



Principles of Anesthetic Management in patients with Congenital Kyphoscoliosis undergoing Laparotomy

KEYWORDS

Anesthetic management, Congenital kyphoscoliosis, Laparotomy.

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ABSTRACT Kyphoscoliosis refers to lateral and posterior curvature of the spine due to which vertebrae are rotated and rib cage is deformed. This results in lack of normal flexibility of the spine. Kyphoscoliosis and the resultant deformity leads to significant decrease in Total Lung Volume (left>right), Vital Capacity, and Forced Expiratory Volume in 1st second (FEV1). There is permanent damage to lung parenchyma, increased pulmonary vascular resistance, and pulmonary hypertension. This ultimately leads to right ventricular failure. Kyphoscoliosis presents a challenge for anaesthetic management as the curvature of the spine and the resultant pulmonary changes pose a difficulty.

We present a case of young male suffering from congenital kyphoscoliosis with superior mesenteric artery occlusion causing bowel gangrene; that was posted for exploratory laparotomy. Resection and anastomosis of the intestine was done. Preoperative assessment of kyphoscoliosis and anesthetic management of the patient are discussed.

Introduction:-

Kyphoscoliosis is a disorder characterized by progressive deformity of spine consisting of lateral and posterior curvature of spine. In the majority (80% of cases), it is idiopathic in origin. Other causes of kyphoscoliosis are: congenital causes, secondary changes related to neuropathic and myopathic changes, and degenerative spondylosis. (1, 2, 3)

The deformity in the spine and the resultant thoracic deformity lead to pulmonary abnormalities. These pulmonary changes cause the restrictive pattern on pulmonary function tests, and leads to progressive hypoventilation, hypercapnia and cor pulmonale.(4) Patients with kyphoscoliosis who present with surgical problems, especially if a laparotomy is needed, pose a challenge for their anaesthetic management. Use of neuro-axial blockade (regional anesthesia) in patient with kyphoscoliosis, though controversial is the preferred mode. (5)

We have discussed the anaesthetic management of a young male with uncorrected congenital kyphoscoliosis with superior mesenteric artery occlusion, which lead to intestinal gangrene. He was posted for exploratory laparotomy and resection & anastomosis of the bowel was done.

CASE REPORT:-

A 27 year old male patient was admitted with complaints of pain in abdomen, nausea and vomiting for 3-4 hours. There was no history of fever or loose motions. He had structural deformity of thoracic and lumbar spine region, chest wall and back since childhood. On examination, he had bradycardia [pulse rate (PR) -60/min], while blood pressure (BP) was on the higher side (190/100 mm of Hg). Extremities were cold and clammy. There was tenderness in the left hypochondriac region, with minimal guarding and rigidity. On auscultation, the heart sounds were normal and air entry was decreased at the right lung base. The patient received antibiotics, antiemetic, antacids and intravenous fluids.

After 12 hours, the patient developed syncope associated with sweating. The blood pressure was low and the pulse was feeble. These responded to a fluid challenge. Emergency

ultrasonography of the abdomen was done which showed free fluid in the peritoneal cavity. Four quadrant abdominal tapping was done which revealed hemorrhagic aspirate. A provisional diagnosis of acute hemorrhagic pancreatitis or mesenteric vascular thrombosis was made. It was decided to perform an exploratory laparotomy. The patient was prepared by insertion of Ryle's tube, Foley's catheterization and a central venous catheter.

The pre-operative blood investigation showed mild anemia (hemoglobin of 10 gm%) with leucocytosis (TLC-29,700 /cumm) with a differential count of 85% neutrophils and thrombocytosis (platelets- 6,82,000 /cumm). There was hypocalcaemia and the serum amylase was elevated (66 IU/ml). The peritoneal fluid amylase was 334 IU/ml.

2D ECHO revealed mild pulmonary hypertension (Pulmonary artery pressure-50 mm of Hg). The chest roentgenogram showed kyphoscoliosis with multiple rib abnormalities with upper rib fusion. Pulmonary function test was not possible as the patient was bed ridden and in severe pain.

In the operation theatre, the patient had tachycardia (PR-124/min), the BP was normal (130/70mmHg). There was hypoxia on room air (Spo2-88%) which was corrected by oxygen therapy (SpO2 98% with venturi mask@ 6 lit/min). ASA Grade IV consent was taken.

It was decided to give epidural anesthesia with 2% lignocaine plus adrenaline (2ml test dose followed by 8ml) at the L2-L3 space (most convex portion of the scoliosis). This was supplemented with bupivacaine 0.5 % (20 cc in incremental doses) and fentanyl (100 micro- grams). Analgesia up to T4 level achieved. Patient was hemodynamically stable intraoperatively and postoperatively. Hemicolectomy with one stage jejunocolic anastomosis was done. Post-operative analgesia was given (ropivacaine 0.2% and fentanyl) through the epidural catheter for 48 hrs.

DISCUSSION-

"Congenital kyphoscoliosis is a rare disease, which occurs in infantile, juvenile, and adolescent forms.(6) Impaired growth

of the lungs early in their development due to the thoracic deformity causes a decrease in lung volumes and a restrictive pattern on the pulmonary function tests. Arterial desaturation and V/Q mismatching due to decreased diffusion capacity and alveolar hypoventilation is the hallmark of congenital kyphoscoliosis. Patient may have increased pulmonary vascular resistance and pulmonary hypertension."(7, 8, 9)

Kyphoscoliosis is characterized by the following pulmonary changes :(10)

- 1) Impaired growth of the lungs early in their development due to the thoracic deformity causing a decrease in the lung volume,
- 2) Alveolar hypoventilation,
- 3) Reduced diffusion capacity,
- 4) Reduced chest wall compliance, and
- 5) Increased pulmonary vascular resistance and pulmonary arterial hypertension (PAH).

PAH is due to the following causes:

- a) increased resistance to blood flow in small pulmonary vessels,
- b) intrinsic pulmonary parenchymal disorder,
- c) chronic hypoxemia,
- d) Reduction in the pulmonary vascular bed by the thoracic deformity.

Congenital scoliosis is a result of congenital anomalies such as hemi vertebrae & fused vertebrae or fused ribs. Neurofibromatosis or Marfan's syndrome are also associated with scoliosis. These underlying conditions may have a major impact on anesthetic plan.

The most common measure of severity of kyphoscoliosis is the Cobb's angle. (11) The greater the Cobb's angle the more profound the pulmonary changes due to the scoliosis. If this angle is greater than 40 degrees, the cardiopulmonary function frequently decreases and if the angle is larger than 100 degrees, it significantly decreases. (12, 13) Weinstein and colleague reported that a Cobbs' angle more than 60° results in progressive pulmonary & cardiac failure. (14)

The severity of the scoliosis and the impairment of pulmonary function increases with the i) number of vertebrae involved, ii) more cephalad location of the curve, and iii) loss of the normal thoracic kyphosis. Severe curves have worst prognosis because they tend to progress & if long standing can cause permanent damage to lung parenchyma, respiratory failure, cor pulmonale and death. (6, 11, 14, 15, 16)

Pulmonary function tests show a decrease in lung volume, and a restrictive pattern with greatest reduction in vital capacity up to 60-80%. Total lung capacity, functional residual capacity, inspiratory capacity, & expiratory reserve volume are also decreased. During exercise or stress, ventilation is usually adequate but tidal volume is decreased and respiratory rate is increased. Inspiratory force is decreased to 70% of normal because the inspiratory muscles work at a mechanical disadvantage resulting from chest wall deformity. (7,8,9,14,15)

Vital capacity is decreased following abdominal surgery presumably because of pain induced- limitation of respiratory excursion. Epidural anesthesia in post operative period has been shown to attenuate this & to permit nearly undisturbed respiratory function. (17) In a patient with kyphoscoliosis undergoing surgery, either general anaesthesia or regional anaesthesia (spinal/ epidural/ spinal+epidural) may be utilized.

General anesthesia: (18)

Indications: i) Patient preference

- ii) Cardiopulmonary disease (18)
- iii) Technical difficulties related to regional block.

Disadvantages:

- i) Does not provide post operative pain relief.
- ii) Respiratory depressant effect of the general anaesthetic drugs causes alveolar hypoventilation leading to acidosis, hypercarbia, and hypoxia and eventually may lead to increase in pulmonary arterial pressure leading to right heart failure.
- iii) Positive pressure ventilation reduces venous return & along with the negative inotropic effect of the anaesthetic agent can lead to severe reduction in blood pressure.
- iv) Coughing and bucking at the end of surgery may transiently but significantly decrease functional residual capacity resulting in further ventilation-perfusion mismatch and hypoxemia.(19)

All the above factors lead to delay in extubation and need for postoperative ventilation. (20)

Regional Anaesthesia: (Spinal anesthesia/epidural anesthesia/ spinal+epidural anesthesia)

All of these modalities have been used in patient with kyphoscoliosis. (21, 22)

Precautions:

- i) severe kyphoscoliosis is associated with reduced volume of cerebrospinal fluid in the subarachnoid space. (23) Hence low dose of anesthetic drug must be used.
- ii) due to the curvature of the spine hyperbaric solutions of the anesthetic drugs tend to pool in the dependent portions of the spine leading to inadequate block.(22) Addition of isobaric preparations of local anaesthetic(LA) drug improves the quality of the block.(5)

Disadvantages:

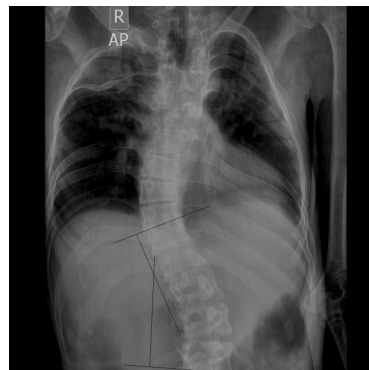
- i) unsuccessful insertion of LA drug,
- ii) Multiple attempts before successful insertion of LA drug. (24)
- iii) Level of anesthesia is less predictable and may be patchy, asymmetric, or high because of shortening and change of spine due to kyphoscoliosis.

Epidural anesthesia is technically difficult but more predictable and safe in patients with kyphoscoliosis as compared with spinal anesthesia. Also, it is possible to give continuous infusion of analgesic/local anesthetic drugs which will prevent pain.

Therefore, Regional Anaesthesia (spinal/epidural/ spinal+epidural) is the anaesthesia of choice for most patients with kyphoscoliosis undergoing surgical procedures. (5, 22, 25, 26, 27)

Conclusion:

There is no perfect anaesthesia solution which will fit all patients with kyphoscoliosis. Individual patients will require meticulous evaluation of their skeletal abnormality as well as cardiovascular physiology. Regional (Spinal/Epidural/ spinal+epidural) anaesthesia appears the safest and most appropriate type of anaesthesia in patients with kyphoscoliosis undergoing laparotomy





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