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Exploring anesthesiologist niche in burn management: Putting the tube where it belongs. A case series on difficult airways in burns

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ABSTRACT

Burn injuries are complex and challenging, requiring a multidisciplinary approach. We have done more than 15 cases of severely distorted airways in patients with burns (photos attached); although the basic case management remains the same, there are a plethora of other concerns that make these patients unique. The most unique and severe 11 cases we have discussed assiduously. Out of all the concerns, airway management remains the most challenging one. Timely intervention and keen vigilance are required to prevent a disaster later on.

Key words: Burn contracture; Airway management; Resuscitation

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INTRODUCTION

When it comes to providing optimal care for burn patients, anesthesiologist plays a crucial role in ensuring successful outcomes. Burn injuries are complex and challenging, requiring a multidisciplinary approach. In this article, we will delve into the intricacies of management in burn patients, highlighting key considerations regarding the role of the anesthesiologist in fluid resuscitation, hemodynamic management, airway management, vascular access, pain management, intensive care management, ventilation strategies, temperature regulation, and providing anesthesia for surgery in burn patients.

CASE SERIES

Here, we present a case series of intraoperative management of 11 burn patients posted for various surgeries in our burn and plastic operation theater. Although the basic case management remains the same, there are plethoras of other concerns that make these patients unique. The most challenging ones have been discussed in detail here in tabular form and also in a short discussion below.

Some cases were unique and required special attention.

Case 8

A 1-year-old male baby presented with specific concerns about airway and fluid management fluid care. The airway in pediatric patients is challenging alone and superimposed in our case was severe pain management along with post-operative fluid management.

Case 9

A 67-year-old male presented with limited mouth opening, restricted flexion, and extension at the neck. Blind nasal

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Patient Parameters	Case 1	Case 2/3	Case 4/5	Case 6	Case 7	Case 8	Case 9	Case 10	Case 11
Age	54-year-old female	27/28-year-old female	58/52-year-old male	18-year-old male	24-year-old male	1-year-old male baby	67-year-old male	28-year-old female	30-year-old male
Type of burn	Chronic	Acute (60%)	Chronic	Acute (60%)	Acute (60%)	Acute (40%)	Chronic	Chronic	Acute (70%)
Airway examination									
Flexion	L	N	N	N	N	N	L	L	L
Extension	N	N	N	N	N	N	L	L	L
Mouth opening	1.5. fingers	1 finger	N	N	N	N	1 finger edentulous	1 finger	½ finger
Nasal Patency	N	Very less on left	N	N	N	N	N	N with small nares	N
Area	Whole neck and chest	Lower face, neck, chest above nipples	Upper-limb elbow contracture	Post electric burn scalp	hands	Chest upper part till nipples	Chest neck and upper limb	Chest back half abdomen bilateral thigh	Extensive facial burn contracture and disfigurement
Technique of intubation	FOI	FOI	NA	Direct laryngoscopic intubation	NA	Supraglottic, i-Gel size 2 inserted	Blind nasal with plan B FOI	FOI with size 5 ETT which was later changed to 6.5 ETT after facial contracture release by direct laryngoscopy	NA
Procedure	Release of contracture from neck	Debridement	Release of contracture	Debridement from forehead with full thickness rotator flap	Debridement with flap	Debridement	Extensive debridement with superficial flap	Ectropion release with lip reconstruction	B/L thigh debridement
Regional	None	Bilateral ESP at T5-T6 level	Supraclavicular block	None	Costoclavicular block	None	None	None	B/l femoral and LCFN Block

intubation was done, with bag movements guided by breath sounds. Intubation was successful in the second attempt.

Case 10

A female patient with extensive fascial burns had small nares due to postburn contracture. A small-sized endotracheal tube (No. 5) was passed through the nostril which was later changed to a bigger size tube by direct laryngoscopy after facial contracture release.

Case 11

The patient was haemodynamically unstable, so regional peripheral nerve block was preferred. Thigh debridement was done under nerve blocks in this patient.

DISCUSSION

Burn patients present with acute or chronic burns. Out of 11 patients, six had acute burns (<48 h) posted for debridement and five had chronic burns for which contracture release was done. The acute burn patients presented for debridement and grafting for which costoclavicular block was given as in Case 7. Upper-limb elbow contractures as in Cases 4 and 5 were operated under supraclavicular block. For post-operative analgesia, as in patients 2 and 3, bilateral erector spinae plane block at level T5 T6 was given. Hemodynamically unstable patient, Case 11, thigh debridement was done under ultrasound-guided femoral and lateral femoral cutaneous nerve block. The patient with neck contracture and limited neck movements was managed with Fibroptic intubation (FOI) as in Case 1. Acute burn patients with debridement of the face and neck were managed with FOI due to reduced mouth opening and extensive erythematous tissue along with mucosal sloughing as in Case 2. On FOI, glottic edema was visualized, and after extubation, nebulization was done in the recovery room with steroid. Case 9- The old age, edentulous was having extensive neck, chest and upper limb burns. The plan A was blind nasal intubation with plan B as fibroptic intubation. Intubation was done on the second attempt. The patient had small nares in Case 10, so a small endotracheal tube was secured through nasal fiber-optic intubation, and then, after facial contracture release, oral intubation with a larger size tube was done under direct laryngoscopy.

Inhalational injury is most common in the supraglottic area as the upper airway has an excellent heat dissipation capability and glottis closure occurs during inhalational injury. Supraglottic thermal injury causes upper airway edema making ventilation and intubation difficult.[1]

Subglottic injury occurs by inhalation of chemicals and irritants causing mucociliary function inhibition, mucosal sloughing, bronchospasm, pneumonia, and acute respiratory distress syndrome (ARDS). A lung protective ventilation strategy is recommended for these patients.

Airway complications can be physiological or mechanical. Glottic edema is rarely encountered due to the innate capability of the upper airway to dissipate heat. Chances of intubation in patients with smoke inhalation are remote but our focus is on patients who may require intubation. There is an ongoing controversy between direct laryngoscopy and fiber-optic intubation with the balance shifting more toward fiber-optic intubation because the presence of soot in the oral cavity may indicate the presence of laryngeal edema.[2] The presence of significant edema, ulceration, and perioral blisters declares the need for intubation.[3]

Case 1: Severe contracture neck limiting flexion extension with limited mouth opening

Case 2: 60% acute burns covering face, neck, chest, limited flexion extension with limited mouth opening

Case 4: Chronic burn contracture involving neck, chest U/L upper limb

Case 6: Young male with electric burn hand and forehead, scalp graft required

No matter how little is the sign of burns in the oropharynx, subglottic involvement can never be ruled out. It has been suggested by Bai et al., that bronchoscopy of the airway is the key and should be part of routine clinical practice.[4]

Edema of the oral mucosa/trachea is found to be within ½ h or it may be delayed for 24 h or more. Hence, suspicion should be kept for 3–4 days.

Impending signs of airway obstruction are more difficult to recognize in pediatrics. They are more susceptible to airway obstruction because of major anatomical differences from adults such as large floppy epiglottis and small diameter trachea.[5]

Anesthesiologists should always have an element of doubt about the presence of edema; thereby, intracuff pressure should be kept less than lower safe limit as there are chances of fistula formation.[6] The endotracheal tube should be

Case 8: 1-year-old male baby, with acute burns for debridement, supraglottic (i-Gel size 2 inserted)

left uncut as edema can advance up to 48 h and there are chances of endotracheal tube migration. Patients should be kept sedated and relaxed as reintubation is difficult due to massive edema up to 48 h. Early tracheostomy has not been found to improve outcomes. In fact, there are chances of superadded infection, development of pneumonia, and ARDS later on. Some authors also suggest the excision of burnt tissue before tracheostomy to lower the risk of respiratory tract infection. It is important not to ignore patients with vocal cord damage and early tracheostomy is advised to prevent further damage to the lower airway. Prolonged intubation or tracheostomy can lead to tracheoesophageal fistula formation and suspicion should be raised whenever there is coughing after swallowing. Nebulization with steroid (anti-inflammatory action), N-acetyl cysteine (mucolytics effect as there is decreased mucociliary function), heparin (anticoagulant effect for bleeding), and albuterol (bronchodilator effect) are found to help in weaning and early extubation.[7]

The difficult airway is anticipated in burn patients due to pain, edema, erythema, blisters, laryngeal edema, tracheal stenosis, and decreased mandibular mobility due to post-burn contractures, and hence, awake fiber-optic intubation is the preferred method of securing the airway. Nerve blocks for fiber-optic intubation are not possible to perform in burn patients due to anatomical distortion and significant edema. The use of topical local anesthetics is recommended. Spray as-you-go technique for local anesthetic spray along with ketamine or dexmedetomidine-induced sedation which preserves pharyngeal muscle tone is recommended. Securing the endotracheal tube is also challenging in facial burn patients. Use of umbilical tape, twill tape, interdental wiring, securing it with suture by tying the knot on the tooth base, use of silicon molds, and more techniques are tried with variable success.[8]

Case 10: Chronic post-burn contracture, external nares constricted, mouth opening limited

Another consideration in airway management for burn patients is carbon monoxide (CO) poisoning. Inhalation of smoke or toxic gases can lead to CO poisoning which impairs oxygen delivery to tissues as it shifts the oxygen hemoglobin dissociation curve to the left. Administering 100% oxygen has been found to reduce the half-life of CO from 5 to 6 h to just 40–80 min.[9] Pulse oximeter is unreliable and the use of a carbon monoxide oximeter is recommended.[10]

Injection fentanyl, paracetamol, ketorolac, and dexamethasone were given as a part of multimodal analgesia intraoperatively, along with regional analgesia wherever possible. Patients were on gabapentine preoperatively. Multimodal pain management strategy is required in managing pain in burn patients. These patients experience continuous background pain with hyperalgesia and allodynia along with procedural pain, breakthrough pain, chronic neuropathic pain, and persistent itching. The use of systemic analgesics such as opioids, ketamine, alpha 2 agonists, gabapentinoids, and non-steroidal anti-inflammatory drugs along with regional analgesia techniques using local anesthetics forms the cornerstones of burn pain management. The use of local anesthetics agents decreases sensitization thereby decreasing the risk of development of chronic pain.[11] They also decrease the requirement of systemic analgesics thereby decreasing the chances of opioid addiction, overdose, tolerance, hyperalgesia, and sedation. Careful dose calculation of local anesthetic is important in burn patients as there are increased chances of (local anesthetic-induced systemic toxicity) due to high vascularity, decreased cardiac output, low-protein binding, and deranged liver and kidney function. Local anesthetic concentration is to be kept minimum to avoid motor block as early mobilization prevents contracture formation. Regional anesthesia is contraindicated in burn patients with cardiovascular instability, peripheral neuropathy, use of therapeutic anticoagulation, coagulopathy, infection at the needle entry site, and local anesthetic allergy. The catheter should not be placed through eschar or burned skin but single-shot nerve blocks can be placed using a sterile technique. Epidural analgesia is not very popular as there are chances of epidural abscess formation. Compartment syndrome can be masked, so regional techniques are to be avoided in patients with circumferential deep burns and electric burns.[12]

Temperature regulation requires meticulous attention as there is a risk of hypothermia. The temperature probe was used to measure patients' temperature and adequate corrective measures were taken. Forced air warmers, warming mattresses along with warm IV fluids were used. Ambient theater temperature was maintained. Burn patients lose their primary protective barrier to heat loss leading to high evaporative heat loss. This along with the change in hypothalamic temperature set point makes them susceptible to hypothermia. General anesthesia with its core to peripheral heat redistribution and changes in central thermoregulation further worsens the situation.[13] Maintaining normothermia is essential to prevent complications of coagulopathy and impaired wound healing. The use of warming devices, warm intravenous fluids, increasing ambient temperature, and temperature monitoring are recommended during anesthesia and throughout the perioperative period.[14]

Infection control

Burn wounds are highly susceptible to infection, making strict infection control measures crucial. Maintaining a sterile environment, appropriate wound dressings, and prophylactic antibiotics are recommended in burn patients. A precise clinical sense, keen observation, and close collaboration with the surgical team are necessary to minimize the risk of infection.[15]

Limitations of the study

The main limitation of the case series was sample size which was small. The pediatric patients were limited. The extremes of age less than one year old and more than 70 years patient were not covered. Acute burn management in triage age was not discussed as patient in elective Operation theatre come after a gap of one or 2 days.

CONCLUSION

Anesthetic management in burn patients requires a comprehensive understanding of the unique challenges and considerations associated with these injuries. By conducting a thorough pre-operative assessment, anticipating a difficult airway with adequate preparation to prevent sudden catastrophe, managing fluid resuscitation, providing effective pain relief, regulating temperature, and implementing infection control measures go a long way in obtaining a successful outcome. With rapidly evolving techniques, the field of burn anesthesia will see the dawn of the day.

AVAILABILITY OF DATA

Our data, including the raw dataset, are available upon request from the corresponding author.

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