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Research Article

Effects of Intravenous Lignocaine on Haemodynamic Responses to Laryngoscopy and Tracheal Intubation in Adults Under General Anaesthesia: A Meta-Analysis

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ABSTRACT

Background: Laryngoscopy and tracheal intubation stimulates a short-lived and sometimes very pronounced sympathetic discharge, which results in an increase of arterial pressure and tachycardia. The pressor response can lead to myocardial ischaemia, arrhythmia or an increase in ICP in patients with limited cardiovascular or cerebrovascular reserve. The use of intravenous (IV) lignocaine as a cheap, simple way to blunt this response has been in use for many years, but there has been inconsistent and sometimes conflicting evidence of its effectiveness, optimum dosage and safety.

Objective: To systematically review the efficacy and safety of pre-intubation intravenous (IV) lignocaine for attenuation of the haemodynamic response to laryngoscopy and tracheal intubation in adults under general anaesthesia and provide a summary of the most recent dedicated meta-analysis on this topic.Objective: To summarise the most recent dedicated meta-analysis of the efficacy and safety of pre-intubation intravenous (IV) lignocaine for attenuation of the haemodynamic response to laryngoscopy and tracheal intubation in adults under general anaesthesia and to synthesize randomised controlled trial (RCT) evidence published between 2022 and 2026 on this topic.

Methods: A structured search of the literature was performed in PubMed/MEDLINE, Embase, Scopus and the Cochrane Library for RCTs and systematic reviews published between 2022 and 2026, which included reports of IV lignocaine use and intubation-related haemodynamic parameters. The population, dosing regimen for lignocaine, comparator, and haemodynamic and safety outcomes were extracted and synthesized narratively and the most recent dedicated meta-analysis on these outcomes that was identified in the literature was used for quantitative pooling.

Results: 18 articles satisfied the eligibility criteria (one dedicated meta-analysis of 18 RCTs, 1056 patients; and 17 other primary studies or related systematic reviews published since 2022). The pooled data shows that IV lignocaine 1-2 mg/kg effectively reduces the mean arterial pressure (MAP) increase observed during laryngoscopy/scope intubation, and its effect on heart rate (HR) is not consistent with dose or population characteristics. These are corroborated by individual trials 2022-2025, including obstetric, paediatric, neurosurgical and comparator-drug contexts, and an overall favourable safety profile compared to control.

Conclusion: IV lignocaine 1.0-2.0 mg/kg given 1-3 minutes prior to laryngoscopy is an effective and inexpensive adjunct to help reduce the MAP response to intubation and has a more variable effect on HR. More large-scale, multi-center studies using consistent doses, dose timing and reporting of adverse events are needed to further clarify dosing recommendations for different patient populations.

Keywords: Lignocaine; Lidocaine; laryngoscopy; Tracheal intubation; Haemodynamic response; General anaesthesia; Systematic review; Meta-analysis

INTRODUCTION

Direct laryngoscopy and tracheal intubation are vital parts of induction of general anaesthesia, but also are some of the most stimulating manoeuvres that the patient will undergo during the perioperative period. Mechanical stimulation of the epiglottis, vallecula and posterior pharyngeal wall stimulates afferent glossopharyngeal and vagal pathways which in turn release a flood of circulating catecholamines. Clinically it is the elevation of heart rate, systolic and diastolic blood pressure and mean arterial pressure (MAP), which usually reaches its peak in 1-2 minutes after intubation and subsides in 5 minutes in healthy individuals, but which, in individuals with coronary artery disease, cerebrovascular disease, poorly controlled hypertension, or elevated intracranial pressure, can be not only uncomfortable but potentially dangerous; case reports and cohort data have identified exaggerated pressor responses as a risk factor for myocardial ischaemia, arrhythmia and intracranial haemorrhage [1-4]. It can be proposed that the haemodynamic action of lignocaine is mediated through a number of mechanisms

including the suppression of the afferent neural traffic resulting from laryngoscopy, direct membrane-stabilising action on cardiac and vascular tissue and a suppression of the central sympathetic response to airway stimulation, and it is these effects that may help to explain its proposed role in blunting this response, which is also its role as an analgesic for the pain associated with propofol and rocuronium injection, and suppression of cough when induced by opioid administration or intubation. The evidence supporting the haemodynamic efficacy of IV lignocaine has been inconsistent, and has been in use for decades without adequate research. In parallel to the earlier evidence base, and in the last five years, a new body of primary research has investigated lignocaine use in various contexts, including obstetric, paediatric and neurosurgical settings, as well as various comparator drug groups, all of which allows an opportunity to revisit and expand on the conclusions of the 2025 meta-analysis. This paper aims to conduct a systematic review of the RCTs and systematic-review evidence published in the last five years (2022-2026) investigating the effect of IV lignocaine on haemodynamic responses to laryngoscopy and tracheal intubation in adults under general anaesthesia. Its goal is to (i) summarise the direction and consistency of the reported effect on MAP and HR, (ii) explore the effects of dose, timing, and population on efficacy, (iii) characterise the reported safety profile and (iv) place lignocaine in the context of other pharmacological alternatives, specifically dexmedetomidine, esmolol, and remifentanil [4-8].

METHODS

Protocol and reporting

This review was written and reported according to the general structure that has been recommended for systematic reviews of interventions but with the following points made a priori for inclusion: a structured search strategy and a transparent method for synthesizing data. A quantitative pooling of raw trial data was not repeated due to the diversity of dosing regimens, comparators and outcomes reported across the identified literature, and so this review synthesises findings narratively and where a rigorously conducted dedicated meta-analysis was available in the literature also includes the pooled effect estimates from that meta-analysis and the primary trials identified independently for the 2022-2026 window.

Search strategy

The following databases were searched electronically: PubMed/MEDLINE, Embase, Scopus and the Cochrane Central Register of Controlled Trials as well as hand searching of reference lists of retrieved articles and related reviews. Search terms included the terms “lignocaine” or “lidocaine”, “laryngoscopy” or “tracheal intubation” or “endotracheal intubation”, and “haemodynamic” or “heart rate” or “blood pressure” or “pressor response”, and were limited to human studies published between January 2022 and July 2026. No language restrictions were put in place at the search phase, however, non English reports that were not translated were removed [9-11].

Eligibility criteria (PICOS)

Population: Adult (aged ≥18) patients under general anaesthetic needing laryngoscopy and tracheal intubation. Intervention: IV lignocaine prior to laryngoscopy, at any dose or time. Placebo, no intervention, alternative dose of lignocaine, alternative pharmacological agent (e.g. dexmedetomidine, esmolol, remifentanil, magnesium sulphate). Outcomes: change in heart rate, systolic/diastolic/mean arterial pressure from baseline to the post-intubation period, and reported adverse events. Designs: RCTs and systematic reviews/meta-analyses of RCTs. Studies in which lignocaine was given with another agent to such an extent that the effect of the other agent could not be separated were excluded as were case reports, narrative commentaries and studies limited to cardiac surgical populations undergoing sternotomy[12-15].

Study selection and data extraction

Titles and abstracts of retrieved records were checked to see if they matched the eligibility requirements, and complete copies of all records that were not clearly eliminated at this stage were retrieved. These data were extracted from each eligible study: authors, year and country of the study, number of patients, population of patients, any identified clinical sub-group (e.g. pre-eclampsia, paediatric, neurosurgical), dose of lignocaine and timing of administration following laryngoscopy, comparator arm, direction and, if reported, magnitude of changes in HR and MAP, and adverse events (if any).

Data synthesis

Due to the heterogeneity in the dosage regimens used (fixed 40 mg dose versus weight adjusted dosage of 0.5-2 mg kg), timing (30 seconds before laryngoscopy to 15 minutes before laryngoscopy) and reporting the outcome (as death, survival, or number of successful procedures) across the identified literature from 2022-2026, a narrative synthesis approach was adopted, categorised by dose, timing, population subgroup, and comparator. If a rigorously conducted meta-analysis provided pooled mean difference and 95% confidence interval for MAP and HR, these are reported, but the preponderance of existing rigorously conducted meta-analysis did not provide pooled mean differences and CI for MAP and HR, so these were not re-computed but rather identified as the best available quantitative synthesis and are explicitly attributed to their source[15-21].

RESULTS

Overview of Included Evidence

Of the 18 sources that were eligible for this review, 3 were selected. These included one systematic review and meta-analysis of IV lignocaine for intubation-induced haemodynamic effects (18 RCTs, 1056 adult participants) (searches to February 2025),[1] and a second cohort of primary RCTs and related systematic reviews published from 2022 to 2025 on lignocaine or alternative agents in obstetric, paediatric, neurosurgical, urological and general surgical populations. A representative sample of these 2022-2025 primary trials is summarised in Table 1, which includes the design of the individual trials and their main results [19,21-25].

Effect on mean arterial pressure

In an Egyptian study published in 2023, 2 mg/kg of IV lignocaine caused a larger decrease in pressor-response than 1.5 mg/kg or a fixed dose of 40 mg, which supports the dose-ranging study that

Table 1: Representative characteristics of RCTs (2022-2025) evaluating intravenous lignocaine and comparators for haemodynamic attenuation at laryngoscopy and intubation

Study (Year)	*Country*	*Population*	*Lignocaine regimen*	*Comparator*	*Key haemodynamic finding*
Nabil et al. (2023)	Egypt	Severe pre-eclampsia, caesarean section	Nebulised lignocaine, pre-induction	Saline nebulisation	Attenuated pressor surge at laryngoscopy in a high-risk obstetric population
Mostafa et al. (2023)	Egypt	Elective surgery, adults	IV lignocaine 1, 1.5, 2 mg/kg (dose comparison)	Three lignocaine doses, no placebo arm	2 mg/kg produced the greatest attenuation of post-intubation heart-rate rise
Kaszy□ski & Kuczerowska et al. (2025)	Poland	Children, laparoscopic appendectomy	1.5 mg/kg bolus + 1.5 mg/kg/h infusion	Saline placebo	No significant reduction in mean arterial pressure or metabolic-hormonal stress markers
Joshi et al. (2023)	India	Elective surgery, adults	IV lignocaine 2%, weight-adjusted	Nebulised lignocaine 2%	IV route produced greater attenuation of heart rate and blood pressure rise than nebulisation
Ibiribigbe (2023)	Nigeria	Controlled hypertensive adults	IV lignocaine 1.5 mg/kg + magnesium sulphate	Magnesium sulphate alone	Combination therapy improved pressor-response control versus magnesium alone
Liu et al. (2022)	China	Intracranial tumour resection	1 mg/kg bolus + 1 mg/kg/h infusion	Saline infusion	Stable intraoperative haemodynamics with preserved motor-evoked potentials
Mendonça et al. (2022)	Brazil	Elective surgery, adults	IV lignocaine, weight-adjusted	Esmolol	Esmolol produced more consistent heart-rate control; lignocaine comparably effective for blood pressure

IV lignocaine is potent at attenuating pressor-response when given at a dose of 1-2 mg/kg, but not at 0.5 mg/kg or as a fixed dose of 40 mg, respectively. [4] A 2025 paediatric trial of IV lignocaine (1.5 mg/kg bolus followed by an infusion) did not show significant MAP-attenuating effect relative to placebo, suggesting that the dose-dependence of IV lignocaine's effect on MAP may not be applicable to children. [6]

Effect on Heart Rate

The other two major haemodynamic parameters – heart-rate control with IV lignocaine and IV calcium channel blockade – have been less consistent. This dose by ethnicity interaction is notable, as it contrasts to the standard assumption of a simple linear dose-response relationship, and is consistent with the comparative Indian trial in this review, which found that the intravenous route of administration led to superior heart-rate control compared with nebulisation at the same dose (esmolol 1.5 mg/kg vs. lignocaine 40 mg).[7] The comparator data adds further colour: a recent Brazilian trial showed that esmolol achieved more consistent heart-rate attenuating effect than lignocaine, even though the two drugs were generally similar in terms of blood-pressure control (2022).[13]

Dose and Timing

The timing of administration prior to laryngoscopy ranged from 30 seconds to 15 minutes across the studies identified, with the best evidence supporting administration one to three minutes before laryngoscopy, in order to achieve peak plasma levels at the same time as airway stimulation is initiated at laryngoscopy; however, the 2025 meta-analysis did not find this a significant independent source of heterogeneity once dose was accounted for.

Special Populations

The use of lignocaine has been supported by several trials conducted from 2022-2025, increasing the current evidence base to include groups at high risk of haemodynamic instability when intubated. A bolus and infusion schedule with the use of nebulised lignocaine, however, did not significantly alter mean arterial pressure or the metabolic-hormonal stress markers in children with laparoscopic appendectomy when compared with placebo, so the haemodynamic benefit shown in adults cannot be extrapolated to paediatric patients[4, 25-40].

Comparative Efficacy Against other Pharmacological Agents

Nebulised strategies to attenuate the intubation stress response that have been explored include oral melatonin or clonidine, which are also considered as multimodal approaches, and continue to have an interest in these approaches; however, direct comparisons between these agents and dexmedetomidine or other less commonly used agents have not been performed to date. A systematic review and meta-analysis of remifentanil for intubation without neuromuscular blockade also confirms the general principle that opioid-based strategies can achieve equivalent or better hemodynamic stability than lignocaine, with different trade-offs regarding respiratory depression and cost. Direct comparison trials suggest that esmolol may offer somewhat more consistent heart-rate control than lignocaine, while lignocaine and magnesium sulphate may be complementary rather than interchangeable, as combination regimens have been shown to be superior to either agent alone for patients with hypertension.

Safety

Across trial identified in this study reported serious lignocaine-attributable cardiovascular or neurological adverse events at doses studied. No individual trial reported a serious adverse event in the lignocaine arm, apart from the injection being painful or causing cough, which would be considered non-lignocaine-specific. There was a general lack of consistency in reporting on adverse events

across this literature, with only the 2025 meta-analysis reporting a significantly lower rate of adverse events in the lignocaine arm compared to non-lignocaine arms (relative risk approximately 0.6).[1] Overall, IV lignocaine was generally well tolerated, with the majority of adverse events being of an injection-related nature.

DISCUSSION

The evidence collated in this review is consistent in supporting a real (although small) MAP-attenuating effect of IV lignocaine at doses of 1-2 mg/kg, and given shortly before laryngoscopy, while heart-rate control seems to be much more sensitive to dose, timing and population characteristics. Regarding the interactions between lignocaine dosage and ethnicity on heart-rate outcomes, this finding is both striking and comparatively new, and it is reasonable to assume that it could be explained by differences in autonomic reactivity, induction protocols and/or baseline heart-rate across trial populations, as well as differences in sodium-channel sensitivity, but this interpretation is a hypothesis and should be regarded as such rather than as definitive. Caution should be used when considering 1.5 mg/kg as a standard dose, as the dose-ranging results reviewed here indicate that this dose may not be optimal for all patients, particularly those with intracranial pathology in whom blood-pressure control is a key factor, or patients with uncontrolled hypertension, where heart-rate control is the primary issue. The evidence is less comforting for patients at special risk of tachycardia (e.g., those with ischaemic heart disease), and agents with different properties (such as esmolol) may provide more predictable heart rate control, as indicated by direct comparative information. [13] The expansion of lignocaine research into the obstetric, neurosurgical and paediatric population is a positive thing for 2022-2025, although the results are not all positive. Interestingly, the trial used in this review was a nebulised (not intravenous) bolus-and-infusion regimen and the negative result in children suggests that either their autonomic response to laryngoscopy or their pharmacokinetics to the use of lignocaine in the paediatric patient differs significantly from adults, adding to the off-label caution already used in paedriatic use of lignocaine. IV lignocaine sits somewhere between the extremes of comparator agents. It is not as effective as esmolol for heart-rate control nor is it devoid of the respiratory and cost issues associated with opioid-based management, but it is cheap, well known, and also has the incidental benefit of decreasing pain with injection of induction agents and cough upon intubation. Placed alongside comparator agents, IV lignocaine occupies a pragmatic middle ground. It is neither as reliably potent as esmolol for heart-rate control nor free of the respiratory and cost considerations attached to opioid-based strategies such as remifentanil, but it is inexpensive, familiar, and carries the incidental benefit of reducing induction-agent injection pain and intubation-related cough.[3,12,13] In resource-limited settings, or where multimodal strategies are preferred over reliance on a single potent agent, lignocaine's favourable safety profile and low cost support its continued inclusion in intubation protocols, potentially in combination with agents such as magnesium sulphate, as the combination data in hypertensive patients suggest.[8]

Taken together, the 2022-2026 literature reinforces rather than overturns the central conclusions of the most recent dedicated meta-analysis: IV lignocaine 1-2 mg/kg is an effective, low-risk adjunct for blunting the MAP response to laryngoscopy and intubation, but its heart-rate effect requires more individualised dosing consideration, and its benefit cannot be assumed to generalise uniformly across all patient populations, in particular children.[1]

LIMITATIONS

There are a number of restrictions to this review. In addition, the 2022-2026 window of additional primary studies identified is heterogeneous in population, dosing regimen, comparator and outcome-reporting format, which precludes formal quantitative pooling and requires a narrative rather than a statistical synthesis. Third, by restricting the dates of the papers included to include only papers from the year of 2022 onwards, this review could only include the most recent evidence available, but will not necessarily represent a comprehensive systematic review of the entire lignocaine literature. Fourth, adverse-event reporting in the studies identified was inconsistent, which further reduces the extent of the characterisation of lignocaine's safety profile, specifically as a component of the safety profile of co-administered agents. Lastly, as in the underlying meta-analysis, the current evidence base is limited to relatively low-risk (ASA I-II) adult surgical populations and the clinical relevance of the pressor response in higher-risk populations (those with significant cardiovascular or cerebrovascular comorbidities) needs to be directly established.

CONCLUSION

The RCTs published since 2022 and the latest dedicated meta-analysis of the issue suggest that IV lignocaine 1.0-2.0 mg/kg, administered about 1–3 minutes prior to laryngoscopy, is effective and inexpensive in reducing the increase in mean arterial pressure (MAP) that follows tracheal intubation during GA in adults. It has less of an effect on heart rate, and this effect is not as predictable as it is for other drugs and appears to be dependent on dose as well as possibly on population characteristics; its safety profile in this dose range is favourable. Clinicians using lignocaine for this indication need to be aware that there is a balance between blood-pressure control and heart-rate control which may vary from patient to patient and must be considered when choosing the drug and should be aware that, at present, there is little evidence for the automatic transfer of adult doses to paediatric patients. Future priorities include large, multicentre trials of standardised dose and timing protocols, systematic reporting of adverse events and direct comparison of esmolol, dexmedetomidine, and remifentanil in wider surgical and medical risk groups.

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