Original Research Paper

Volume - 10 | Issue - 8 | August - 2020 | PRINT ISSN No. 2249 - 555X | DOI : 10.36106/ijar

Anesthesiology

ANAESTHETIC MANAGEMENT OF A 6-YEAR-OLD WITH MAROTEAUX–LAMY SYNDROME (MPS -VI) UNDERGOING ADENOTONSILLECTOMY AND INGUINAL HERNIA REPAIR

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ABSTRACT Mucopolysaccharidosis VI or MPS-VI is a subgroup of mucopolysaccharidosis which is inherited through autosomal recessive manner. The disease is due to mutation in the enzyme Arylsulfatase B (also called N-acetylgalactosamine-4-sulfatase). It leads to defect in metabolism of Glycosaminoglycans (GAGs) and accumulation of dermatan sulfate in different body tissue. Patient suffering from MPS-VI has some common features as like other types of mucopolysaccharidosis are short stature, typical course faces, spinal deformity, corneal clouding and hepatosplenomegaly. The other features which are specific to MPS-VI are valvular heart disease and normal cognitive function with no mental retardation. We are presenting the perioperative management of a child with MPS-VI for congenital inguinal hernia repair and adeno-tonsillectomy procedure. Difficult airway anatomy and presence of cardiac abnormalities are few challenges the anesthesiologist while managing these groups of patients.

KEYWORDS : Mucopolysaccharidosis, Arylsulfatase B, Maroteaux–Lamy syndrome, MPS-VI, glycosaminoglycan

INTRODUCTION:

Mucopolysaccharidosis is syndrome due to defect in the lysosomal enzymes responsible for breakdown of glycosaminoglycan (GAGs) [1,2]. The mutation in the enzyme leads to malfunctioning of the enzymes and defect in breakdown mucopolysaccharides. There is accumulation of mucopolysaccharides (like dermatan sulfate, heparan sulfate, chondroitin sulfate etc.) in different body tissues such as respiratory system, skeletal system, blood, bone marrow leads to organ dysfunction [3,4].

Mucopolysaccharidosis has some similar features common in its seven subgroups that is multiple organ involvement, typical facial features and skeletal involvement. Mucopolysaccharidosis is subdivided into seven subgroups i.e. I to IX (excluding V and VII)[5].

The genetic inheritance of mucopolysaccharidosis is mainly as autosomal recessive trait with the exception of MPS-II (Hunter syndrome) which is inherited through X- linked recessive manner[6].Maroteaux–Lamy syndrome (otherwise known as mucopolysaccharidosis type) is due to quantitative defect in the enzyme Arylsulfatase B which leads to accumulation of dermatan sulphate and chondroitin-4-sulfate[7]. The symptoms of the patients can range asymptomatic cases to severe form of disorder. Some of the features which are specific to MPS-VI are course facial features, umbilical hernia, joint disorder, clouding of cornea, hepatosplenomegaly. The intelligence coefficient of the patient is generally normal in most of the cases[8].

Progressive accumulation keratan sulfate in the soft tissues of upper airway and skeletal system which is the main cause behind the difficult airway in patients with MPS-VI. The presence of congenital heart disease as well as other system involvement creates problem during perioperative anesthesia management. Careful airway assessment and preparation for emergency airway management are the key to anesthetic management of these groups of patients.

CASE PRESENTATION:

A 6 years old male child presented to our surgical department with chief complaint of inguinal swelling by birth and noisy breathing during sleep. The patient has a history of surgical repair of right inguinal hernia at the age of one month. At the age of 3 months, the patient developed increase back curvature. There were skeletal developmental abnormalities in the skull bone that is sagittal craniosynostosis with dolichocephaly. The patient was evaluated for the presence of any congenital genetic abnormality. After all genetic assessments, patient was found to be having Aryl sulfatase B deficient and diagnosed as mucopolysaccharidosis-VI disease (Maroteaux–Lamy syndrome). The patient underwent allogenic stem cell transplantation at the age of 4 years. After stem cell transplantation, the patient`s symptoms improved subjectively as well as the enzyme level increased from the level which was very low. Thickened mitral valve, trivial mitral regurgitation, thickened aortic valve with normal biventricular function were the findings from 2-D Echocardiography. After the ophthalmologic examination, it was found that there was presence of peripheral clouding in cornea in both eyes. On examination, the patient had kyphoscoliosis of the dorsal lumbar spine with course facial features, prominent forehead and other skeletal abnormalities in the form of wrist and ankle widening. The child had a normal milestone development with only delay in speech development. The patient had history of noisy breathing with recurrent episodes of upper respiratory tract infections requiring nebulization. MRI brain of the patient showed multiple small cystic lesions in the subcortical and deep white matter of bilateral cerebral hemisphere with involvement of Corpus callosum. Ultrasonography of the abdomen showing mild splenomegaly. On examination in ENT department, it was found that the patient was having bilateral grade-III tonsillar hypertrophy. It was planned to perform adenoidectomy with umbilical hernia repair under general anesthesia in the same setting.

In the Pre-Anesthetic Clinic (PAC), it was found that the patient had short stature, dolichocephaly, sagittal craniosyntosis, coarse facial feature, bilateral peripheral corneal clouding, kyphoscoliosis involving dorso-lumbar spine, sternal prominence, Harrison's sulcus. The airway examination findings were Modified Mallampati grade III, bilateral grade-III tonsillar hypertrophy, macroglossia & short neck. Hepatosplenomegaly was found after general examination. Other biochemical investigations were with in normal range for the age.

The patient was shifted in operation theatre after consent and standard monitors like ECG, SPO_2, noninvasive blood pressure was attached. Preoperatively patient was calm, conscious, oriented, blood pressure - 109/64mmHg, heart rate - 115/min, Spo2- 98% on room air and sinus rhythm in ECG. Difficult airway cart was arranged and surgical team was ready for the management of any anticipated difficult airway situation. The patient was pre-oxygenated with 100% oxygen till end-tidal oxygen concentration more than 90%. The patient had intravenous cannula in situ. Injection fentanyl 40 µg i.v. was given as pre medication. Injection propofol 40 mg was injected intravenously. Then airway of the patient was evaluated by C-Mac video laryngoscope with lignocaine sprayed in the oral pharyngeal cavity. After ensuring that there was no problem with ventilation, injection vecuronium 2 mg i.v. was given and the patient was ventilated with 100% O2, N2O and Sevoflurane for three minutes. The patient was intubated with 4.5 sized uncuffed endotracheal tube through C-Mac video laryngoscope. After checking proper waveform of capnograph and bilateral air entry, the endotracheal tube was fixed at 11 cm. Then

the patient was ventilated with VCV Mode with O2, N2O and isoflurane. As decided prior the patient was tracheostomized in view of risk progressive accumulation of mucopolysaccharides in upper airway. Endotracheal tube was removed after the confirmation of tracheal tube. Then adenotonsillectomy and hernia repair were performed. Intraoperative period was uneventful and total blood loss was 50 ml. The patient received 600 ml Ringer lactate. For analgesia, patient received inj paracetamol, inj fentanyl i.v. and local infiltration in the surgical site. The patient was not reversed and shifted to ICU for monitoring. The post-operative period of the patient was uneventful and the patient was discharged to home after few days.

DISCUSSION:

Mucopolysaccharidosis which is a rare form of genetic disorder due to mutation in the lysosomal enzymes responsible for metabolism of mucopolysaccharides. The incidence of mucopolysaccharidosis is found to be 1 in 25,000 live birth[9]. MPS-VI possesses a very small percentage of total cases as compare to other subgroups of MPS. The patient with MPS-VI is considered to be a challenge for the anesthesiologist in different fields like airway management, presence of congenital heart disease, spinal deformity and dynamic course of the disease due to progressive accumulation of mucopolysaccharides in soft tissue.

Large size of the tongue with limited mouth opening makes the airway anatomy difficult during laryngoscopy. Other features that make this group of patients a challenge for the anesthesiologist for airway management are deformity of the skull, typical facial feature, anterior position of larynx and pectus carinatum. Care should be taken during laryngoscopy as there is deformity and limited movement in the atlanto- axial joint which multiplies the problem [10,11]. This group of patients are with normal intelligence unlike the other subgroups of mucopolysaccharidosis.

The patient presented to the surgical department for repair of congenital inguinal hernia and adeno- tonsillar hypertrophy at the age of 8 yrs. Age is one of the most important factors that influences the perioperative anesthesia management plan. With the age progression, the disease severity increases which is mostly due to accumulation of mucopolysaccharides in upper-airway. The patient posted for surgery at the early age has lesser incidence difficulty during airway management than those patients of MPS -VI present at the latter age due to progressive dynamic nature of the disease. In our case, the anesthesia management of inguinal hernia repair performed at the early age group was uneventful as compared to the current procedures[12]. Intravenous enzyme replacement therapy (ERT) by galsulfase (Naglazyme®) and bone marrow or hematopoietic stem cell transplantation (HSCT) are two treatment option in MPS VI patients [13,14]. Patient can be improved symptomatically after enzyme therapy or HSCT.

General and systemic examination of the patient should be done judiciously to ruled out the presence of any congenital heart disease as well as the presence of any other organ dysfunction. In the Pre-anesthetic clinic (PAC) itself, the airway of the patient should be examined by a senior anesthesiologist. Enzyme therapy in case of MPS-VI might causes hepatic function derangement and coagulopathy[15]. The patient should be evaluated in a multidisciplinary approach with reference from multiple disciplines like cardiology neurology, pediatrics, otolaryngology, surgery etc.

Preoperatively, the patient should be evaluated for any preoperative neurological deficit due to spinal cord compression. The neurological assessment should be done and should be documented. A thorough cardiovascular examination should be done and ECG, chest radiograph,2D Echocardiography should be ordered to rule out the presence of any congenital valvular heart disease, endocarditis, aneurysm etc. [16,17] Due to progressive accumulation of mucopolysaccharides in the upper airway and oral pharyngeal region, there are symptoms like snoring, stridor and obstructive sleep apnea. When there is presence of stridor, the patient should be examined for the presence of any airway obstruction by chest radiograph and naso-endoscopy. In our case the airway assessment was done thoroughly and airway management plan was made. As there was a risk of progress accumulation mucopolysaccharides in the upper airway, the patient was electively tracheostomized before the surgical procedure.

Detail bedside airway examinations as well as radiological investigation could help in determining the presence of difficult airway anatomy in this group of patients. The difficult airway could be due to difficulty during mask ventilation, laryngoscopy or intubation or all of these. Due to laxity of supraglottic region after neuromuscular blockade causes the large tongue to fall backward and causes airway obstruction during mask ventilation[17].

Preservation of spontaneous ventilation is the main idea behind the management of this group of patients during difficult airway management. In our case, check laryngoscopy was done with a video-laryngoscope before administration of neuromuscular blocker. Many cases are reported highlighting the airway management of patients with mucopolysaccharidosis during anesthesia induction. Different methods of airway management plan could be applicable in these group of patients like awake fibro-optic intubation, video laryngoscope, use of laryngeal mask airway (LMA), check laryngoscopy before laryngoscope attempts [18,19].

The patients of MPS-VI are generally short stature as like other subgroups of mucopolysaccharidosis and there is presence of degenerative joint disease as well as skeletal system involvement. Care should be taken during shifting of the patient in operative room as well as positioning of the patient after anesthesia. The pressure point should be padded to prevent neurological complications due to peripheral nerve compression. Special precaution should be taken by the anesthesiologist during regional anesthesia as there is association of kyphoscoliosis and other skeletal deformity with MPS-VI. Ultrasonography would be a good option during regional nerve blocks. In our case kyphoscoliosis of the dorso-lumbar vertebra was present.

Corneal clouding, refractory error, optic nerve compression, retinal involvements are generally associated with this group of patients[20]. In Pre-Anesthesia-Clinic, visual acuity of the patient should be documented to prevent any medical legal issue in the post-operative period. Deep sedation and general anesthesia should be avoided & regional nerve block should be preferred for patient with history of obstructive sleep apnea. Continuous pulse oximetry, capnometry and CPAP therapy should be considered in the post-operative period for these groups of patients.

Multidisciplinary team approach with preparedness for any kind of difficult airway scenario is the key to anesthesia management of this group of patients.

CONFLICTS OF INTEREST:

There are no conflicts of interests.e

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