health status.[1] Cardiac tamponade occurs mainly due to hemopericardium caused by transseptal puncture or left ventricular (LV) apex perforation with the guidewire or balloon itself.[2] Usually, the perforations of right atrial appendage are not very severe and majority cases resolve with pericardiocentesis and protamine administration. However, LV lacerations are more severe and may cause immediate hemodynamic compromise, and an emergency cardiac surgery is warranted.[3]

BMV at our center is routinely performed under fluoroscopy guidance. However, in high risk cases with very severe MS having poor ventricular functions or associated comorbidities (including pregnancy), the above-mentioned problems are more anticipated and the additional use of transesophageal echocardiography (TEE) not only reduces the duration of radiation exposure but also helps in early detection of such hemodynamic complications.

We would like to discuss one such case posted for BMV where a patient developed intraoperative cardiac tamponade and she was managed successfully for the same.

A 28-year-old female weighing 45 kg with a diagnosis of rheumatic heart disease with severe MS for 3 years was posted for BMV with anesthesia standby. The patient was found to have a loud first heart sound and a mid-diastolic murmur on examination. Her electrocardiogram showed right axis deviation with an excessive overload of the left atrium and two-dimensional echo showed severe MS with a mitral valve area of 0.6 cm², mild MR, moderate tricuspid regurgitation, and severe pulmonary arterial hypertension with good biventricular function. Her routine blood investigations were within the normal limits. She was receiving tablet furosemide 10 mg, tablet digoxin 0.25 mg, and tablet atenolol 25 mg for her cardiac condition at present.

The patient had a 20G intravenous access before the procedure, and a femoral venous and arterial access was acquired for the procedure. Anxiolysis was done using midazolam 0.5 mg and fentanyl 50 mcg and dexmedetomidine infusion was started. Ensuring oral preparation by lignocaine spray and gargles, TEE probe was inserted and was kept at mid-esophageal level.

During the procedure, the guidewire was inserted via the femoral vein into the inferior vena cava (IVC). Its presence was confirmed by TEE in the left atrium; however, to our surprise, the wire was not traversing through the interatrial septum and was not visible in the right atrium [Figures 1-3]. It was decided to proceed further with the insertion of dilator sheath. At this point of time, the patient developed sudden hemodynamic collapse with drowsiness. Her pulse rate went up to 120 bpm and blood pressure dropped to 60/30 mmHg. TEE showed evidence of cardiac tamponade and collection around the right atrium and right ventricular free wall. Resuscitation in the catheterization laboratory was done and a 7 Fr catheter was secured in the right internal jugular vein. The patient was intubated after induction with 0.2 mg/kg of etomidate. A pigtail catheter was inserted into the pericardium by cardiologists and auto perfusion of collected blood was done to maintain preload and reduce the tamponade. The patient was also started on inotropic support with dopamine at 8 U/kg and adrenaline at 0.6 U/kg. The patient was shifted to the operation theater with inotropic support and continued autohemoperfusion.

During the surgery, the patient was found to have 500 ml of blood in the pericardium and a rent in the IVC was found with guidewire coming out of it and re-entering the left atrium bypassing the right atrium and interatrial septum [Figure 4]. The primary closure of the rent was done and the mitral valve was replaced on cardiopulmonary bypass. The patient was shifted to the intensive care unit for elective ventilation on tapered doses of inotropes. She has gradually weaned off inotropes and ventilatory support over 2 days after adequate correction of hemoglobin and coagulation status and was extubated on day 2 postoperatively and discharged subsequently.

BMV involves an Inoue balloon introduced across the mitral valve via the transseptal or retrograde route. Fracture of the valve leaflets at the commissures is done by inflation of the balloon and this improves leaflet excursion and orifice area. To reach the mitral valve, the femoral vein is punctured and the guidewire is inserted through it. This guidewire travels through the IVC, enters the right atrium and after transseptal puncture reaches the left atrium. Cardiac tamponade due to perforation could be by this guidewire, dilator, or the septal puncture needle. Cardiac tamponade should always be suspected when...
there are still cardiac silhouette, hypotension, and elevated right atrial pressures. However, these signs can be unreliable and nonconfirmatory at times. The final confirmation can be done by TEE without wasting any additional time as well.

In this very rare complication of BMV, most of these patients require surgical repair and hence general anesthesia because only partial hemodynamic stabilization can be achieved by pericardiocentesis by a pigtail catheter and autohemoperfusion. The success of repair can be adequately confirmed using TEE immediately after the surgery as well which again advocates the importance of TEE use in such procedures.

The anesthetic considerations for such a complication as we know include:
- Prompt recognition of the complication
- Maintaining preload and afterload
- Avoidance of drug-induced myocardial depression
- Avoiding cerebral hypoxia and residual neurological deficits
- Maintaining body temperature in bleeding patients with poor cardiac reserve.

It is important to note that TEE is helpful in most of the above-mentioned anesthetic considerations. Transthoracic echo is used commonly as a noninvasive method of evaluation in such procedures; however, continuous assessment cannot be used as the hand of the operator might obstruct the fluoroscopic view. Moreover, crucial few minutes could be lost by the time transthoracic evaluation is done in a hemodynamically unstable patient. For the purpose of prompt recognition of complications, TEE serves an important role as it not only diagnoses the condition such as tamponade but it also helps us to see the response to the interventions done subsequently like pericardiocentesis and primary repair of rent. In our case, TEE was quick to detect the collection of blood in the pericardial space and assisted in the insertion of the pericardial drain as well. The drainage of collected blood was guided using TEE and this blood was autotransfused back to the patient avoiding blood loss as much as possible and maintaining the preload adequately.

Thus, by the example of our case, we would like to advocate its use not only in cardiac surgery operation theatres but also in

Figure 1: Midesophageal four-chamber view showing collection in pericardial space (labeled A) compressing the right atrium

Figure 2: Midesophageal bicaval view showing wire in the left atrium (labeled A). We can also see that interatrial septum is pushed toward the right atrium (labeled B) due to elevated left atrial pressure

Figure 3: Transgastric midpapillary view showing massive pericardial collection (labeled A) anteriorly compressing the right ventricle

Figure 4: Rent at the junction of the inferior vena cava and right atrium (labeled A) found intraoperatively after going on cardiopulmonary bypass
the catheterization laboratory and hybrid theaters for high-risk cardiology procedures as well.

Declaration of patient consent
The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) have/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

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Received: 12-Dec-2019 Revised: 16-Jan-2020
Accepted: 01-Feb-2020 Published: 16-Mar-2020

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How to cite this article: Gargava A, Surendhar S, Umbarkar S, Upadhyay R. Transesophageal echo: The time-saver in complications of balloon mitral valvuloplasty. Bali J Anaesthesiol 2020;4:29-31.