Supplement 1 – Clinical Cases

Airway US

CASE 1

A 59-year-old male with PMH of obesity, OSA, status post cervical fusion from C3-6, and lumbar T10 to L5 fusion is scheduled to undergo a total hip arthroplasty revision. His neck circumference is 20 inches. He reports that last time he had surgery, they "had to wake me up as they could not get the tube in."

Indication

This patient is high-risk for a difficult airway and/or failed intubation. An ultrasound of the airway allows for assessment and localization of the cricothyroid membrane in preparation for a cannot ventilate, cannot intubate scenario.

Acquisition

The first step is the identification of the tracheal rings with a linear probe in a transverse plane. As you scan cephalad, you identify the thicker, more anterior, and dome-shaped cricoid cartilage before arriving at the triangular thyroid cartilage. Once you have found the thyroid cartilage, you slide caudad into the space to mark the location of the cricothyroid membrane (CTM) in the transverse plane (also known as the “air gap”). Having identified the CTM in the transverse plane, you rotate the probe ninety degrees into the longitudinal plane to mark the midline. Correct midline position is marked by identification of the "string of pearls" consisting of the larger tracheal cartilage, thicker and more anterior cricoid, as well as the slightly thinner and deeper tracheal rings.

Interpretation

Identifying the cricothyroid membrane in both the transverse and longitudinal planes allows for more precise and expeditious localization of the CTM in a difficult airway scenario, particularly in obese patients. **(Supplement 2 - Figure 1)** It is crucial to identify the CTM in both planes to ensure both the correct level and precise true midline.

Medical management

You topicalize the patient's airway with an atomizer to anesthetize the glossopharyngeal nerve, perform an ultrasound-guided superior laryngeal block, and perform a transtracheal recurrent laryngeal nerve block. This topicalization is followed by an uneventful awake fiberoptic intubation with an otolaryngologist on standby in the room to perform a cricothyrotomy if needed.

CASE 2

You are performing a general anesthetic for a total shoulder arthroplasty in an ASA3 patient with moderate CHF and COPD. Upon laryngoscopy, you unexpectedly encounter a grade three Cormack-Lahane view and pass the endotracheal tube down what you believe to be the trachea. The CO2 analyzer is calibrating, breath sounds are minimal, and the misting of the endotracheal tube is minimal.

Indication

Airway ultrasound is highly useful in situations where confirmation by conventional means is not possible, equivocal, or whenever real-time assessment of the correct endotracheal position (non-esophageal and non-endobronchial) is needed.

Acquisition

The image is obtained supine with the ultrasound probe placed left of the midline in a transverse plane. This view allows for real-time visualization of endotracheal or esophageal intubation and the application of paratracheal pressure to decrease or prevent the risk of aspiration on induction. Typically, a linear probe is used with depth settings of about 4-6 cm. With an additional step, endobronchial intubation can be ruled out by visualization of bilaterally pleural sliding in the midclavicular line between the 2nd and 4th intercostal space. If there is endobronchial intubation, then lung sliding will only be seen on one side (typically the right side), while endotracheal intubation will show bilateral lung sliding.

Interpretation

In the above scenario, the suspicion for esophageal intubation is high. Ultrasound imaging demonstrates the double trachea sign confirming the suspicion.

Medical management

Once esophageal intubation is confirmed, the endotracheal tube is removed, and an alternative means of intubation is performed with video laryngoscopy.

Lung US

CASE 1

A celiac plexus block was performed in a patient with severe abdominal pain secondary to terminal pancreatic carcinoma. The procedure was completed uneventfully but on arrival in the post anesthetic care unit (PACU), the patient became short of breath and showed signs of increased work of breathing. Initial supportive measures included increasing the FIO_2, elevating the head of bed and frequent vital signs monitoring. After gathering relevant clinical information and reviewing the anesthetic record, it was decided to perform a LUS.

Indication

This patient has developed acute respiratory distress in the PACU. There are several differential diagnoses that LUS can help to rule-in or rule-out including pneumothorax, pleural or abdominal collections, lung consolidation/atelectasis, and pulmonary edema. In addition, LUS can guide the treatment and evaluate patient response.

Acquisition

With the patient lying supine, a high frequency linear probe (8-12 MHz) is placed on the anterior chest over the 2 intercostal space and moved slowly towards the posterior chest. Confirmation of sliding pleura, seashore sign (M mode), B lines (normal if located predominantly in the posterior thorax and maximum of three), lung pulse (B and M mode) would rule out pneumothorax in the assessed area. The presence of barcode sign (M-mode) or the discovery of a lung point on 2D highly suggests pneumothorax.

The probe should be placed on the anterior chest wall in a cephalad-caudal orientation to allow visualization of at least two ribs with the pleural line in between. This minimizes the risk of mistaking the rib border for a non-moving pleural line. The pleural line should be visualized at multiple interspaces (2nd to 4th) and from medial to lateral in the least dependent zone of the thorax. Comparison with findings on the contralateral side may facilitate interpretation.

In a supine patient with suspected pneumothorax (absence of lung sliding, pulse, and vertical artifacts on one side of the image), the lung point is identified by rotating the probe transversely over an intercostal space and sliding laterally and posteriorly. A lung point can be visualized in a non-complete pneumothorax when the beam insonates the transition between the intra-pleural air and expanded lung adhering to the parietal pleura without interposed air.

Interpretation

Lung sliding, lung pulse, and vertical artifacts (B and Z lines) are all absent over the anterior right hemithorax. Barcode sign and lung point are seen on the anterior right hemithorax. Using the clinical history and the above sonographic findings, the diagnosis of a right pneumothorax is made.

It is worthy to mention that the absence of sliding pleura doesn't confirm the diagnosis of pneumothorax as there are other lung conditions when the visceral pleura doesn't slide against the parietal pleura (e.g., apnea, pleurodesis, inflammatory adherence, over-inflation, severe bullous disease and endobronchial intubation).

Medical management.

Supportive measurements are continued while a right pigtail catheter is inserted for drainage.

CASE 2

A left sided interscalene brachial plexus block was performed in a patient undergoing arthroscopic shoulder surgery. Patient has a history of atrial fibrillation, past CHF and CAD. Patient also underwent general anesthesia without incident. Upon arrival to PACU, the patient was found to low O_2 saturation down to low 80s.

You started appropriate initial supportive measurements (increasing FIO_2, bag mask ventilation), gather relevant clinical information, review the anesthetic record and ordered blood work.

Indication

This patient has developed acute respiratory failure. There are several differential diagnoses that LUS can help to rule-in or rule-out including pneumothorax, pleural collections, diaphragmatic dysfunction, and pulmonary edema. In addition, LUS can guide the treatment and evaluate patient response.

Acquisition

With the patient in the supine position, a high frequency linear probe (8-12 MHz) is placed on the anterior chest and moved slowly towards the posterior chest. Attention is focused on the sliding pleura and the presence of vertical artifacts to rule out pneumothorax. Then over the mid axillary line at the 8^{th} – 9^{th} intercostal space, the diaphragm is accessed to evaluate the change in thickness during end inspiration and end expiration.

Alternatively, a low frequency curvilinear probe (2-5 MHz) can be placed between the midclavicular and anterior axillary lines in the subcostal region (right side) or between the mid and posterior axillary line (left side) to access excursion of the diaphragmatic dome. M-mode can be used to quantify the diaphragmatic excursion during quiet respiration (resting tidal volume), deep inspiration and sniffing.

Interpretation

Lung sliding and lung pulse are present bilaterally, scarce B-lines are seen only on the posterior hemithorax and there are no pleural effusions. B and M-modes reveal paradoxical upward motion of the left hemidiaphram during inspiration. There is less than 12% change in left diaphragmatic thickness between end inspiration and end expiration. Together with the clinical history and these sonographic findings, the diagnosis of unilateral diaphragmatic paresis is made.

Medical Management

Supportive measurements are continued and non-invasive mechanical ventilation is started. After a few hours, a follow up LUS exam shows no evidence of left hemidiaphram paradoxical movement, excursion is more than 2 cm and the change in left diaphragmatic thickness is more than 25%, confirming resolution of left hemi diaphragmatic paresis. **(Supplement 2 - Figure 2)**

CASE 3

A right supraclavicular brachial plexus catheter was placed in a patient undergoing extensive elbow reconstruction. Patient was involved in a high speed car accident 24h ago. During the procedure the patient had an incomplete block, necessitating small doses of opioids, ketamine and field infiltration. Upon completion of surgery, the patient was transferred to the PACU where he started to develop tachypnea, hypotension (BP 85/50) and decreased LOC.

Appropriate initial supportive measurements were initiated including placing a non-rebreathing mask, crystalloid bolus and phenylephrine to maintain SBP > 90 mmHg. After gathering relevant clinical information and reviewing the anesthetic record it was decided to perform a LUS.

Indication

This patient is in decompensated shock. LUS can help to rule-out life threatening pathologies including pneumothorax, pleural or abdominal collections, lung contusion/atelectasis, and diaphragmatic paresis. In addition, LUS can guide the treatment and evaluate patient response to medical interventions.

Acquisition

With the patient in the supine position, a high frequency linear probe (8-12 MHz) is placed on the anterior chest over the 2 intercostal space and moved slowly towards the posterior chest. Presence of sliding pleural, lung pulse or vertical artifacts is evaluated. Then a low frequency curvilinear probe (2-5 MHz) is placed between the midclavicular and anterior axillary line on the right side and between the mid and posterior axillary line on the left side to access diaphragmatic excursion and thickening.

Finally, a low frequency curvilinear probe is placed in a cephalad-caudal orientation between the 8 -10 intercostal spaces in the mid-axillary line. The probe is rotated slightly counterclockwise and directed posteriorly towards the vertebral column to ensure visualization of the most dependent portion of the pleural space. The image should display lung artifacts and diaphragm to the left with the liver/spleen and the vertebral column, and potentially the kidney to the right. Visualization of the spine and kidney provides confirmation that the beam is interrogating the most dependent region of the thoracic cavity.

Interpretation

Lung sliding and lung pulse are present bilaterally, scarce B-lines are seeing only on the posterior hemithorax. Diaphragmatic dome excursion is reduced on the right side. An anechoic collection above the right diaphragm is visualized. This collection is occupying 2/3 of the right hemithorax causing collapse of the ipsilateral lung. **(Supplement 2 - Figure 3)** Using the clinical history and the above sonographic findings, the diagnosis of a right hemothorax is made.

Medical Management

Crystalloid and blood transfusion were started. A right chest tube is inserted for drainage of hemothorax.

Gastric US

CASE 1

A 46-year-old man with type 2 diabetes mellitus presents for an open fixation of a fifth metacarpal fracture under brachial plexus blockade and intravenous sedation. The patient had a cup of tea with milk and biscuits six hours ago.

Indication

This patient carries a risk of delayed gastric emptying due to his co-morbid status (diabetes), as well as a recent injury. Delayed gastric emptying may increase the risk of pulmonary aspiration following induction of general anesthesia or deep sedation despite adhering to fasting guidelines. Point-of-care gastric ultrasound is indicated in this case to determine the risk of pulmonary aspiration with intravenous sedation.

Acquisition

The patient is placed in the right lateral decubitus position and a low-frequency, curved array ultrasound transducer is used to scan the epigastrium. After sweeping from left to right, you find the key sonographic landmarks at the level of the aorta demonstrating the gastric antrum posteriorly to the left lobe of the liver.

Interpretation

The gastric antrum is small, with a thick muscularis propria layer. There is minimal fluid in the antrum, consistent with a Grade 0 antrum and an empty stomach **(Supplement 2 – Video 1**).

Medical Decision-Making

In the clinical context of an elective procedure with the history and time-interval since last ingestion of food and fluids, and an adequate image acquired, you determine that it is safe to proceed with the anesthetic plan of a regional anesthetic and intravenous sedation.

CASE 2

A 71-year-old woman with a history of severe aortic stenosis with left ventricular diastolic dysfunction and preserved systolic function presents for an open reduction and internal fixation of a fractured neck of femur in the supine position. She is confused, has received intravenous opioids for analgesia and believes she has not eaten for more than six hours. You plan to perform a femoral nerve block for analgesia and a general anesthetic. You would like to proceed with a slowly titrated induction of anesthesia with tight hemodynamic control and a supra-glottic airway device.

Indication

There is a potential conflict in anesthetic goals between her cardiac condition which would dictate a slowly titrated induction of general anesthesia and could include management with a supra-glottic airway device versus the possibility of a “full stomach” which would require a rapid sequence induction of anesthesia and endotracheal intubation. This patient carries a risk of delayed gastric emptying due to pain and the use of opioid analgesia. The patient is also confused, and you cannot be certain about her fasting status. To determine the risk of pulmonary aspiration and guide you to choose the safest anesthetic technique, you perform point-of-care gastric ultrasound.

Acquisition

After performing a femoral nerve block, you place the patient in the semi-recumbent position and use a low-frequency, curved array ultrasound transducer in the exposed epigastrium. After sweeping from left to right, you find the key sonographic landmarks at the level of the aorta demonstrating the gastric antrum posterior to the left lobe of the liver.

Interpretation

The gastric antrum is distended, with a thin muscularis propria layer. There is active peristalsis noted and both anechoic (fluid) and hyperechoic (solid) content within the antrum, consistent with a full stomach (**Supplement 2 – Video 2**).

Medical Decision-Making

In the clinical context of an urgent procedure with the history and sonographic findings (adequate image acquired), you determine that the safest option is to proceed with a general anesthetic using a modified rapid sequence induction technique and endotracheal intubation. You also decide to place an arterial line prior to induction to best monitor her hemodynamic state and quickly respond to possible changes.

Focused Assessment with Sonography for Trauma (FAST)

CASE 1

A 22-year-old otherwise healthy female is scheduled for R total hip arthroscopy. Induction of anesthesia is uneventful, and a 4cc 1.5 mepivacaine spinal is placed. Sedation is maintained with propofol, and the surgery is uncomplicated. Near the end of the operation, the patient becomes restless; blood pressure is 78/40, and the propofol is discontinued. A fluid bolus is initiated, and 10mg ephedrine is given.

The procedure is quickly finished, and over the next five minutes, she begins to complain of severe diffuse abdominal pain, and the blood pressure remains borderline low. Based on her presentation, a decision is made to perform a FAST exam.

Indication

This patient has severe abdominal pain and hypotension at the end of a surgical procedure. A FAST exam can be used to identify and/or narrow the differential diagnosis, which includes hematoma formation versus fluid extravasation. The FAST exam can also be used to get a general view of the pericardium to evaluate for pericardial effusion.

Acquisition

A diagnosis can be made from the right upper quadrant and pelvic views. In general, a large curvilinear abdominal probe with low frequency is preferred, but a cardiac probe can be used as well. The patient should be positioned supine. To obtain the right upper quadrant view, the transducer should be placed at the mid-axillary line at around the 10th or 11th rib. The orientation marker should be faced towards the patient's head. If only the liver is seen, slide the probe caudad until the kidney is seen. If only the kidney is seen then the probe should be slide cephalad until the liver is seen. The ideal view reveals both the liver and the kidney, and the space between them is known as the hepatorenal space or Morrison's pouch. Usually, the liver and kidney are right next to each other, and the hepatorenal space is more of a potential space that appears hyperechoic.

The pelvic views are obtained with the curvilinear probe as well; note that urine in the bladder makes evaluation of the pelvis much easier. To obtain views of the pelvis, the probe should be placed midline superior to the pubic symphysis with the orientation marker facing the patient's right. If the bladder is not seen it can become visible by aiming the probe towards the patient's feet, but this assumes that the bladder has urine. Once the bladder is identified, sweep caudad and cephalad to view the structure of the pelvis. Rotating the probe ninety degrees counterclockwise so that it faces the patient's head will give a cross-sectional view. In general, in males, free fluid tends to pool just below the bladder between the bladder and prostate.
In females, however, fluid often can collect posterior to the uterus initially but given more volume will expand to the space between the bladder and the uterus.

Interpretation

The right upper quadrant view reveals significant fluid building in the hepatorenal space. In the pelvis views, there is a considerable amount of fluid with multiple pouches between the bladder and the uterus. Based on these findings, a diagnosis of intraabdominal fluid extravasation is made.

Medical Management

Supportive care is initiated; the patient is started on a phenylephrine infusion to maintain blood pressure, and the patient is started on an IV PCA and admitted for overnight observation. The phenylephrine is weaned over the next three hours. The patient is discharged home the following day, and the rest of her post-operative course is uneventful.

CASE 2

A 54-year-old male with a past medical history of chronic pancreatitis is scheduled for a neurolytic celiac plexus block. Following an uncomplicated procedure, the patient transferred to the PACU. In the PACU, he begins to complain about Left greater than right-sided abdominal pain. Over the next 10 minutes, the patient becomes hypotensive with a blood pressure of 79/42. You are called to the bedside, and following standard resuscitative measures decide to perform a FAST exam.

Indication

This patient has hypotension and abdominal pain following an invasive procedure. A FAST exam will help to elucidate new pathology such as hematoma versus chronic pathology such as ascites. In addition, it can be further used to guide care. The patient is complaining of left-sided abdominal pain, and so the initial focus should be in the left upper quadrant views.

Acquisition

A large curvilinear abdominal probe with low frequency is preferred, with the patient in the supine position. Note that if there is a concern for hematoma, placing the patient in the Trendelenburg position can assist in allowing fluid to pool in the right upper and left upper quadrant (RUQ and LUQ) views. Likewise, if there is a concern for fluid in the pelvis, the patient can be placed into reverse Trendelenburg, but keep in mind that this may exacerbate hypotension.

To obtain the LUQ view, note that the spleen is a little more posterior and superior to the liver. Thus, the transducer should be placed in the posterior axillary line around the eighth rib. The orientation marker should be pointing towards the patient's head. Finding the correct landmarks can be more challenging than the RUQ view. In the optimal situation, one can visualize both the kidney and the spleen. If only the kidney is seen, slide the probe more cephalad until the spleen is seen. If nothing can be seen, consider sliding the probe even more posteriorly.

Once the spleen and kidney are located, fanning the probe in multiple directions can help to examine the area thoroughly. As with the RUQ, the interface between the kidney and the spleen appear hyperechoic. Cephalad to the spleen, the diaphragm will appear as a thick hyperechoic line.

Note that unlike the RUQ view where the fluid is predominantly in the hepatorenal recess, in the LUQ view, fluid is most likely to be found between the spleen and the diaphragm (subphrenic space). However, fluid can still appear in the splenorenal recess as well.

Interpretation

A sizeable hypoechoic fluid collection is found in the subphrenic space. Oher views revealed fluid in multiple views. Given the new-onset on hypotension and severe abdominal pain, a diagnosis of hemorrhage was made.

Medical management

Aggressive resuscitation measures were initiated, including the placement of large-bore IVs and activation of the massive transfusion protocol. The patient was transferred to the OR for abdominal exploration, and a large liver laceration was identified and repaired. Serial FAST exams were performed in the post-op period showing no further evidence of significant hemorrhage.

Focused Cardiac Ultrasound (FoCUS)

CASE 1

A previously healthy 40-year-old woman is scheduled for a cervical plexus block for treatment of somatic pain referred to the mandible. An uneventful block is performed with 5cc of 0.5% Bupivacaine (25mg total). Approximately 20 minutes later, in the post-anesthetic care unit, the patient becomes short of breath and hypotensive, with a noninvasive blood pressure of 74/40.

Initial supportive measures include applying a face mask and increasing the FO2, placing the patient in Trendelenburg, and giving a 500cc lactated Ringer's bolus. After a quick chart review is performed, a focused cardiac ultrasound exam is conducted, including a parasternal short-axis view is obtained.

Indication

The patient has developed respiratory distress and hypotension in the PACU. A focused cardiac exam can be used in this situation to help narrow the differential and potentially identify etiologies such as hypovolemia, right ventricular failure, pericardial effusions, and cardiac tamponade. Moreover, we can use the exam to help guide and optimize further treatment.

Acquisition

Ideally, the patient should be lying in the left lateral decubitus position, but in emergent situations, adequate views can be obtained with the patient in the supine position. A cardiac probe (phased array) is used and is initially placed between the third and fourth intercostal space immediately left of the sternum. The orientation marker should be facing towards the left shoulder. Slide the probe back and forth between the intercostal spaces and towards/away from the sternum until the optimal scanning window is obtained.

To evaluate the cardiac chambers, the depth should be adjusted to include the entire heart as well as the pericardium. The subcostal view requires the most depth, and the depth should be decreased when scanning the more shallow apical and parasternal views.

In this view, the myocardium of then ventricles will typically appear as a hyperechoic (light or grey circular shape), while the blood within the ventricular chamber will be hypoechoic (dark). Look for a hypoechoic area outside of the ventricular wall, as this may be indicative of pericardial effusion. The right ventricle can also be seen, and one should take note of its size. At the basal level, the mitral valve will appear in a cross-sectional view. The ventricular walls can be examined from this point, and special attention should be given to the septal wall to evaluate for the right ventricular pressure and volume overload. This will be seen as a septal wall flattening in systole, diastole, or both. In addition, the ventricular walls can be examined for symmetrical movement and thickening.

From the basal level, the tail of the probe can be tilted toward the right shoulder to further evaluate the ventricular walls. In the mid-papillary short axis view of the heart, the papillary muscles will appear and decreased preload would appear as a kissing papillary sign. This view is ideal for qualitatively estimating left ventricular systolic function (normal, mildly reduced, moderately reduced, severely reduced). Tilting the tail further up will present the apical segments of the heart where one can continue to look for specific wall motion abnormalities.

Rotating the probe counterclockwise with the orientation marker towards the right shoulder will allow one to obtain the parasternal long-axis views. These views can be useful to help narrow down the differential diagnosis or further rule out other cardiac abnormalities.

Interpretation

The parasternal short axis, long axis and apical views reveals severely reduced global left ventricular systolic function without any evidence of specific wall motion abnormalities. (**Supplement 2 – Video 3-5)** Given the recent procedure, a diagnosis of bupivacaine-induced local anesthetic toxicity with subsequent severe myocardial depression is made.

Medical management

The patient was transferred to the cardiac critical care unit, and hemodynamics were aggressively managed. By post-op day three, the patient's symptoms had improved significantly. And repeated bedside cardiac exam revealed grossly normal left ventricular function.

CASE 2

A 62 yo male with a history of hypertension and diabetes is scheduled for a total knee replacement. Surgical anesthesia is achieved with a 4cc 1.5% mepivacaine spinal. A propofol infusion is started at 25mcg/kg/min. Fifteen minutes after placement of the spinal blood pressure is 68/35, and the heart rate is 84. The patient is given a 10mg ephedrine bolus with nominal improvement. In order to elucidate the cause of hypotension, a decision is made to perform a focused cardiac ultrasound exam.

Indication

The patient has developed an acute onset of hypotension following the induction of anesthesia. The differential diagnosis is broad includes ischemia versus infarction, pulmonary embolism, and hypovolemia. After narrowing the diagnosis, we can use FoCUS to both guide treatment and evaluate for appropriate patient response.

Acquisition

Evidence can be obtained from the subcostal IVC and the parasternal long-axis views. To obtain the subcostal view, a cardiac probe is placed approximately 2cm below the xiphoid process with the patient in the supine position. A view of the heart should be seen below the liver margin at a depth of 16-20cm. A traditional subcostal view can be obtained with the orientation marker directed towards the left; however, to obtain the IVC long axis view, the orientation marker should be rotated ninety degrees counterclockwise so that it faces up towards the head. At this point, one should see the IVC, but make sure that the IVC is coming into the right atrium as it may be confused with the descending aorta, which runs below. Measurement of the IVC is typically done 2 cm inferior to the junction of the IC and the right atrium.

For the parasternal long-axis view, the patient should be placed in the left lateral decubitus position if possible to avoid lung artifact and put the heart closer to the probe. However, in an emergent situation, this may not be possible, and one can often obtain adequate imaging in the supine position. A cardiac probe and is placed between the third and fourth intercostal space immediately left of the sternum. The orientation marker should be facing towards the right shoulder. From there, slide the probe back and forth between the intercostal spaces and towards/away from the sternum until the optimal scanning window is obtained. As with the PSAX view, to evaluate cardiac chambers, the depth should be between 12-16cm.

In this view, the left ventricle will typically appear as a hyperechoic(light or grey circular shape, while the chambers will be hypoechoic(dark). Posteriorly the descending aorta can be seen in the cross-sectional view. Anterior to this is the left atrium and AV junction. The left ventricular outflow tract, including the aortic valve, are seen, and the right ventricle is seen closest to the probe.

In this view, the apex of the left ventricle should not be visualized; this indicated that the probe is too far out from the sternum, and it should be slide back to near the sternum.

Interpretation

In the subcostal IVC view, the IVC walls are found to be touching(kissing wall sign) during the respiratory cycle. (**Supplement 2 – Video 6)** In spontaneously ventilating patients, IVC collapse of greater than 50% is highly suggestive of low RA pressure. In the parasternal long-axis view, the patient is found to have grossly normal contractility, but the heart appears empty in diastole consistent with decreased preload and hypovolemia.

Medical management

The patient was given a bolus of 1000cc of lactated ringers and later 500cc 5% albumin. An arterial line was placed, and a temporary infusion of phenylephrine was initiated. Following the albumin bolus, the patient's blood pressure improved to 107/68, and the phenylephrine infusion was stopped. The patient had no further issues during the perioperative course.