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Title: Does pre-hospital ketamine administration improve outcomes in paediatric trauma patients?

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Does prehospital ketamine administration improve outcomes in paediatric trauma patients?

Clinical Scenario: Paramedics respond to a 10 year old male who has been ejected from his bike, following a car collision. The patient is conscious, breathing, and stable; however, there is a visible deformity to his right forearm. After further inspection, the paramedics suspect the patient has a distal radius fracture. The patient has a Glasgow Coma Score (GCS) of 15, and a heart rate of 140 beats per minute, otherwise all other vital signs are within normal limits. The patient is complaining of severe pain, and consents to the administration of an analgesic.

PICO: In paediatric trauma patients, is the use of pre-hospital ketamine safer and more effective than morphine and fentanyl?

Search Rationale:

Due to their early stages of mental and physical development, paediatrics are vulnerable to traumatic injuries. Young children are prone to injuries due to the fragility of their bodies, and their inability to adequately assess for potential dangers. For these reasons, injury is a leading cause of death in paediatrics and a major cause of hospitalisation in Australia (Australian Government, 2020). The current 2021 Queensland Ambulance Service (QAS) guidelines suggest that at an advanced care paramedic level, the use of fentanyl and morphine are the preferred analgesics. Given the prevalence of paediatric trauma in Australia, it is important to determine the efficacy and safety of administering ketamine for paediatric trauma patients in the pre-hospital setting to improve patient outcomes. The findings of this study can then be used to guide future clinical practice guidelines.

Search Strategy:

The search identified 63 articles, of which 17 met the inclusion criteria. After further review, four relevant articles were subject for further analysis. Figure 1 displays a PRISMA diagram demonstrating the search process, while table 1 shows the key findings of each study.

Search Terms: (Pre-hospital OR “pre hospital” OR out-of-hospital OR “out of hospital” OR paramedics OR ambulance) AND (trauma OR traumatic) AND (ketamine) AND (analgesia OR analgesic OR analgesics)

Databases: Cochrane, Embase, Medline

Time period: Initially from January 2016 to September 2021; however, it was extended to January 2009 to September 2021 due to the initial search locating minimal relevant articles.

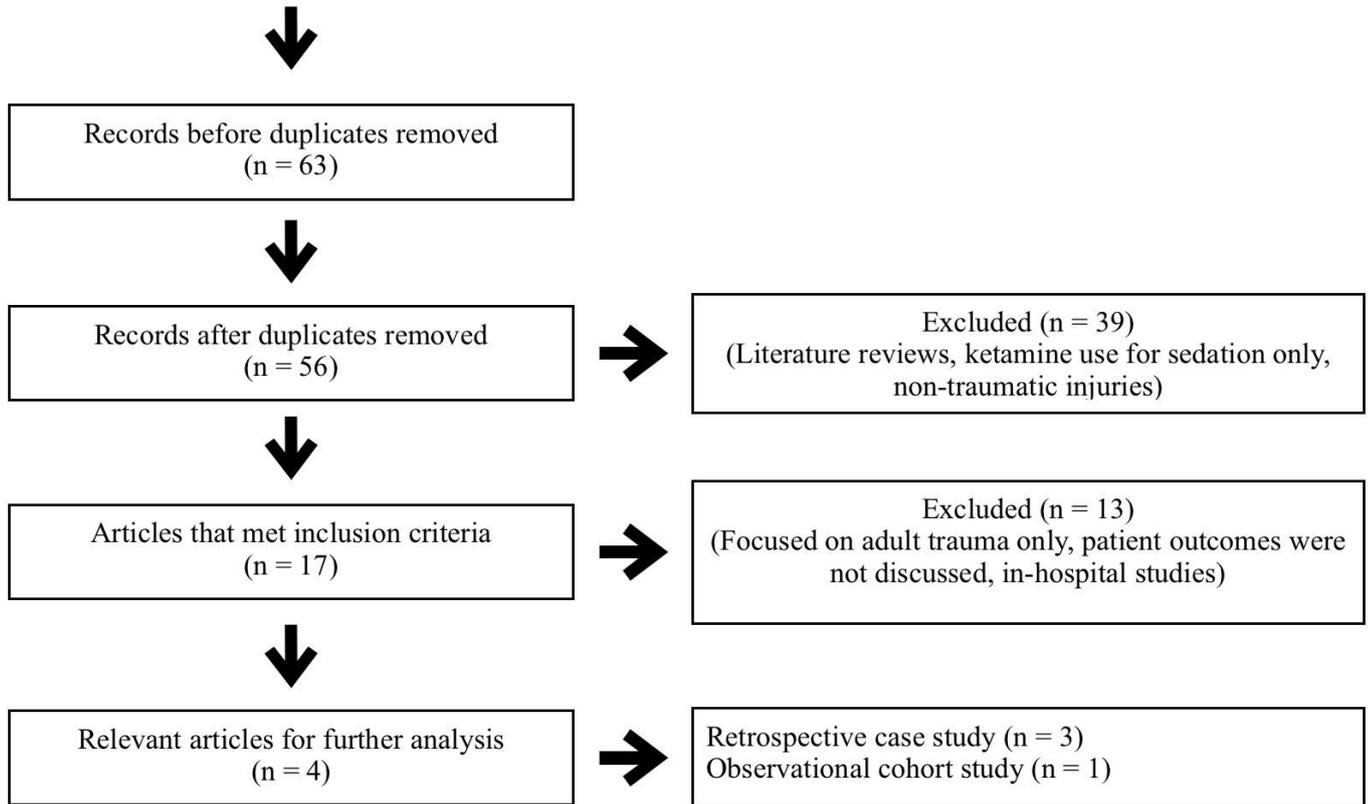


Figure 1: PRISMA diagram

Results:

Author, Year	LOE	Study Design	Population	Study Aims	Results	Strength and limitations
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Hill et al., 2019	3	Observational Cohort Study	555 patients with a traumatic head injury (between 1-17 years)	To determine the safety of ketamine administration in paediatric patients that have sustained a head injury.	The data set shows no distinct difference in mortality, LOHS, ventilator free days, and ICU days, amongst paediatric patients with head trauma that received ketamine. There was a significant reduction in GCS in patients receiving ketamine.	(+) Study was undertaken out of hospital (+) Study was conducted over a long period (9 years) (-) Only 6.5% of the patients received ketamine and 93.5% did not receive ketamine. Thus, there is less data on the outcome of patients receiving ketamine. (-) The GCS scores were not available pre-administration of ketamine. Thus, the study cannot state whether the reduction in GCS scores were due to ketamine, or the characteristics of the cohort (-) Data was included even if it was incomplete in the registry (-) Does not include data on the efficacy of ketamine use
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Author, Year	LOE	Study Design	Population	Study Aims	Results	Strength and limitations
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Hollis et al., 2016	2	Retrospective analysis	153 patients with a traumatic injury (68%) or sedation (25%) (aged 1-97 years)	Describe the use of ketamine by ACT Ambulance Service in the prehospital setting	<p>17% of patients administered with ketamine required EI, of these patients there were no paediatrics (under 12 years) Patients who received ketamine for analgesia, and required EI had a reduction in GCS and thus could no longer maintain their airway. All incidences of EI occurred in the ED.</p> <p>Patients who received prehospital ketamine for combativeness were more likely to be incubated than patients who received ketamine for analgesia 16 year old was administered 50mg total (0.8mg/kg) for pain, and required intubation due to a decrease in GCS.</p>	<p>(+) Study is conducted out of hospital (+) Included data of individual patients which included their injury, dose of ketamine, and whether they required intubation (-) There were several patients included in the study with incomplete data (-) There was a lack of documentation with patient's weight in 37% of the cases (-) As the data includes a broad age range, it is difficult to draw conclusions on paediatrics specifically (-) Focuses on the use of ketamine rather than the patient outcomes/ effects of ketamine as an analgesic</p>
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Author, Year	LOE	Study Design	Population	Study Aims	Results	Strength and limitations
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Schauer et al., 2018	2	Retrospective review study	618 patients (<17 years)	Describe the use of prehospital analgesia in paediatric trauma patients in Iraq and Afghanistan	For the patients administered with ketamine, the most common type of causes for trauma was explosive (59%) and gun shot wound (26.2%) Ketamine was most commonly used in ages 5-14 years old. Those administered with analgesia had higher injury severity score, longer ICU, and LOHS. Of the 12 receiving ketamine, 33.6% required EI during their pre hospital course. The analgesic agents compared are: morphine, fentanyl, ketamine, paracetamol, NSAID,	(+) Study is conducted out of hospital (+) Focused on paediatric patients only (+) Data mentioned specific injuries that ketamine was used to provide pain relief (-) Subjects were included, despite missing data (-) There is no data on quality of life after discharge from hospital (-) The data does not provide the route of drug administration (-) With patients who received ketamine and were intubated, it is unknown whether they received ketamine as a sedative prior to intubation. (-) There was no data on what drugs the clinician had access to (-) There is no pain score data (-) There is no data on which patients may have declined analgesia (-) Focuses on the use of analgesia and not the efficacy and safety of ketamine
Author, Year	LOE	Study Design	Population	Study Aims	Results	Strength and limitations

Bredmose et al., 2009	2	Retrospective review study	164 patients (0-15 years) Median age: 10 years old	To examine the indications, doses, and complications of ketamine for administration to paediatric trauma patients in the prehospital setting.	Ketamine was predominantly used in awake non-trapped patients with blunt trauma for sedation and analgesia. The study does not demonstrate any major side effects, death, loss of airway patency, decreased SPO2, or clinically significant reactions to ketamine. Mean recorded dose was 1.0mg/kg. The dominant mechanisms of injury were road traffic accidents (43%), burns (23%), fall from a height (21%).	(+) The study is conducted in the pre hospital setting (+) The study evaluates the complications of ketamine in only paediatric patients (-) It is a retrospective review study, thus there may be data that was not documented (-) Only first and last oxygen saturation's were available and thus desaturation may have occurred in between (-) The study is conducted in 2009 meaning the information is at the risk of being outdated; however, it can be a foundation for further research
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Table 1: Summary of key findings

Abbreviations: LOE; level of evidence, SPO2; oxygen saturation, ICU; intensive care unit, EI; endotracheal intubation, LOHS; length of hospital stay, GCS; Glasgow Coma Scale, ED; emergency department, NSAID; non-steroidal anti-inflammatory drug

Comments:

Despite there being a lack of high quality relevant studies that explore the effects of pre-hospital ketamine on paediatric trauma patients, the sourced literature suggests that ketamine is potentially safe to use as an analgesic in the pre-hospital setting. Furthermore, patients with higher injury severity scores were administered ketamine which suggests that potentially ketamine is more effective at providing analgesic qualities compared to fentanyl and morphine (Schauer et al., 2018; Bredmose et al., 2009). However, conclusions cannot be made on the effect of ketamine administration on the LOHS due to conflicting evidence between sources; however, the literature suggest that ketamine administration does not have an effect on mortality, and overall there were no significant adverse events (Bredmose et al., 2009; Hill et al., 2019). Ketamine was observed to cause a slight decrease in GCS in some cases (Hollis et al., 2016; Hill et al., 2019); however, both of the studies lack information on the difference between GCS scores prior and post ketamine administration, and thus conclusions can not be drawn from this trend.

Consider:

While, the current literature suggests that ketamine may be safe and potentially effective as an analgesic, the literature has not yet reached a consensus on the outcomes of ketamine on paediatric

trauma patients. This is due to the majority of studies being conducted in hospital, lacking relevant information, being outdated, and having less reliable study designs. Despite this, the articles sourced can be used as a foundation for further research on how the safety and efficacy of ketamine compares to other analgesics when administered out of hospital. Additionally, further investigation on the most effective and safe paediatric ketamine doses and route of administration would assist in determining the effect on patient outcomes.

Clinical Bottom Line:

The current research on prehospital ketamine use for paediatric trauma patients relies on weak evidence to determine the efficacy and safety of ketamine. Despite this, the articles sourced suggest that ketamine is safe and potentially effective as an analgesic. Thus, the results of the study should be interpreted with caution and used as a foundation for further research, before incorporating the information into current practice.

References

- Australian Government (2020). *Australia's Children*. <https://www.aihw.gov.au/reports/children-youth/australias-children/contents/health/injuries>
- Bredmose, P.P., Grier, G., Davies, G.E., Lockey, D.J. (2009). Pre-hospital Use of Ketamine in Paediatric Trauma. *Acta Anaesthesiologica Scandinavica*, 53(4), 543-545. <https://doi.org/10.1111/j.1399-6576.2008.01852.x>
- Hill, G.J., April, M.D., Phil, D., Maddry, M.D., Schauer, S.G. (2019). Prehospital Ketamine Administration to Paediatric Trauma Patients with Head Injuries in Combat Theatres. *The American Journal of Emergency Medicine*, 37(8), 1455-1459. <https://doi.org/10.1016/j.ajem.2018.10.046>
- Hollis, G.J., Keene, T.M., Ardlie, R.M., Caldecott, D.G.E., Stapleton, S.G. (2016). Prehospital Ketamine Use by Paramedics in the Australian Capital Territory: A 12 month retrospective analysis. *Emergency Medicine Australasia*, 29(1), 89-95. <https://doi.org/10.1111/1742-6723.12685>
- Queensland Ambulance Service (QAS). (2021). *Drug Therapy Protocols: Morphine*. https://www.ambulance.qld.gov.au/docs/clinical/dtprotocols/DTP_Morphine.pdf
- Queensland Ambulance Service (QAS). (2021). *Drug Therapy Protocols: Fentanyl*. https://www.ambulance.qld.gov.au/docs/clinical/dtprotocols/DTP_Fentanyl.pdf
- Schauer, S.G., Arana, A.A., Naylor, J.F., Hill, G.J., April, M.D. (2018). Prehospital Analgesia for Paediatric Trauma Patients in Iraq and Afghanistan. *Military Medicine*, 22(5), 608-613. <https://doi.org/10.1080/10903127.2018.1428839>