Manajemen Airway pada Luka Bakar

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WHY??

- Sekitar 500.000kasus rawat inap dan 3.400 kematian akibat luka bakar dan cedera pernafasan di AS selama 2013.
- Luka bakar merupakan cedera traumatis yang unik namun umum terjadi, yang menempati urutan kedua setelah kecelakaan kendaraan bermotor sebagai sumber utama kematian akibat kecelakaan.
- Tiga faktor risiko menentukan angka kematian: cedera inhalasi, ukuran luka bakar melebihi 40% dari TBSA, dan usia lebih dari 60 tahun. Kematian telah terbukti menjadi 0,3%, 3%, 33%, dan 90% dengan adanya faktor risiko masing-masing 0, 1, 2, dan 3.1

Barash, Paul G *et al. Clinical Anesthesia 8th Ed*. Wolters Kluwer. 2017
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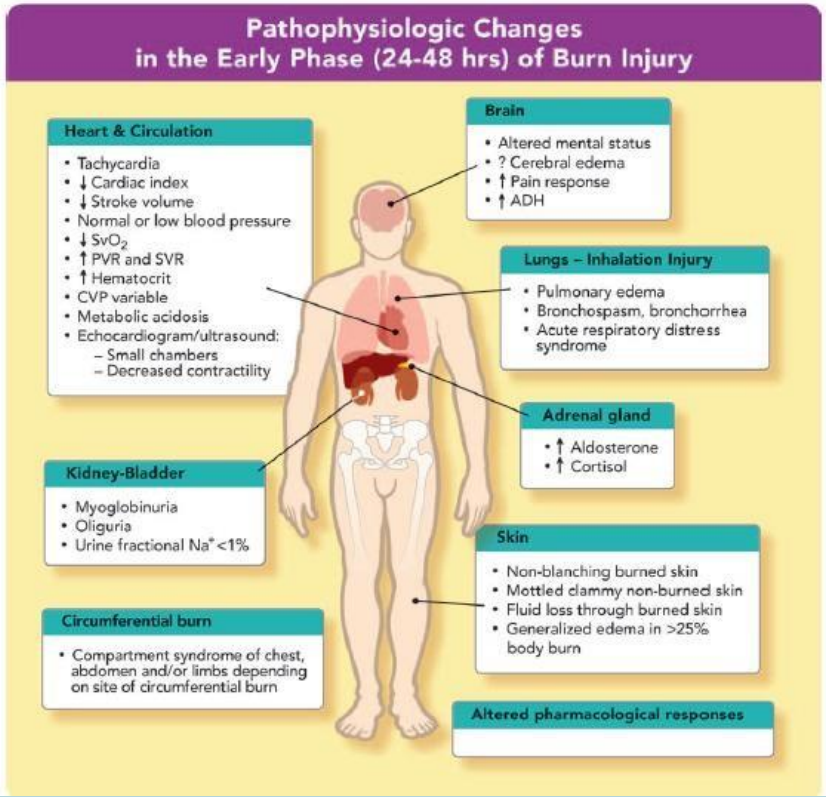
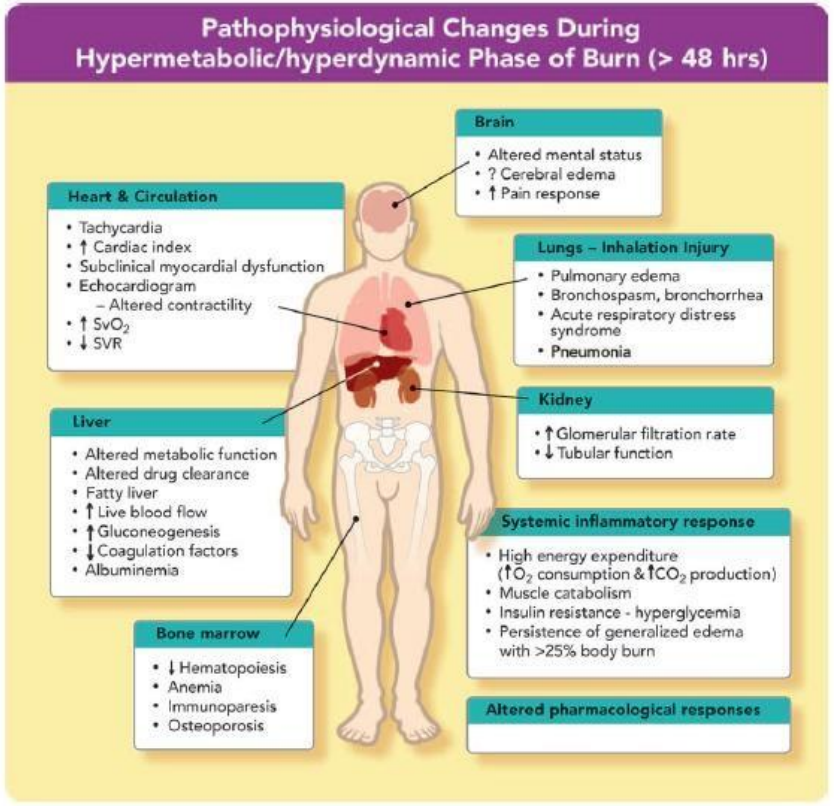
PATOFISIOLOGI PADA LUKA BAKAR





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KLASIFIKASI

TABLE 125-2 Burn Depth Features: American Burn Association Burn Classification

Burn Classification	Burn Characteristics	Disposition
Major burn	Partial-thickness >25% BSA, age 10–50 years Partial-thickness >20% BSA, age <10 years or >50 years Full-thickness >10% BSA in anyone Burns involving hands, face, feet, or perineum Burns crossing major joints Circumferential burns of an extremity Burns complicated by inhalation injury Electrical burns Burns complicated by fracture or other trauma Burns in high-risk patients	Burn center treatment
Moderate burn	Partial-thickness 15–25% BSA, age 10–50 years Partial-thickness 10–20% BSA, age <10 years or >50 years Full-thickness burns ≤10% BSA in anyone No major burn characteristics present	Hospitalization
Minor burn	Partial-thickness <15% BSA, age 10–50 years Partial-thickness <10% BSA, age <10 years or >50 years Full-thickness <2% in anyone No major burn characteristics present	Outpatient treatment

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TABLE 125-1 Burn Depth Features Classified by Degree of Burn

Burn Depth	Histology/Anatomy	Example	Healing
Superficial (first degree)	Epidermis No blisters, painful	Sunburn	7 days
Superficial partial-thickness (superficial second degree)	Epidermis and superficial dermis Blisters, very painful	Hot water scald	14–21 days, no scar
Deep partial-thickness (deep second degree)	Epidermis and deep dermis, sweat glands, and hair follicles Blisters, very painful	Hot liquid, steam, grease, flame	3–8 weeks, permanent scar
Full-thickness (third degree)	Entire epidermis and dermis charred, pale, leathery; no pain	Flame	Months, severe scarring, skin grafts necessary
Fourth degree	Entire epidermis and dermis, as well as bone, fat, and/or muscle	Flame	Months, multiple surgeries usually required

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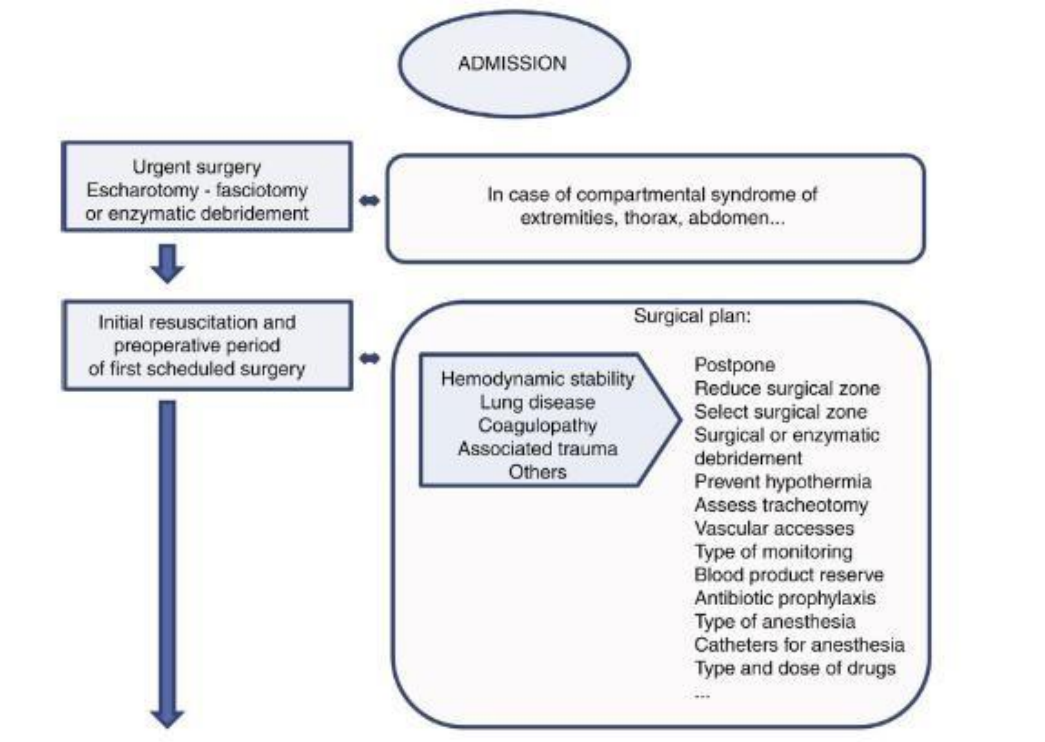
ALUR SECARA UMUM APABILA TERDAPAT KASUS LUKA BAKAR



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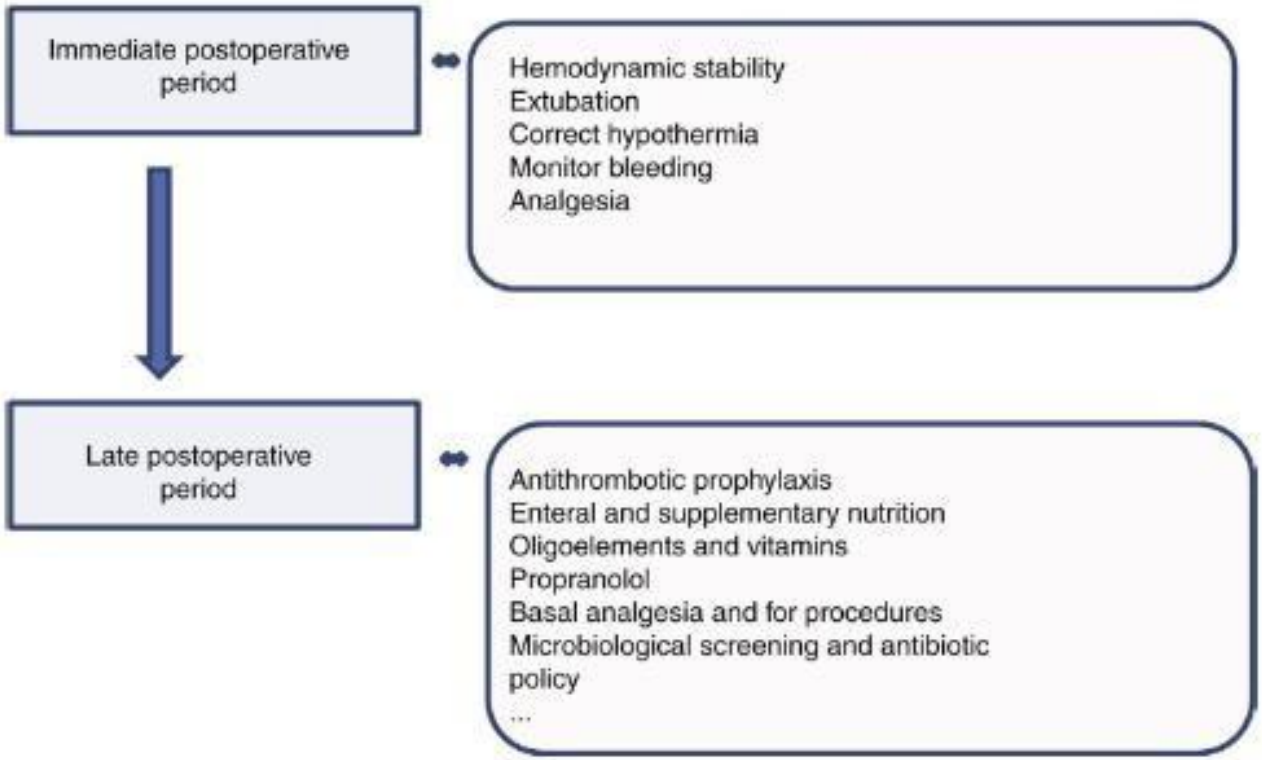

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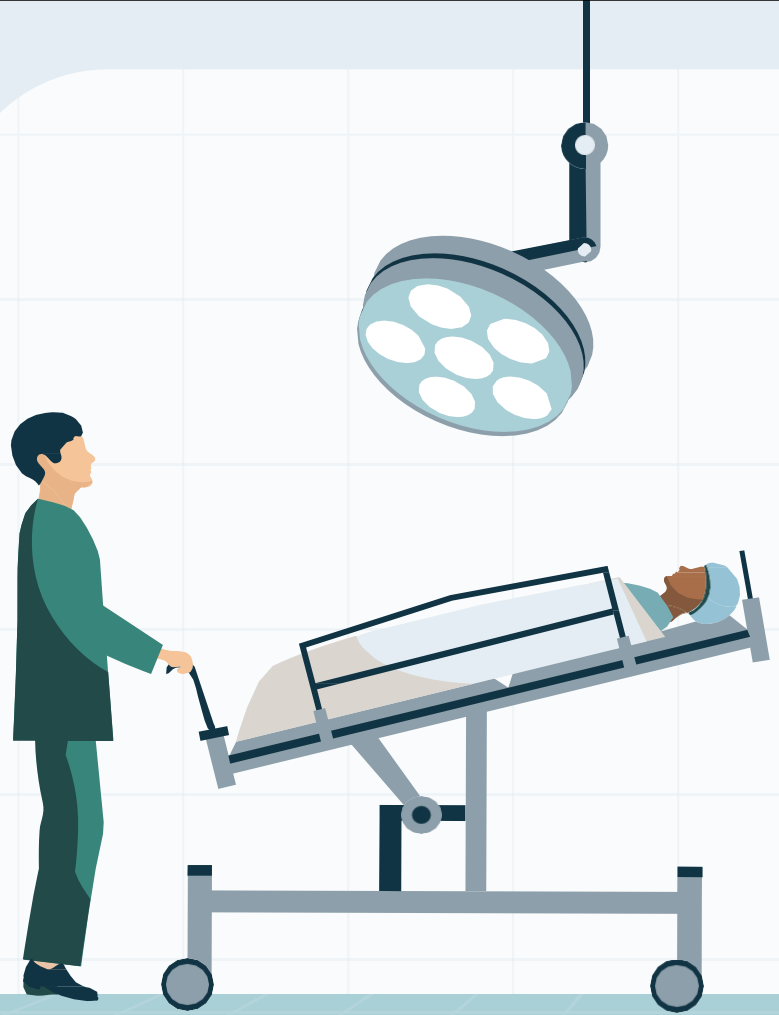

Manajemen luka bakar

- Bagaimana *Mechanism of injury?*
- Adakah komplikasi pada Airway?
- Kedalaman dan luas luka bakar ?

MECHANISM OF INJURY?

- Trauma termal yang disebabkan oleh api di ruang tertutup kemungkinan besar terkait dengan kerusakan saluran napas.
- Luka bakar akibat kecelakaan kendaraan bermotor, pesawat terbang, atau industri dapat diperparah oleh cedera traumatis lainnya.
- Luka bakar yang disebabkan oleh sengatan listrik mungkin menunjukkan sedikit bukti eksternal tetapi dapat dikaitkan dengan patah tulang yang cukup berat, hematoma, cedera visceral, dan cedera otot rangka dan jantung yang mengakibatkan nyeri, mioglobinuria, dan disritmia atau kelainan EKG lainnya.

Barash, Paul G *et al. Clinical Anesthesia 8th Ed*. Wolters Kluwer. 2017
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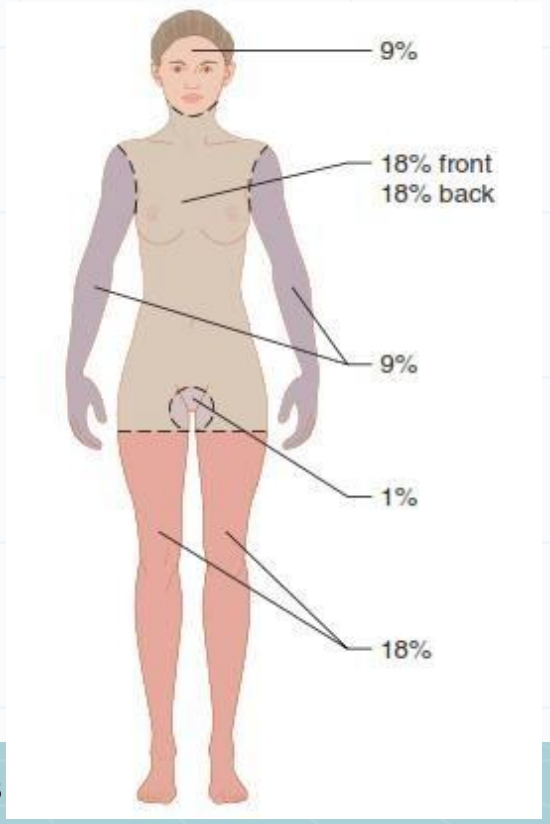
LUAS LUKA BAKAR

Menghitung luas luka bakar :
Dewasa → menggunakan metode **Rule of Nine**

Head and neck	**9%**
Upper extremities	9% each
Chest (anterior and posterior)	9% each
Abdomen	9%
Lower back	9%
Lower extremities	18% each
Perineum	1%



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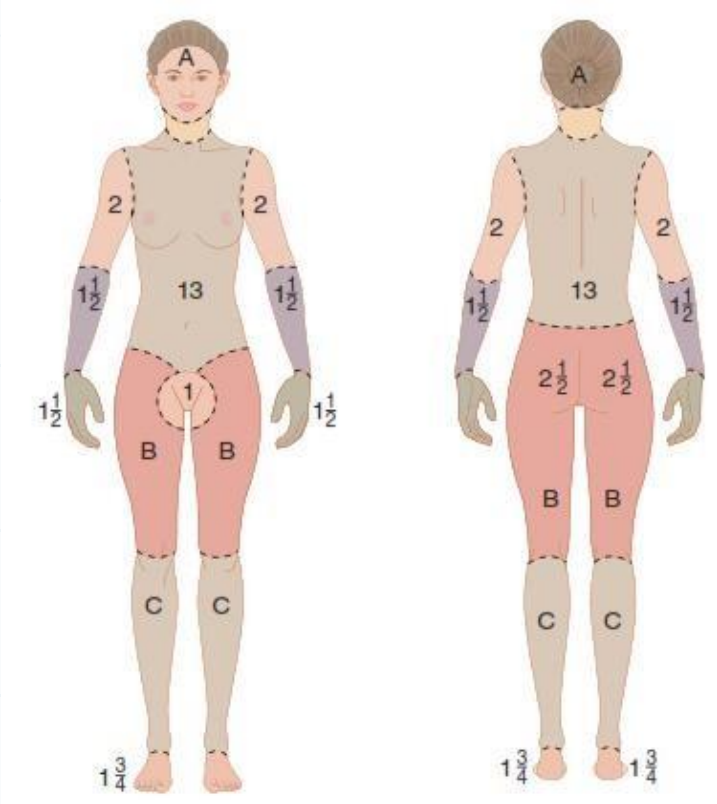
Anak- anak → Metode Lund Browder atau menggunakan telapak tangan (0,5%)



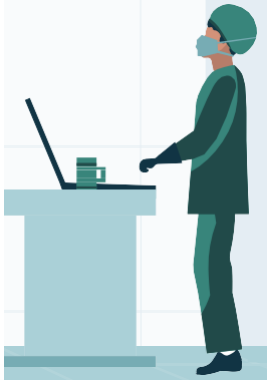
Lund Browder

FOKUS PERHATIAN UTAMA PADA KASUS LUKA BAKAR

Table 1. Immediate Concerns in Burn Care.

Problem	Comments*
Airway	
Is intubation required to prevent airway obstruction?	Indicators of a requirement for intubation (if in doubt, perform endotracheal intubation): Burn size >40% of TBSA (lower threshold if burns are deeper) Burns to the head and mouth Clinically significant smoke-inhalation injury Delayed transfer to burn center Altered level of consciousness Change in voice or hoarseness
Breathing	
Does the patient have carbon monoxide poisoning?	Indicators of carbon monoxide poisoning: elevated carboxyhemoglobin (arterial blood gas values and pulse oximeter readings are of no value) and persistent metabolic acidosis Administer 100% oxygen until carbon monoxide poisoning is ruled out
Does the patient have smoke-inhalation injury?	Indicators of smoke-inhalation injury: history of exposure to smoke in enclosed space and bronchoscopic evidence of carbonaceous material or injury below vocal cords
Circulation	
Determining burn severity and fluid requirements	Surface-area estimate is based on Rule of Nines or Lund–Browder chart Presence of deeper burns increases fluid requirements Children require more fluid/kg/% of TBSA burned than adults Delayed resuscitation increases fluid requirements Smoke inhalation increases fluid requirements Alcohol intoxication increases fluid requirements
Determining the initial resuscitation volume and rate of administration	Adjust the rate based on urine output, with a target output of approximately 0.5 ml/kg for adults and 1 ml/kg for children weighing <30 kg; urine output above these levels indicates over-resuscitation
Parkland formula	4 ml/kg/% of TBSA burned, with starting rate based on giving half the 24-hr volume in the first 8 hr Example of a 100-kg person with 80% of TBSA burned: 4×100×80 = 32,000 ml in 24 hr 32,000÷2 = 16,000 ml in first 8 hr Starting rate = 16,000÷8 = 2000 ml/hr Adjust rate up or down for target urine output of 50 ml/hr (0.5 ml/kg/hr)
Brooke formula	2 ml/kg/% of TBSA burned, with starting rate based on giving half the 24-hr volume in the first 8 hr Example of a 100-kg person with 80% of TBSA burned: 2×100×80 = 16,000 ml in 24 hr 16,000÷2 = 8000 ml in first 8 hr Starting rate = 8000÷8 = 1000 ml/hr Adjust rate up or down for target urine output of 50 ml/hr (0.5 ml/kg/hr)

* TBSA denotes total body-surface area.



Greenhalgh, David G. Review Article : Management of Burns. *The New England Journal of Medicine*. 2019

RESUSITASI CAIRAN

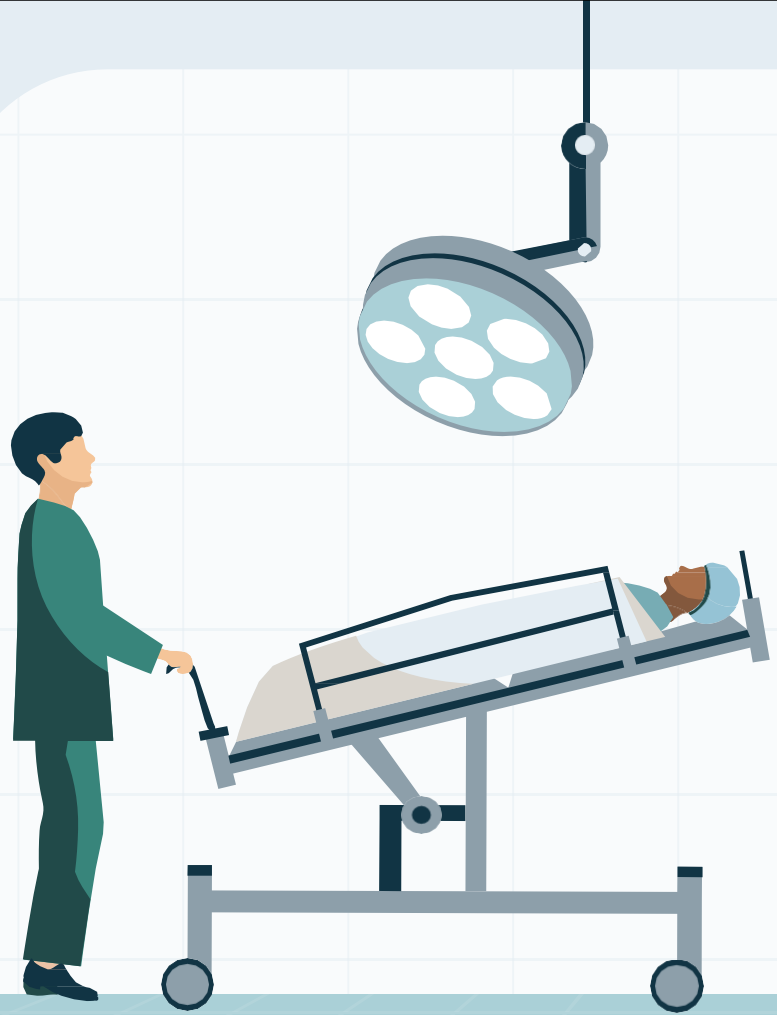
TABLE 125-3 Parkland Formula for Fluid Resuscitation

Adults

LR 4 mL × weight (kg) × % BSA burned* over initial 24 h
Half over the first 8 h from the time of burn
Other half over the subsequent 16 h
Example: 70-kg adult with 40% second- and third-degree burns:
4 mL × 70 kg × 40 = 11,200 mL over 24 h

Children

LR 3 mL × weight (kg) × % BSA burned* over initial 24 h plus maintenance
Half over the first 8 h from the time of burn
Other half over the subsequent 16 h



Manajemen Airway

Manajemen saluran napas rutin yang terkait dengan anestesi umum

- Evaluasi saluran napas sebelum anestesi
- Persiapan dan pemeriksaan peralatan
- Posisi pasien
- Pra-oksigenasi (penghilangan nitrogen)
- Ventilasi dengan kantong dan masker
- Intubasi trakea atau pemasangan laryngeal mask airway (jika diperlukan)
- Evaluasi ketepatan pemasangan
- Ekstubasi

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PADA KASUS LUKA BAKAR, APAKAH TERJADI KOMPLIKASI PADA AIRWAY?

- Cedera jalan napas dan paru-paru juga dapat terjadi tanpa inhalasi melalui mediator inflamasi yang dilepaskan dari jaringan yang terbakar, infeksi, dan resusitasi cairan.
- Gangguan pernapasan pada fase awal luka bakar biasanya disebabkan oleh panas langsung atau cedera uap pada faring atau laring.
- Rambut wajah hangus, luka bakar wajah, disfonia atau suara serak, batuk, jelaga di mulut atau hidung, dan kesulitan menelan pada pasien dengan atau tanpa gangguan pernapasan harus meningkatkan kecurigaan cedera saluran napas atas (sering) dan saluran napas bawah (sesekali).
- Pemberian konsentrasi O2 setinggi mungkin melalui masker wajah adalah prioritas pertama pada pasien luka bakar sedang hingga parah dengan jalan napas paten.

Barash, Paul G *et al. Clinical Anesthesia 8th Ed*. Wolters Kluwer. 2017
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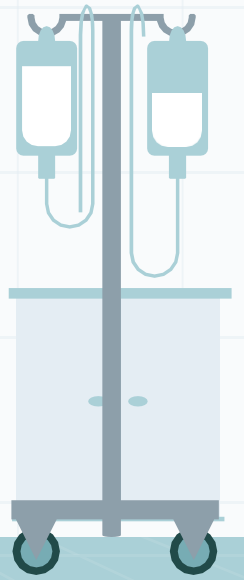
Masalah utama airway pada kasus luka bakar :

obstruksi jalan napas bagian atas

APAKAH HARUS MEMASANG ENDOTRACHEAL TUBE?



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INDIKASI PEMASANGAN ETT

- Perubahan status mental setelah luka bakar dan menghirup asap.
- Tingkat HbCO2 melebihi 20% (mereka yang secara teratur merokok memiliki tingkat HbCO2 hingga 10%)
- Suara serak, dispnea, takipnea, dan adanya stridor
- GCS <8
- Hipoksia atau hiperkapnia
- Luka bakar leher full-thickness dan luka bakar wajah yang dalam (deep facial thickness)
- Edema Orofaringeal
- TBSA >40% (edema masif mungkin terjadi selama resusitasi cairan)

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CONTOH KASUS

Pada pasien dengan luka bakar **masif**, stridor, gangguan pernapasan, hipoksemia, hiperkarbia, kehilangan kesadaran, atau perubahan mental

→ **PEMASANGAN ETT**

- Namun, sebagian besar pasien dengan luka bakar tidak memerlukan intubasi, karena luka bakarnya relatif kecil.
- Studi terbaru menunjukkan bahwa 1/3 dari pasien rawat inap dengan luka bakar diekstubasi dalam waktu 1 hari setelah masuk

Pasien dengan luka bakar yang luas dan dalam, luka bakar pada wajah, dan trauma inhalasi

→ **PEMASANGAN ETT**

- Jika ragu melakukan pemasangan ETT → dapat dilakukan pemeriksaan jalan napas bagian atas dengan laringoskop atau bronkoskop

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Dalam konteks manajemen saluran napas pada pasien dengan luka bakar, beberapa poin penting yang dibahas dalam buku **"Morgan & Michail's Clinical Anesthesiology"** sebagai berikut:

Evaluasi luka bakar pada saluran napas:

evaluasi untuk menentukan tingkat keparahan luka, adanya obstruksi saluran napas, atau kemungkinan komplikasi lainnya seperti edema atau perubahan anatomi yang mempengaruhi manajemen saluran napas.

Patensi saluran napas:

Pastikan bahwa saluran napas tetap terbuka dan bebas dari obstruksi. Pembersihan saluran napas dari debris, lendir, atau benda asing dapat diperlukan sebelum atau selama anestesi.

Intubasi endotrakeal:

Pada kasus luka bakar yang parah atau saat ada risiko obstruksi saluran napas, intubasi endotrakeal dapat menjadi pilihan untuk melindungi saluran napas dan memastikan ventilasi yang adekuat. Namun, prosedur ini harus dilakukan dengan hati-hati untuk menghindari kerusakan lebih lanjut pada jaringan yang terbakar.

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Penggunaan Laryngeal Mask Airway (LMA)

Jika intubasi endotrakeal tidak memungkinkan (misalnya pada kasus kerusakan saluran napas), penggunaan LMA dapat menjadi alternatif dalam manajemen saluran napas pada pasien dengan luka bakar.

Monitorisasi dan perawatan selama tindakan anestesi:

Pemantauan yang ketat terhadap fungsi saluran napas dan ventilasi pasien harus dilakukan selama tindakan anestesi. Penggunaan oksigen dengan konsentrasi yang tepat dan ventilasi mekanis jika diperlukan harus diperhatikan untuk memastikan oksigenasi yang memadai.

Perawatan pasca-operasi:

Setelah tindakan anestesi selesai, perawatan saluran napas harus terus dipantau dan harus diwaspadai adanya risiko komplikasi seperti edema saluran napas. Terapi oksigen dan teknik ventilasi yang sesuai diperlukan selama fase pemulihan pasca operasi.

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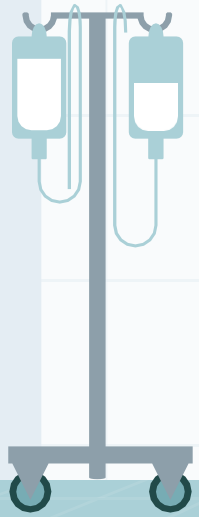
KONSIDERASI ANESTESI



Preoperative	Intraoperative	Postoperative
Anaesthetic history	Temperature: hot theatre (32°C), fluid warmers, monitor—aim to lose <1°C	Analgesia: regional blocks
TBSA+planned surgery	Monitoring limitations	Early use of multimodal analgesia including pregabalin
Co-morbidities	Oesophageal Doppler	High opioid use
Airway assessment	Airway management, large minute ventilation, often high PEEP	Others: ketamine, topical morphine
Hb/coagulation/electrolytes—ensure blood products available if necessary	Neuromuscular blocking agents: avoid succinylcholine after 24 h, resistant to non-depolarizing muscle relaxants (NDMR)	Pain team—involve early
Vascular access	Vasopressors/inotropes	Location—possible need for critical care
Limited fasting	Epinephrine used in soaked swabs to reduce blood loss	Warm room
If IPPV+high PEEP/airway pressures, consider procedure in room	Positioning: prolonged procedure, may be proned	Clinical psychology involvement
	Timing—often prolonged procedure	Physiotherapy

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Fluids	Crystalloids are mainstay of therapy during early phase of burn injury; consider colloids > 24 hours after burn injury.
Succinylcholine	Succinylcholine okay within < 24 hours of burn injury; avoid if > 24 hours and for at least 18 months after burn injury.
Nondepolarizing muscle relaxants	↑ Dose frequency and requirements (2- to 5-fold) during hyperdynamic phase, reversal agent requirements are unchanged.
	Consider rocuronium (up to 1.2 mg/kg) for rapid-sequence induction if > 24 hours after burn injury.
IV anesthetics	↓ Dose requirements during early phase; ↑ Dose requirements during hyperdynamic phase of injury.
	Consider multimodal therapy (eg, opioids, propofol, ketamine, benzodiazepines).
Inhalation agents	↓ MAC during early phase of burn injury; ↑ MAC during hyperdynamic phase of burn injury
	May be beneficial in the setting of inhalation injuries.
Beta blockers	Attenuates the hyperdynamic phase of burn injury
Insulin	Attenuates the hyperdynamic phase of burn injury

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SEDASI DAN ANESTESI

Stage of Injury	Background Anxiety	Background Pain	Procedural Anxiety	Procedural Pain
Acute burn ventilated	#1 Midazolam infusion	Morphine infusion	Midazolam boluses	Morphine boluses
	#2 Dexmedetomidine infusion	Morphine infusion	Dexmedetomidine higher infusion rate	Morphine boluses
	#3 Antipsychotics	Morphine infusion	Haloperidol (very slow) boluses	Morphine boluses
	#4 Propofol infusion (<48 h)	Morphine infusion	Propofol boluses	Morphine boluses
Acute burn not ventilated	Dexmedetomidine IV or scheduled lorazepam IV or PO	Morphine IV or PO	Lorazepam IV/PO	Morphine IV/PO or Ketamine IV
Chronic acute burn	Scheduled lorazepam or antipsychotics (PO)	Scheduled morphine or methadone	Lorazepam or antipsychotics (PO)	Morphine PO or oxycodone

Fentanyl infusions could be substituted for morphine infusions. In view of the increased incidence of delirium with benzodiazepines, minimal use of them is advocated.

IV = intravenous; PO = per oram (by mouth).

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Terima Kasih