

Trauma Anaesthesia



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ΠΓΝΘ “ΑΧΕΠΑ”

Vascular access

Hypothermia

Anaesthesia

- Pharmacology
- Hemodynamic pitfalls

Airway

Traumatic brain injury

**Make it easy for yourself
to have a success!**

Vascular Access

What Are Your Strategies?

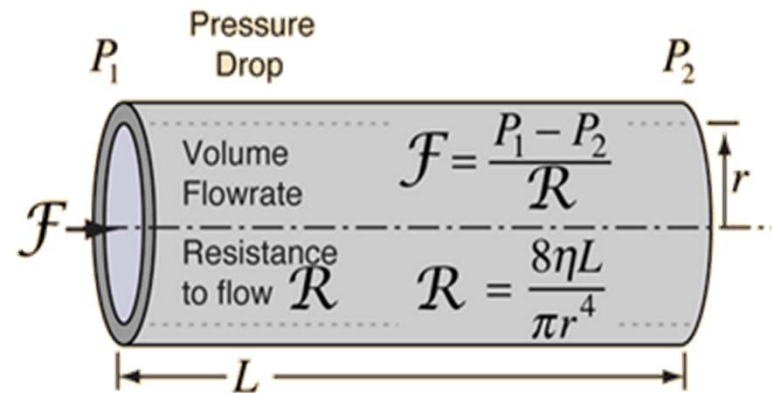
Peripheral

Intraosseus

Central access

Pressure bags

Stopcocks / Extension sets / Valves



Costs approx
50ml/min – each:



Flow Rates

mm	2.2	1.8	1.3	1.1	0.9	0.7
ml/ min	315	210	110	65	38	13
ml/ min (målt)	440	340	193	125	91	



Photo: Nina Holt

Hypothermia

Plenty of reasons & known effects

- Decreased drug clearance, e.g. citrate metabolism
- Coagulopathy & decreased platelet function

All guidelines recommend to prevent heat loss

- *We recommend early application of measures to reduce heat loss and warm the hypothermic patient in order to achieve and maintain normothermia. (Grade 1C)*

Hypothermia Prevention

Ambient temperature

Covering up the patients

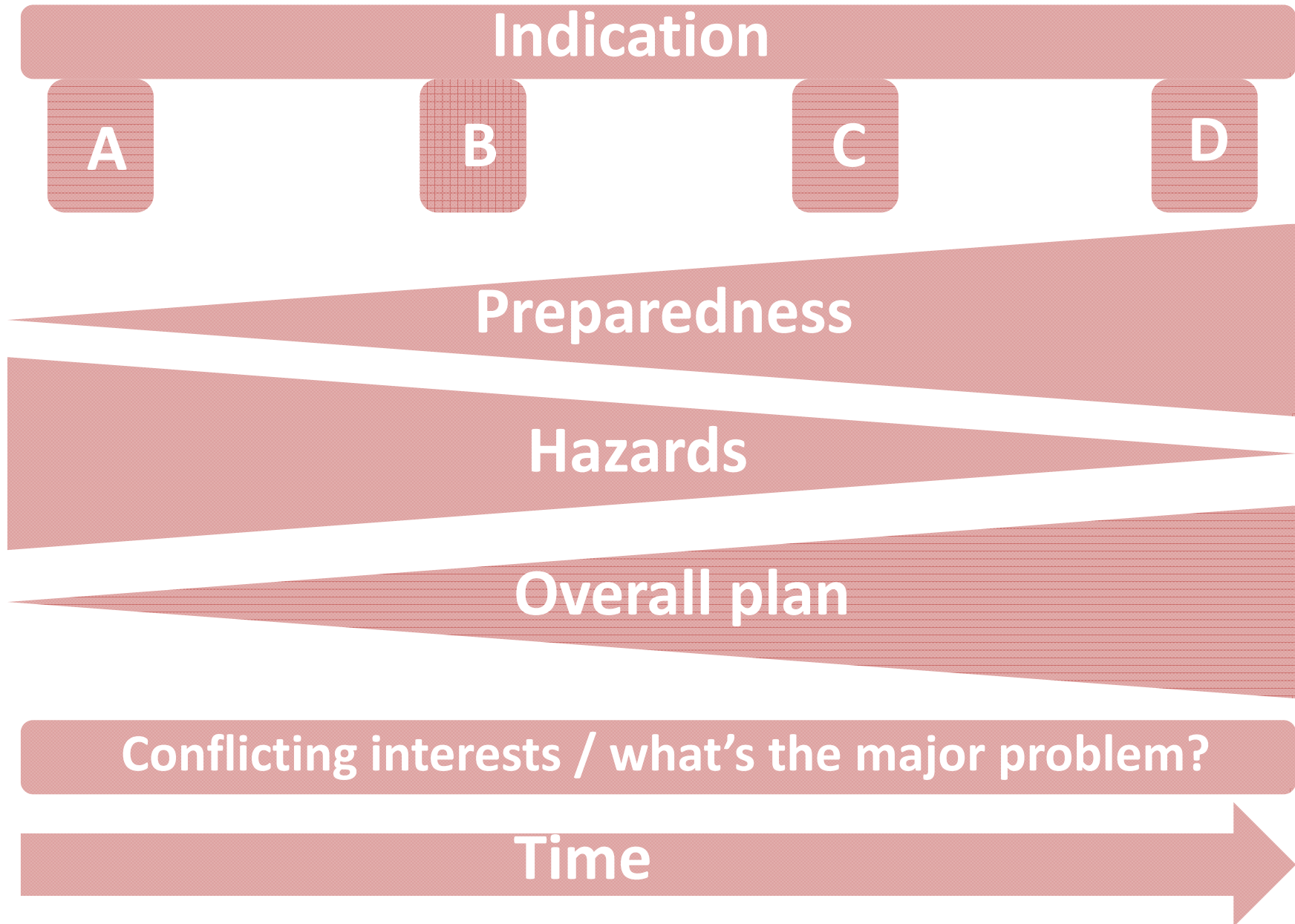
Fresh gas flow / heating in intubated patients

Warmed irrigation fluids

Fluid heaters

Anaesthesia induction

Timing RSI



Cardiovascular Challenges RSI

Shock

- Hypovolemic
- Obstructive
- Distributive
- Cardiogenic

ANYONE CAN
INTUBATE



*A Step-by-Step Guide
to Intubation and
Airway Management*

Christine E. Whitten, M.D.

Or
cannot?



FENTA,
NO FANTA!!



What do you use ?

The Ideal Induction Drug for RSI

- Physical properties
- Pharmacokinetic properties
- Pharmacodynamic properties

Thiopental

Advantages

- ➔ Rapid onset [30-45sec]
- ➔ Short acting [5-10min - distribution]
- ➔ Preservation of autonomic responsiveness

Thiopental

Disadvantages & Considerations

- ⇒ Negative inotropic action
- ⇒ Vasodilatation
- ⇒ ↓ BP
- ⇒ → ↓ CO

Thiopental

Use with caution

Reduce the dose

⇒ <3mg/kg

is convincing **first choice** in severe haemodynamic compromise

Propofol

Advantages

- ➔ Short acting [5-10min]
- ➔ Stable HR

Propofol

Disadvantages & Considerations

⇒ ↓ BP

⇒ ↓ CO

Propofol

Use with caution

Reduce the dose

⇒ ↓ 1/3

NOT a good choice in severe haemodynamic compromise
Better avoid it

Etomidate

Advantages

- ➔ Rapid onset [30-45sec]
- ➔ Short acting [5-10min]
- ➔ Minimal changes in pharmacokinetics
- ➔ Minimal changes in pharmacodynamics
- ➔ Ø Increased drug sensitivity
- ➔ Ø Dose adjustment required

Etomidate

Advantages

- ⇒ ∅ Vasodilatation
- ⇒ ∅ Myocardial depression
- ⇒ Preserves pressor response to INT

Seems a **good & safe** choice
in severe haemodynamic compromise

Etomidate

Disadvantages & Considerations

- ⇒ Corticus study
- ⇒ Adrenal suppression [12-24hrs]
- ⇒ Outcome???

Steroid suppression did NOT seem to affect outcome (mortality & length of stay) in non-septic trauma patients

Single induction dose of etomidate versus other induction agents for endotracheal intubation in critically ill patients (Review)

Cochrane Database Syst Rev. 2015 Jan 8;1:CD0102

OBJECTIVES: The **primary objective** was to assess, in populations of critically ill patients, whether a single induction dose of etomidate for emergency airway intervention affects mortality. The **secondary objectives** were to address, in populations of critically ill patients, whether a single induction dose of etomidate for emergency airway intervention affects adrenal gland function, organ dysfunction, or health services utilization (as measured by intensive care unit (ICU) length of stay (LOS), duration of mechanical ventilation, or vasopressor requirements). We repeated analyses within subgroups defined by the aetiologies of critical illness, timing of adrenal gland function measurement, and the type of comparator drug used.

Single induction dose of etomidate versus other induction agents for endotracheal intubation in critically ill patients (Review)

Cochrane Database Syst Rev. 2015 Jan 8;1:CD0102

RESULTS: We included eight studies in the review and seven in the meta-analysis. Of the seven studies, only two were judged to be at low risk of bias. Overall, no strong evidence that etomidate increases mortality in critically ill patients when compared to other induction agents (odds ratio (OR) 1.17; 95% confidence interval (CI) 0.86 to 1.60, 6 studies, 772 participants, moderate quality evidence). Due to a large number of participants lost to follow-up, we performed a post hoc sensitivity analysis. This gave a similar result (OR 1.17; 95% CI 0.86 to 1.53). There was evidence that the use of etomidate in critically ill patients was associated with a positive adrenocorticotrophic hormone (ACTH) stimulation test, and this evidence was more pronounced at between 4 to 6 hours (OR 19.98; 95% CI 3.95 to 101.1) than after 12 hours (OR 2.37; 95% CI 1.61 to 3.47) post-dosing. Etomidate's use in critically ill patients was associated with a small increase in SOFA score, indicating a higher risk of system organ failure (mean difference (MD) 0.70, 95% CI 0.01 to 1.39, 2 studies, 591 participants, high quality evidence), but this difference was not clinically meaningful. Etomidate did not have an effect on ICU LOS (MD 1.70 days; 95% CI -2.00 to 5.40, 4 studies, 621 participants, moderate quality evidence), hospital LOS (MD 2.41 days; 95% CI -7.08 to 11.26, 152 participants, moderate quality evidence), duration of mechanical ventilation (MD 1.00 days; 95% CI -1.67 to 5.95, 3 studies, 621 participants, moderate quality evidence), or duration of vasopressor use (MD 1.00 day; 95% CI -0.53 to 2.53, 1 study, 469 participants).

Single induction dose of etomidate versus other induction agents for endotracheal intubation in critically ill patients (Review)

Cochrane Database Syst Rev. 2015 Jan 8;1:CD0102

AUTHORS' CONCLUSIONS: Although we have not found conclusive evidence that etomidate increases mortality or healthcare resource utilization in critically ill patients, it does seem to increase the risk of adrenal gland dysfunction and multi-organ system dysfunction by a small amount. The clinical significance of this finding is unknown. This evidence is judged to be

The effect of single dose etomidate during emergency intubation on hemodynamics and adrenal cortex

Ulus Travma Acil Cerrahi Derg. 2015 Sep;21(5):358-

Group I patients were intubated with a 0.3 mg/kg etomidate IV (Etomidate Lipuro, Braun, Germany) and a 1.2 mg/kg rocuronium IV (Esmeron, Organon, Belgium).

Group II patients were intubated with a 0.3 mg/kg etomidate IV and rocuronium 1.2 mg/kg IV following a 2 mg/kg methylprednisolone IV (Prednol, Mustafa Nevzat, Turkey) given 2–4 minutes before etomidate.

Group III patients were intubated with a 0.15 mg/kg midazolam^[7] IV (Dormicum, Roche, France) and 1.2 mg/kg rocuronium IV.

The effect of single dose etomidate during emergency intubation on hemodynamics and adrenal cortex

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Results

- ⇒ ↓ SBP at 24hrs [Group 1]
- ⇒ Adrenal suppression max at 4hrs [Group 1]
- ⇒ ↑ HR [Group 1]

Methylprednisolone can prevent adrenal insufficiency

Ketamine

Advantages

- ⇒ Rapid onset [30-60sec]
- ⇒ Short acting [5-10min]
- ⇒ Stimulatory effect on cardiovascular system
 - ⇒ Centrally mediated sympathetic responses
- ⇒ Inhibition of noradrenaline re-uptake
- ⇒ Preserves spontaneous breathing



Severely shocked patients with catecholamine exhaustion & resistance

➔ **collapse might still occur**

Ketamine

Disadvantages & Considerations

⇒ ↑ Intracranial Pressure

⇒ TBI

⇒ impairment of autoregulation

⇒ CBF ~ CPP

⇒ ↓ Cerebral Oxygen Consumption

Maybe overall balance is favorable & outweighs potential risks

Benzodiazepines

Considerations

- ⇒ ↑ Protein bound
- ⇒ Slow onset
- ⇒ ↓ SVR
- ⇒ ↓ BP
- ⇒ Prevents compensatory tachycardia

Of **little value** for RSI

Ketofol: Ketamine+Propofol

Medline

- ⇒ 76 results [starting 2007]
- ⇒ Many animal studies
- ⇒ A few clinical studies
- ⇒ Mainly used as a “procedural sedation” agent

Ketamine/propofol admixture (ketofol) is associated with improved hemodynamics as an induction agent: A randomized controlled trial *J Trauma Acute Care Surg.* 2012;73:9

Randomized, double-blinded clinical trial

- ⇒ 80 patients ASA-PS: I-II
- ⇒ Elective surgery
- ⇒ Ketofol [1.5+0.75mg/kg] vs Propofol [2mg/kg]

Primary outcome

- ⇒ Haemodynamic stability [↓20%BP]

Ketamine/propofol admixture (ketofol) is associated with improved hemodynamics as an induction agent: A randomized controlled trial

J Trauma Acute Care Surg. 2012;73:9

Table 3. Changes in Systolic Blood Pressure 30 Minutes After Induction of General Anesthesia

	Propofol (N = 43), %	n	"Ketofol" (N = 41), %	n	Odds Ratio	Comparison 95% CI
(20%)	48	21	12	5	6.87	2.07 to 26.15
(20%)	48	21	17	7	4.64	1.54 to 14.92
P (20%)	44	19	10	4	7.12	1.98 to 31.64
(20%)	67	29	39	16	3.24	1.21 to 8.75
(20%)	62	27	41	17	2.38	0.91 to 6.29
P (20%)	60	26	35	14	2.84	1.07 to 7.65
(20%)	76	33	68	28	1.53	0.52 to 4.55
(20%)	90	39	78	32	2.74	0.68 to 13.19
P (20%)	83	36	75	30	1.71	0.51 to 5.97

Ketofol is associated with improved haemodynamics in ASA-PS: I-II patients

etamine/propofol admixture (ketofol) at
duction in the critically ill against etomidate
EEP PACE trial): study protocol for a
ndomized controlled trial

Smischney et al. *Trials* (2015) 16:
DOI 10.1186/s13063-015-0687-0

First randomized clinical trial

- ➔ Emergent or urgent EIT
- ➔ Critically ill patients
- ➔ Ketofol vs Etomidate

Primary outcome

- ➔ Haemodynamic stability

ketamine/propofol admixture (ketofol) at induction in the critically ill against etomidate (KEEP PACE trial): study protocol for a randomized controlled trial

Smischney et al. *Trials* (2015) 16:
DOI 10.1186/s13063-015-0687-0

In summary, KPA was not superior to a reduced dose of etomidate in terms of hemodynamic profile and new-onset vaso-pressor need after emergent intubation in critically ill patients. There were no differences in frequency of delirium or intubation difficulty. KPA appears to be a safe alternative induction agent compared with reduced dose etomidate and should be considered whenever adrenal insufficiency is a concern.

Rapid sequence induction in the emergency department: induction drug and outcome
patients admitted to the intensive care unit

Emerg Med J 2009;26:576-5

Methods

- ⇒ 525 patients → RSI [ED] → ICU
- ⇒ Choice of induction drug not controlled

Results

- ⇒ Etomidate → 184
- ⇒ Thiopental → 306
- ⇒ Propofol → 35

rapid sequence induction in the emergency department: induction drug and outcome
patients admitted to the intensive care unit

Emerg Med J 2009;26:576-5

Conclusion

- ➔ No difference in mortality
- ➔ Induction drug was not related to outcome

Physicians should choose an **induction drug** based on
individual patient circumstances

Opioids

Classical RSI ➔ ∅ Opioids

Fentanyl ➔ accepted as best choice [1-3µg/kg]

Pros

- ➔ Blunts sympathetic surge of INT
- ➔ Rapid onset
- ➔ Short duration

Cons

- ➔ Mild drop in BP
- ➔ Chest wall rigidity [100µg/kg]

Opioids allow ↓ dose of the sedative agent & thus the side effects

Muscle Relaxant

Suxamethonium vs Rocuronium

Suxamethonium

Pros

- ➔ Rapid onset [30-45sec]
- ➔ Short duration [3-10min]

Cons

- ➔ Triggering malignant hyperthermia
- ➔ Hyperkalemia [burn patients>24hrs]

Muscle Relaxant

Suxamethonium vs Rocuronium

Rocuronium

Pros

- ➔ Rapid onset [55-75sec]
- ➔ Failed INT ➔ Suggamadex [16mg/kg]

Cons

- ➔ Long duration [50-70min]

Timing of administration

“Predetermined” vs “Sleep” dose

Timing of administration

“Predetermined” dose
rapidly inject a precalculated dose

Pros

⇒ Shorter time to INT

Cons

⇒ Overdosing

⇒ Underdosing

Timing of administration

“Sleep” dose

titration of the dose until loss of consciousness

Pros

⇒ Titration to avoid over/underdosing

Cons

⇒ Prolongation of induction time

At risk interval time [LOC-INT] is the same regardless of the technique used

Defasciculation

Non depolarizing NMBD 3min prior to Succs \Rightarrow \downarrow Incidence side effects

Pros 

- \Rightarrow Penetrating eye injury
- \Rightarrow \uparrow ICP

Cons 

- \Rightarrow Emergency airway does not allow it
- \Rightarrow Pharyngeal weakness?
- \Rightarrow Breathing difficulties?
- \Rightarrow Pulmonary aspiration?

Manual ventilation

Cons



- ⇒ Gastric insufflation
- ⇒ ↑ Aspiration risk

Gentle mask ventilation acceptable

- ⇒ Certain patients
 - ↑ risk of desaturation
 - INT might be difficult or prolonged
- ⇒ Experienced physicians
- ⇒ Cricoid pressure application

Cricoid Cartilage Pressure

“Firm” pressure application

[1kg: awake patient / 3kg: LOC]

Pros

⇒ Prevents regurgitation

Cons

CP should be immediately released in case of difficult INT or active vomiting

⇒ High possibility of incorrect application

Patient Position

Elevated sniffing position [30°]

Trauma patients: Reverse Trendelenburg position

Pros

⇒ Prevents from passive regurgitation

Cons

⇒ Active vomiting → Inevitable aspiration

Patient Position

Elevated sniffing position [30°]

Trauma patients: Reverse Trendelenburg position

Pros

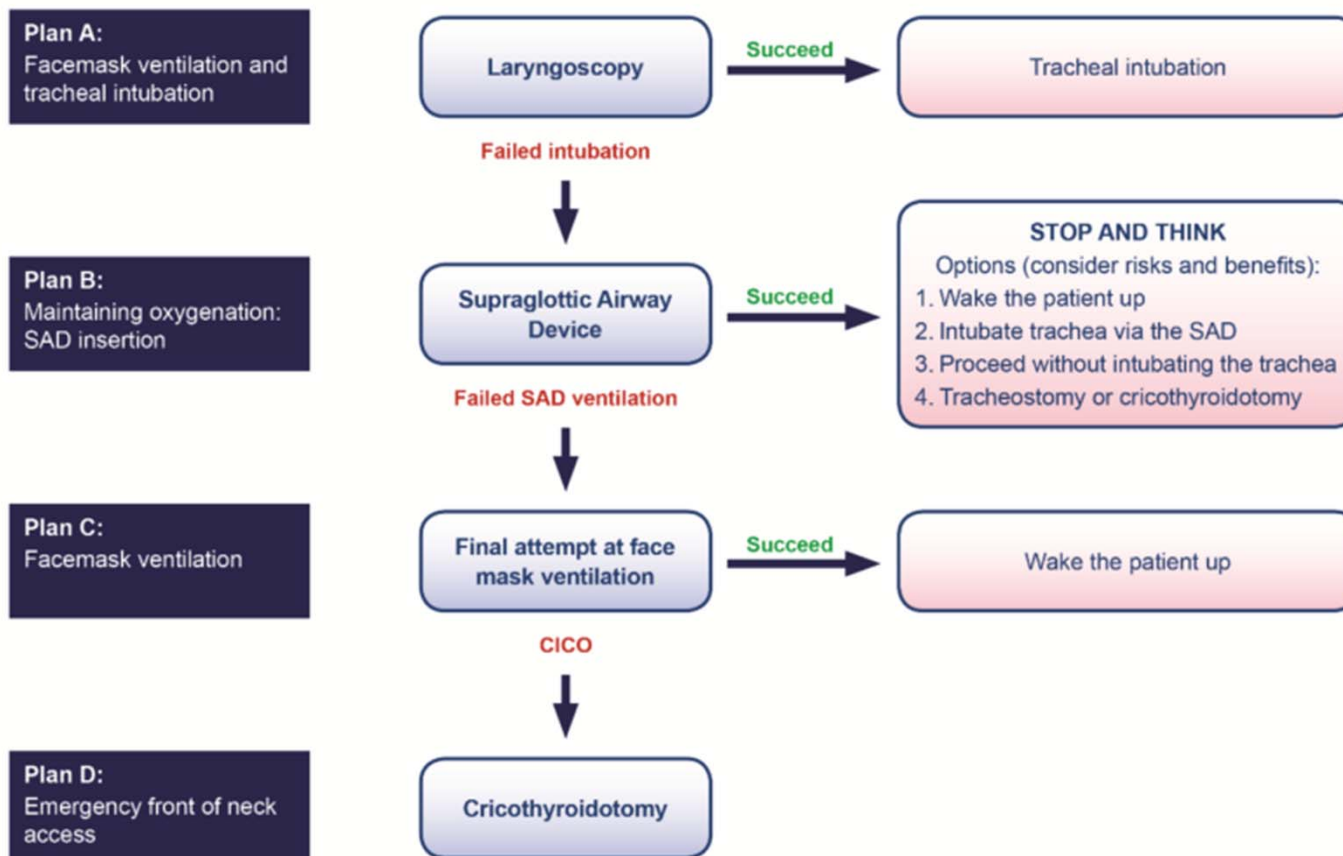
➔ Prevents from passive regurgitation

Cons

Active vomit ➔
Table should be tipped head down ➔
Any vomitus will be directed
away from trachea



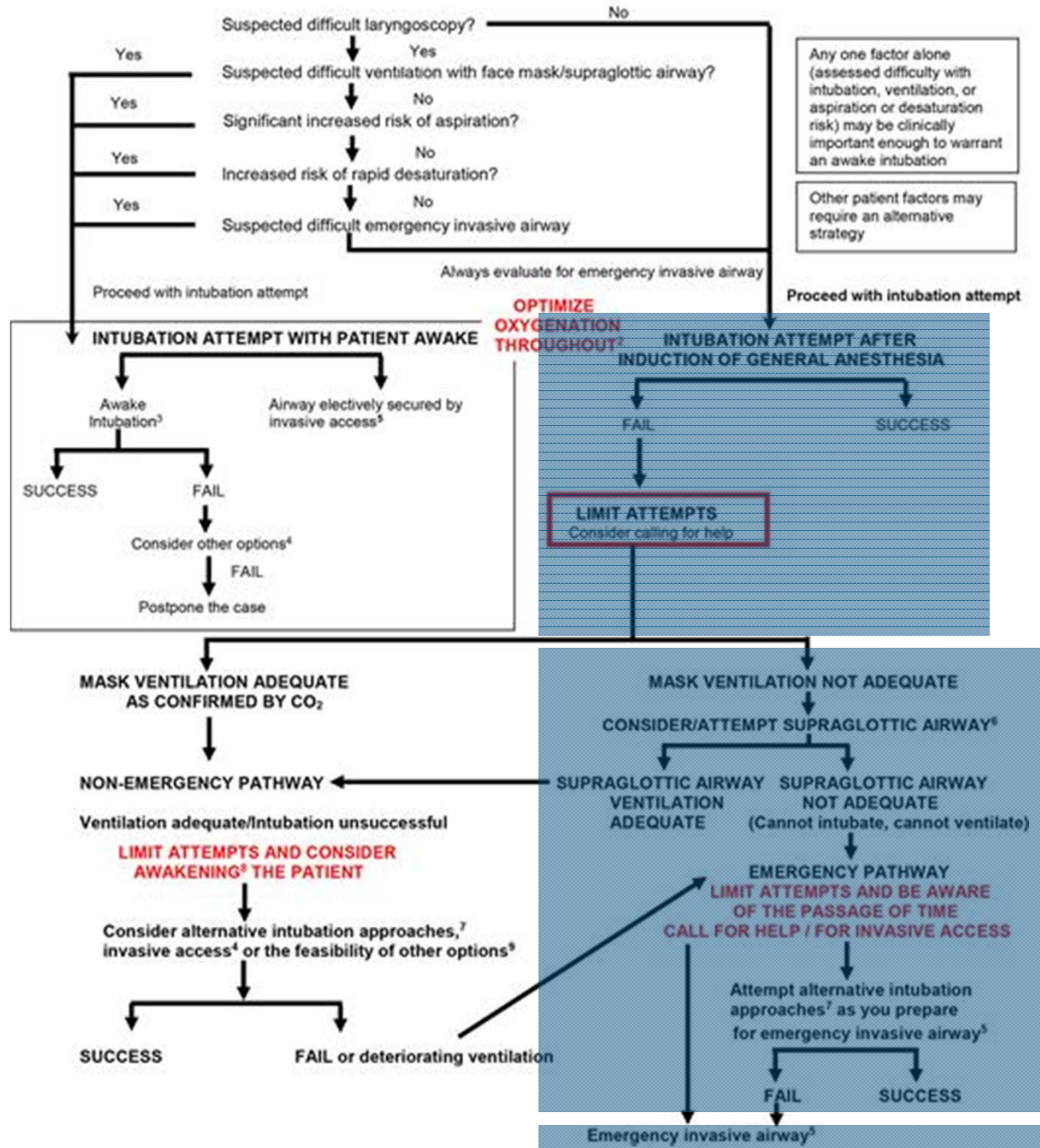
DAS Difficult intubation guidelines – overview



This flowchart forms part of the DAS Guidelines for unanticipated difficult intubation in adults 2015 and should be used in conjunction with the text.

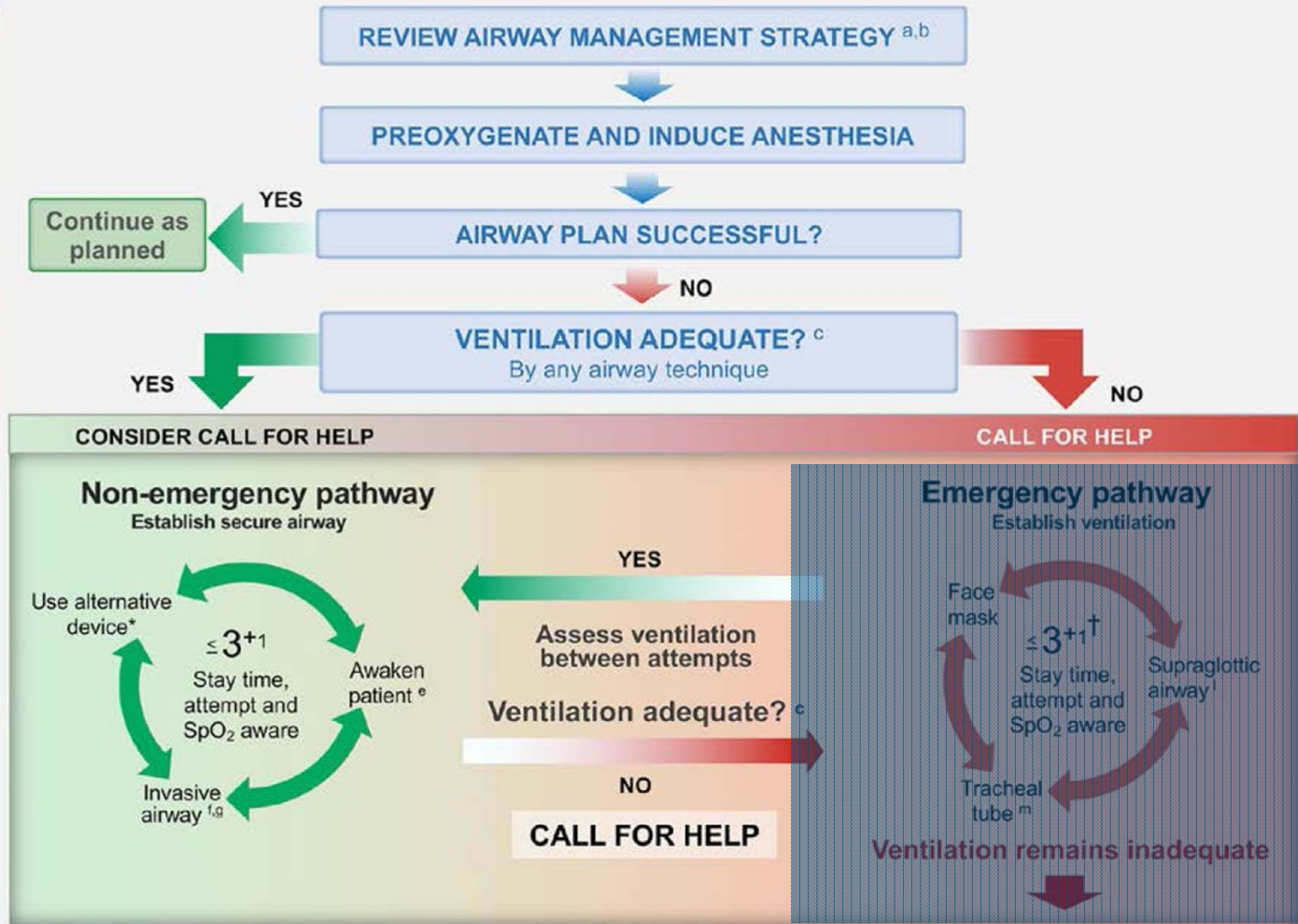
ASA DIFFICULT AIRWAY ALGORITHM: ADULT PATIENTS

Pre-Intubation: Before attempting intubation, choose between either an awake or post-induction airway strategy. Choice of strategy and technique should be made by the clinician managing the airway.¹



Part 3: Airway Management with Induction of Anesthesia

Deliver oxygen / optimize oxygenation^j



[†] Limit attempts^j, alternate & optimize^k techniques, avoid task fixation

* Alternative device examples: supraglottic airway, direct laryngoscope, videolaryngoscope, flexible intubation scope

**Emergency invasive airway^{f,g,d}
Rigid bronchoscopy, ECMO**

?

Summary

Balance

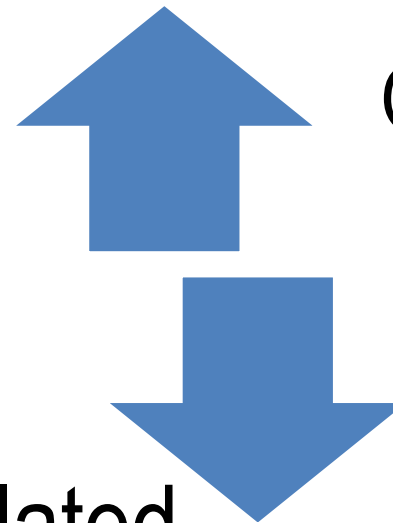
No magic recipe

Several controversial issues

No standard RSI protocol

Individualised best choice

- ⇒ Patient related
- ⇒ Clinical situation related
- ⇒ Physician related



Overdosing

Underdosing