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Comparing anesthesia modes in major burns: Total intravenous anesthesia versus general anesthesia - A cross-sectional study in a Central Indian government hospital

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ABSTRACT

Background: Burn injuries remain a significant public health concern, causing complex trauma. Early excision and skin grafting are standard in burn management to reduce infection and scarring. The choice of anesthesia is critical for optimal pain control and hemodynamic stability. **Aims and Objectives:** This study aims to compare total intravenous anesthesia (TIVA) and general anesthesia (GA) in patients of major burns. **Materials and Methods:** The study was conducted in the Department of Anaesthesia, M.G.M. Medical College and M.Y. Hospital, Indore, over a period of 12 months. One hundred and twenty patients with 10–12% total burn area were included and randomized into two groups of 60 patients each. Group T patients received TIVA and Group G patients received GA. **Results:** Both the groups were comparable with respect to age, gender, and baseline vitals. The mean heart rate, systolic and diastolic blood pressure, and mean MAP were significantly higher in Group G at 0, 30, and 60 min. In Group T, all patients achieved an Aldrete score of 9 or more within 10 min. Pain was more prevalent in Group G patients, and the comparison was found to be statistically significant. The mean time to first rescue analgesia in Group T was later than Group G, and the difference was found to be statistically significant. **Conclusion:** From the results, we may conclude that TIVA provides superior hemodynamic stability, shorter post-anesthesia unit recovery time, and improved analgesia compared to GA. However, there are lacunae in the literature, hence we recommend that larger studies comparing these two anesthesia modes be conducted before generalizing the present findings to the general population.

Key words: Major burn patients; Early excision and skin grafting; Total intravenous anesthesia; General anesthesia; Aldrete score

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INTRODUCTION

Burn injuries pose significant challenges in terms of morbidity and mortality despite advancements in medical care.[1] Epidemiological studies conducted across various regions of India have highlighted the widespread prevalence of burn injuries, particularly among individuals from low socioeconomic backgrounds who often seek treatment at government hospitals[2] Burns inflict complex trauma on patients, impacting their physical, mental, and social well-being. The extent of damage caused by burns can vary, ranging from skin injuries to potentially affecting internal organs.

A major burn is characterized by specific criteria, including a partial thickness burn involving more than 20% of the total body surface area (TBSA) in adults or more than 10% TBSA in young or elderly individuals. In addition, a major burn can be classified as a full-thickness burn affecting more than 5% of TBSA, an inhalational burn injury, or any significant burn that impacts critical areas such as the face, eyes, ears, genitalia, or joints.[3]

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The thermal destruction of the cutaneous mechanical barrier, coupled with the presence of non-viable avascular burn eschar, increases the susceptibility of burn patients to local and systemic infections. In addition, burn injuries induce various hemodynamic changes. Post-resuscitation care primarily focuses on topical antimicrobial therapy, burn wound excision, and closure through grafting. The presence of burnt tissue creates an environment favorable for Gram-positive organisms, leading to delayed wound healing, functional deficits, and psychological impairment. Debridement of burn tissue plays a crucial role in the overall survival and outcome of burn patients.[4] The primary goal of management is to stabilize the patient and provide biological cover for the wounds.[5]

Kisslagglu et al., revealed that early excision and skin grafting procedures resulted in reduced hospitalization duration and lower costs of burn treatment compared to conservative management.[6] These procedures aim to minimize the risk of infection and scarring while improving cosmetic outcomes.

Pain management represents a critical aspect of burn injury interventions, as various procedures such as dressing changes, excision, skin grafting, and physical therapy can induce pain. Patterson's burn pain paradigm provides insight into the five phases of burn pain: background pain, procedural pain, breakthrough pain, post-operative pain, and chronic pain.[7,8] Adequate hemodynamic management is another crucial factor in determining the prognosis of burn patients. Burn injuries lead to significant hypovolemia, characterized by initial systemic and pulmonary vasoconstriction in the early stage, followed by a hyperdynamic state with high cardiac output and increased oxygen consumption. Achieving the appropriate fluid balance poses a challenge for intensivists and anesthesiologists, as both under- and over-resuscitation can have negative impacts on patient outcomes.[9]

Early excision and skin grafting, typically performed within the first 3–5 days of burns, have become the standard of care in burn management.[10] However, surgical excision can lead to blood loss and hypothermia, necessitating a staged surgical approach with limited excision per operative session. Conventional skin grafting involves the use of autotransplants to minimize the risk of immune rejection.[11]

The choice of anesthesia plays a crucial role in ensuring optimal analgesia and hemodynamic stability during burn procedures. Ketamine is commonly used for treating burn patients due to its analgesic properties. However, it can increase heart rate and blood pressure. Skin grafting is typically performed under general anesthesia (GA), utilizing a combination of inhalational and intravenous agents.[12-14]

Total intravenous anesthesia (TIVA) without definitive airway management eliminates the need for endotracheal intubation, which may suppress the host immune response.[5] Studies have suggested that propofol, an intravenous anesthetic, can result in less early post-operative pain compared to anesthesia based on isoflurane.[15]

The choice of anesthesia approach can significantly impact the release of cytokines, which is crucial for patients with severe burns. Inhalational agents tend to induce the release of pro-inflammatory cytokines more frequently than intravenous agents, potentially leading to increased post-operative morbidity and complications.[16] Burn patients present unique anesthetic challenges, including difficulties in establishing intravenous access, compromised airways, challenging bag and mask ventilation, and altered hemodynamic parameters.[17]

There is no study which has compared TIVA and GA in major burn patients. With this gap in the literature, the present study was undertaken to compare two different modes of anesthesia, TIVA and GA, in patients with major burns requiring early excision and skin grafting. The comparison focuses on hemodynamic parameters, recovery time from anesthesia, immediate post-operative pain, and the time required for rescue analgesia.

Aims

To compare the efficacy of TIVA and GA in major burn patients.

objectives

Comparison of hemodynamic parameters, recovery time from anesthesia, immediate postoperative pain, and the time required for rescue analgesia.

MATERIALS AND METHODS

This cross-sectional study was conducted in the Department of Anaesthesia, M.G.M. Medical College and M.Y. Hospital, Indore, over a period of 12 months on patients with 10–12% of total burn area and posted for early tangential excision and skin grafting.

Patients with 10–12% of total burn area, posted for early tangential excision and skin grafting, of age 18–60 years of ASA Grade I or II, with Mallampati Grade 1 or 2 were included in the study. Patients with inhalational burn; pregnant or lactating women; patients with Mallampati Grade 3 or 4; patients with asthma, COPD, bronchitis, etc.; and those not willing to participate in the study were excluded.

One hundred and twenty patients with 10–12% of total burn area and posted for early tangential excision and skin

grafting were enrolled and randomized using computer-generated numbers into two groups of 60 patients each.

Group T patients were given TIVA, whereas patients in Group G were given GA.

We included 120 patients with 10–12% of total burn surface area and posted for early tangential excision and skin grafting.

Material required

Anesthesia workstation with oxygen supply, suction apparatus; multipara monitor; laryngoscope with blades of different sizes (Macintosh Curved Blade 3, 4); endotracheal tubes of appropriate size; silicone mask of appropriate size; intravenous fluid; ketamine (vial containing 50 mg/mL); propofol (vial containing 10 mg/mL); muscle relaxant (injection atracurium 10 mg/mL); analgesic (injection fentanyl 50 μg/mL); glycopyrrolate (ampule containing 0.2 mg/mL); neostigmine (ampule containing 0.5 mg/mL); and emergency drugs (injection atropine, injection adrenaline, injection lignocaine, etc.).

Method

After obtaining voluntary written informed consent from each patient participating in the study, all the study-related procedures were initiated. Medical and surgical history was noted, a day prior to the surgery. All the patients were kept nil by mouth for at least 6 h prior to surgery.

After the patient was taken into the operation theater, baseline ECG, NIBP, HR, and SpO_2 were noted. A peripheral intravenous line was secured and Ringer's lactate was administered. The patients received premedication consisting of intravenous administration of injection glycopyrrolate at a dose of 0.01 mg/kg and injection midazolam at a dose of 0.02 mg/kg. In addition, both the groups of patients were administered injection fentanyl at a dose of 1–2 μg/kg intravenously.

Group T patients received an induction of injection ketamine (1–2 mg/kg) and injection propofol (1–2 mg/kg) intravenously. Assisted bag and mask ventilation was provided until spontaneous respiration resumed, with an oxygen flow rate at 5 L/min. Maintenance doses of one-tenth of the induction dose of injection ketamine and injection propofol were intermittently administered. Oxygen flow was increased if oxygen saturation levels dropped, and vital signs were continuously monitored throughout the procedure.

Group G patients received induction with injection propofol (1–2 mg/kg) followed by a loading dose of injection atracurium (0.5 mg/kg) intravenously. They were intubated via the oral route using an appropriately sized endotracheal tube. Intraoperatively, patients were maintained with O_2, N_2O, isoflurane, and a maintenance dose of injection atracurium (0.1 mg/kg). At the end of the surgery, reversal was achieved using injection glycopyrrolate (0.01 mg/kg) and injection neostigmine (0.05 mg/kg).

Post-operatively, pain assessment was conducted using verbal parameters. Accordingly, it was graded as mild, moderate, and severe pain. Recovery time from anesthesia was evaluated using the modified Aldrete score at 10 min, 30 min, and 120 min. Patients were closely monitored for the next 24 h, and the time of rescue analgesia administered were noted. Injection paracetamol (1 g) was administered as the initial rescue analgesia, with injection tramadol (100 mg) being administered if pain persisted.

The study was approved by the Institutional Ethics Committee, and prior to enrollment, voluntary written informed consent to participate in the study was obtained from each patient. All the rights of the patients were secured. Vulnerable patients were not included in the study.

Ours being a state government-run hospital, all the costs toward admission, medication, surgery, investigations, etc., are borne by the government. Furthermore, no additional investigation or procedure was conducted for the specific requirement of the study. Hence, there was no financial burden on any of the patients. All the study-related expenses were borne by the researcher.

Statistical software IBM SPSS version 20.0.0.0 was used for doing the statistical analysis. Comparison of means between the two groups was done using unpaired *t*-test and proportional comparison was done using Fisher's exact test. Association between two non-parametric variables was seen using Pearson Chi-square test. $P < 0.05$ was considered statistically significant.

RESULTS

We included 120 patients with early tangential excision and skin grafting with 10–12% of total burn area, who were randomized into two groups of 60 patients each. Group T patients received TIVA, whereas Group G patients received GA.

Most of the patients in both the groups were in the age group of 21–40 years. The mean age of the patients in Group T was 33.95±10.33 years, and in Group G patients, it was 32.75±13.28 years. The difference was found to be statistically not significant (P=0.582).

In Group T, there were 41.7% of females and 58.3% of males, whereas in Group G, there were 33.3% of females

and 66.7% of males. Both the groups were comparable with respect to sex of the patients (χ^2=0.889, df=1, P=0.346).

The mean baseline heart rate in Group T was 92.08±08.81 per min, and in Group G, it was 92.68±13.03 per min. The mean baseline heart rate was comparable between the two groups (P=0.768), whereas the mean heart rate at 0 min, 30 min, and 60 min was significantly higher in Group G compared to Group T (P<0.05) (Table 1).

The mean baseline systolic blood pressure in Group T was 128.90±9.84 mmHg, and in Group G, it was 131.30±9.92 mmHg. The mean baseline systolic blood pressure was comparable between the two groups (P=0.186), whereas the mean systolic blood pressure at 0 min, 30 min, and 60 min was significantly higher in Group G compared to Group T (P<0.05) (Table 1).

The mean baseline diastolic blood pressure in Group T was 79.23±6.71 mmHg, and in Group G, it was 80.57±5.97 mmHg. The mean baseline diastolic blood pressure was comparable between the two groups (P=0.253), whereas the mean diastolic blood pressure at 0 min, 30 min, and 60 min was significantly higher in Group G compared to Group T (P<0.05) (Table 1).

The mean baseline MAP in Group T was 95.79±7.22 mmHg, and in Group G, it was 97.48±6.85 mmHg. The mean baseline MAP was comparable between the two groups (P=0.11), whereas the mean MAP at 0 min, 30 min, and 60 min was significantly higher in Group G compared to Group T (P<0.05) (Table 1).

The mean SpO_2 at baseline, 0 min, 30 min, and 60 min was comparable between the two groups (P>0.05).

A modified Aldrete's score cutoff value of 9 was used. At 10 min, in Group T, all the patients had a modified Aldrete score of >9, whereas in Group G, 20 (33.3%) patients had a modified Aldrete score of <9 and 40 (66.7%) patients had a score of >9. The proportional comparison was found to be statistically significant (P=0.001). While, at 30 min and 120 min, in both the groups, all the patients had a modified Aldrete score of >9 (Table 2).

In Group T, 36 (60%) patients had mild pain and 24 (40%) patients had moderate pain, and in Group G, 19 (31.7%) patients had mild pain, 37 (61.7%) patients had moderate pain, and 4 (6.7%) patients had severe pain. Higher pain grades were more prevalent in Group G, and this association was found to be statistically significant (χ2=12.025, df=2, P=0.002) (Table 3).

The mean time to first rescue analgesia in Group T was 509.00±127.13 min, and in Group G, it was 435.50±82.39 min. The mean time to first rescue analgesia was significantly longer in Group T compared to Group G (P=0.001) (Table 4).

DISCUSSION

The National Health Portal published that 2.4 lakh people in India suffer from some form of disability and 1.4 lakh deaths occur each year due to burn injuries. Nearly 7 million burn injuries occur each year in India. Over a million people in India suffer from moderate-to-severe burn injuries each year.

Table 1: Comparison of hemodynamic parameters between Group T and Group G at different time intervals

Parameter	Group T	Group G	"t" value, df	P-value
Heart rate (per min)				
Baseline	92.08±08.81	92.68±13.03	−0.295, df=118	0.768, NS
0 min	83.65±07.92	96.52±11.96	−6.948, df=118	0.001*
30 min	84.07±08.51	90.00±10.16	−3.466, df=118	0.001*
60 min	84.63±08.01	95.85±09.96	−6.8, df=118	0.001*
Systolic blood pressure (mmHg)				
Baseline	128.90±9.84	131.30±9.92	−1.331, df=118	0.186, NS
0 min	122.83±8.42	131.57±8.50	−5.652, df=118	0.001*
30 min	122.83±8.66	126.87±7.68	−2.698, df=118	0.008*
60 min	124.07±8.28	133.03±6.84	−6.464, df=118	0.001*
Diastolic blood pressure (mmHg)				
Baseline	0.23±6.71	80.57±5.97	−1.15, df=118	0.253, NS
0 min	75.13±6.02	81.00±5.99	−5.351, df=118	0.001*
30 min	74.67±5.93	78.10±5.04	−3.416, df=118	0.001*
60 min	75.47±5.76	81.90±4.75	−6.673, df=118	0.001*
Mean arterial pressure (mmHg)				
Baseline	95.79±7.22	97.48±6.85	−1.315, df=118	0.191, NS
0 min	91.03±6.39	97.86±6.42	−5.834, df=118	0.001*
30 min	90.72±6.46	94.36±5.54	−3.307, df=118	0.001*
60 min	91.67±6.10	98.94±5.00	−7.153, df=118	0.001*

Table 2: Comparison of modified Aldrete's score between Group T and Group G at different time intervals

Time interval	Modified Aldrete's score	Group T	Group G	Fisher's exact test P- value
10 min	<9	0 0.0%	20 33.3%	0.001*
	≥9	60 100.0%	40 66.7%	0.001*
30 min	<9	0 0.0%	0 0.0%	-
	≥9	60 100.0%	60 100.0%	-
120 min	<9	0 0.0%	0 0.0%	-
	≥9	60 100.0%	60 100.0%	-

Table 3: Comparison of pain between Group T and Group G

Pain grade	Group T	Group G
Mild pain	36 60.0%	19 31.7%
Moderate pain	24 40.0%	37 61.7%
Severe pain	0 0.0%	4 6.7%
Total	60 100%	60 100%

Table 4: Comparison of mean time to first request of rescue analgesia

Groups	No.	Mean±SD	"t" value, df	P-value
Group T	60	509.00±127.13	3.758, df=118	0.001*
Group G	60	435.50±82.39		

In the present study, we included 120 patients with 10-12% total burn surface area and posted for early tangential excision and skin grafting, who were further randomized into two groups of 60 patients each. Group T (n=60) patients received TIVA and Group G (n=60) patients received GA.

Both the groups were comparable with respect to age and sex. The mean baseline heart rate, mean systolic blood pressure, mean diastolic blood pressure, mean MAP, and mean SpO_2 were comparable between the two groups, whereas these parameters were significantly higher in Group G at 0 min, 30 min, and 60 min, compared to Group T. TIVA provided better hemodynamic stability in comparison to GA. Lower heart rate and blood pressure and better hemodynamic stability in the intraoperative period provided more comfort to the surgeon. TIVA provided better intraoperative hemodynamic stability[18] which is consistent with our study's finding.

At 10 min, the prevalence of patients with a modified Aldrete score of 9 or more was significantly higher in Group T compared to Group G, whereas at 30 min and at 60 min, all the patients in both the groups had a modified Aldrete score of 9 or more. The time spent in post-anesthesia care unit was significantly lower in Group T patients, as all the patients achieved a modified Aldrete score of 9 or more within a short time. Salgaonkar et al., in their study, had administered TIVA with tumescent infiltration anesthesia (TIA) and found that 95.8% of the patients had achieved an Aldrete score of 9 or more at 10 min post-surgery.[5]

The prevalence of moderate and severe pain was significantly higher in Group G compared to Group T, whereas the prevalence of mild pain was significantly higher in Group T compared to Group G. Pain management was better in Group T patients compared to Group G patients.

The mean time to first rescue analgesia was significantly longer in Group T compared to Group G. TIVA provided longer analgesia compared to GA.

Our study's primary limitation stems from the absence of existing research comparing TIVA and GA in major burn patients. Given this gap in the literature, we advocate for further studies to be conducted, specifically comparing these two types of anesthesia in major burn patients. However, despite this limitation, our findings indicate that TIVA demonstrates superior outcomes compared to GA in this patient population.

Limitations of the study

a. Lacunae of literature comparing TIV and GA in major burn patients.
b. Small sample size.
c. Being a single-center study, we recommend that large multicentric study be conducted with similar aim and objectives, so that the findings can be extrapolated to the general population.

CONCLUSION

Based on the results we obtained, it is evident that TIVA offers superior hemodynamic stability, shorter post-anesthesia care unit recovery time, and improved analgesia compared to GA.

However, it is essential to acknowledge the existing gap in the literature, preventing us from generalizing these findings to the broader population. To validate and confirm our results, we strongly advocate for further comprehensive studies that directly compare these two anesthesia modes in major burn patients.

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SJ - Concept, design, clinical protocol, manuscript preparation, editing, and manuscript revision, definition of intellectual content; **NS -** Literature survey, prepared first draft of manuscript, implementation of study protocol, data collection, data analysis, manuscript preparation and submission of article, preparation of figures; **SV -** Coordination and manuscript revision, design of study, statistical analysis, and interpretation; **AKK -** Review manuscript.

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