

Efficacy Of Intravenous Ketamine as an Adjunct To Local Anesthesia in Pain Relief From Double Lumen Catheter Placement for Hemodialysis In The Emergency Department

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ABSTRACT

Objective: To compare the efficacy of intravenous Ketamine combined with local anesthesia for pain relief and procedural sedation for patients requiring DLC (double lumen catheter) insertion for urgent hemodialysis presenting in the emergency department.

Study design: Quasi-experimental study

Place and Duration of study: Accident and Emergency Department, Pak-Emirates Military Hospital, Rawalpindi, Pakistan, from Jan to Dec 2021.

Methodology: 110 patients were included in the study, divided into a Ketamine Group (n=55) and a Local Anesthetic Group (n=55). Primary variables measured were pain on the VAS at the time of needle prick, 15 and 30 minutes after the procedure, and changes in heart rate and mean arterial pressure at the time of needle prick, 15 and 30 minutes following the procedure.

Results: The mean visual analog scale for the Ketamine group at the time of prick and after 15 and 30-minutes post-procedure showed a marked improvement in response to pain versus the Lignocaine group ($p<0.0001$). The same statistically significant change was seen for both primary parameters, mean arterial pressure (MAP) as well as heart rate ($p<0.0001$). The difference between both groups was more marked at the time of prick and gradually decreased as time post-procedure increased. However, pain scale, MAP, and heart rate all remained significantly stable and better in the Ketamine group.

Conclusion: We conclude that Ketamine is an effective adjunct to local anesthesia for DLC insertion in the ER in ESKD patients, resulting in low pain scores, hemodynamic stability, and improved success of the procedure.

Keywords: DLC catheter, Ketamine, Pain Relief, Procedural Sedation

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INTRODUCTION

End-stage kidney disease (ESKD) is a worldwide health issue with a global prevalence of 14%, with the incidence of ESKD increasing substantially in the last decade.¹ The increase in incidence is attributed to the local disease burden, affected by demographic and socioeconomic patterns in every region of the globe.² But as things stand, ESKD continues to put a substantial burden on nations worldwide, crippling medical resources and debilitating medical costs, especially in developing countries.³

It is estimated that a total of 5-7 million and 10-15% of patients with AKI worldwide require renal replacement therapy (RRT), with the need for the modality increasing with every passing year.⁴ An AV fistula remains the best method to provide RRT, followed by a tunneled central catheter.⁵ An AV fistula requires 6-8 weeks for proper functioning.⁶ A tunneled

catheter procedural modality is not available at all centers, especially in the developing world. Since a substantial number of these patients usually require urgent hemodialysis due to electrolyte and acid-base disturbances, an emergency temporary double lumen catheter (TDLC) insertion is usually required in the ER at presentation.

The incidence of emergency DLC insertion is around 7-9%, with half of these being inserted in the ER.⁷ The right internal jugular vein is the most preferable vessel for placement due to a lower chance of thrombosis and a lower incidence of stenosis.⁸ However, its insertion, apart from pain, results in considerable apprehension and stress on the part of the patient, resulting in difficulty and failure during insertion. Even though local anesthesia is used to ameliorate the pain during the procedure, patient apprehension results in considerable chances of complications and failure of insertion⁹. Therefore, adequate procedural sedation, keeping in mind the deranged metabolic parameters, can result in patient

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comfort and a lower chance of non-insertion of the DLC.

Ketamine, used for augmented analgesia and procedural sedation, has been the drug of choice in debilitated patients due to its good hemodynamic stability profile and, when given in incremental doses, does not produce apnea, which is beneficial in the ER setting.¹⁰ The only major drawback is dissociation associated with the drug, but it is seen less with low-dose increments.

This study aims to compare the efficacy of intravenous Ketamine combined with local anesthesia for pain relief and procedural sedation for patients requiring DLC (double lumen catheter) insertion for urgent hemodialysis presenting in the emergency department. The hope is better patient comfort, good post-procedure analgesia, and increased success of insertion.

METHODOLOGY

This Quasi-experimental study was carried out at the Department of Accident and Emergency, Pak-Emirates Military Hospital, Rawalpindi, Pakistan, from Jan to Dec 2021. A total of 110 patients were included in the study calculating sample size with the WHO calculator keeping the confidence interval at 95%, margin of error at 5% keeping the population proportion of patients receiving double lumen catheterization in the emergency department at 7%.⁷

Inclusion Criteria: included all patients with ESKD presenting in the emergency room requiring urgent hemodialysis with deranged metabolic parameters including blood pH <7.0, blood K levels more than 6.0 mmol/l, severe fluid overload, and ECG changes signifying hyperkalemia or hypercalcemia.

Exclusion Criteria: comprised patients with a history of coagulopathy, deranged coagulation profile, functioning AVF or tunneled DLC, previous insertion of DLC in the right internal jugular vein in the last 2 weeks, thrombosis or stenosis in the right internal jugular vein, and patients with low GCS <7 on presentation.

The study method included all patients as per the inclusion criteria furnished. The patients were randomly allocated into two groups (Ketamine versus Local Anesthetic group) by non-randomized consecutive sampling once they presented to the ER. All patients were thoroughly counselled about the procedure and the complications of the drugs used.

Ethical permission was obtained from the ERB of the institute vide letter no. dated.

Standard monitoring, including blood pressure, heart rate, ECG, and pulse oximetry, was performed, ensuring aseptic conditions in the procedure room before the start of the procedure. The Ketamine group received a bolus dose of 1 mg/kg of intravenous Ketamine given over 30 seconds, followed by local anesthetic insertion of 3 mL 2% Lignocaine without adrenaline at the prick site under ultrasound guidance, whereas the Local Anesthetic Group received 3 mL 2% Lignocaine without adrenaline under ultrasound guidance. The procedure was started after 3 minutes to give adequate time for the onset of Ketamine and the local anesthetic. Baseline blood pressure and heart rate were recorded and then recorded at 15 and 30 minutes following the procedure. The procedure was performed by a senior ER resident with good experience in DLC insertion under ultrasound guidance, under standard strict aseptic measures. (Figure)

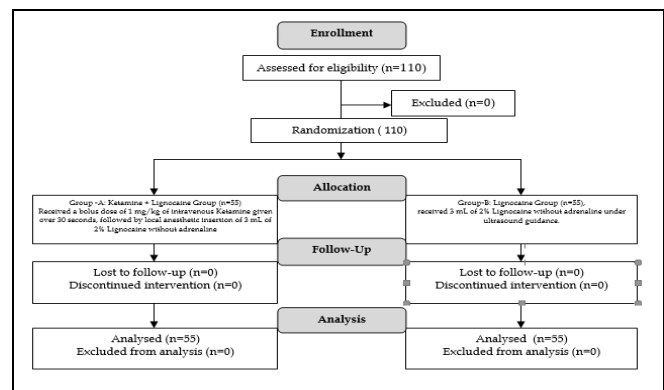


Figure: Patient Flow Diagram

Primary variables measured were pain on the VAS at the time of needle prick, 15 and 30 minutes after the procedure, and changes in heart rate and mean arterial pressure at the time of needle prick, 15 and 30 minutes following the procedure. Secondary outcomes measured were the failure rate of insertion due to patient agitation and complications during the procedure due to patient discomfort.

Demographic data were statistically described in terms of mean $\pm$ SD, frequencies and percentages when appropriate. Mean values were compared using the independent samples t-test. Frequency variables were compared using the Chi-square test. A *p*-value of ≤ 0.05 was considered statistically significant. All

statistical calculations were performed using Statistical Package for Social Sciences 26.0.

RESULTS

A total of 110 patients, 55 in the Ketamine group and 55 in the Lignocaine group alone, were analyzed for the primary and secondary outcome parameters furnished. The mean age of patients was 55.69 ± 4.39 years in the Ketamine group versus 56.78 ± 4.81 years in the Lignocaine-only group. While analyzing the gender distribution, the Ketamine group comprised 42(76.4%) males and 13(23.6%) females versus 41(74.5%) males and 14(25.5%) females. Gender distribution in both groups was comparable.

Table-I: Demographic Variables (n=110)

Variable	Ketamine+ lignocaine group (n=55)	Lignocaine group (n=55)
Age (mean years)	55.69 ± 4.39	56.78 ± 4.81
Gender		
Male	42 (76.4%)	41 (74.5%)
Female	13 (23.6%)	14 (25.5%)

While studying the primary outcome parameters, the mean visual analog scale for the Ketamine group at the time of prick and after 15 and 30-minutes post-procedure showed a marked improved response to pain versus the Lignocaine group (Table-II) ($p < 0.0001$).

Table-II: Primary Outcome Variables Between Both Groups (n=110)

Variable	Ketamine+lignocaine group (n=55)	Lignocaine group (n=55)	p value
Pain (visual analog scale)			
At time of prick	1.29 ± 0.45	3.62 ± 0.52	< 0.001
After 15 min of procedure	1.05 ± 0.22	2.22 ± 0.49	< 0.001
After 30 min of procedure	1.05 ± 0.22	1.27 ± 0.44	< 0.001
Mean arterial pressure (map) (mm hg)			< 0.001
At time of prick	78.58 ± 3.81	90.38 ± 6.15	< 0.001
After 15 min of procedure	78.15 ± 4.64	86.71 ± 6.27	< 0.001
After 30 min of procedure	79.62 ± 4.38	86.84 ± 6.50	< 0.001
Heart rate (bpm)			
At time of prick	83.71 ± 6.56	97.56 ± 4.86	< 0.001
After 15 min of procedure	83.75 ± 7.52	94.09 ± 7.00	< 0.001
After 30 min of procedure	82.40 ± 7.27	91.05 ± 7.98	< 0.001

Table-III: Secondary Outcome Variables Between Both Groups (n=110)

Variable	Ketamine+ lignocaine group (n=55)	Lignocaine group (n=55)
Success in inserting dlc	55(100.0%)	52(94.5%)
Complications		
No complications	51(92.7%)	46(83.6%)
Artery puncture	03(5.5%)	07(12.7%)
Hematoma formation	00(0.0%)	02(3.6%)
Ketamine associated dissociation	01(1.8%)	00(0.0%)

*DLC - Double Lumen Catheter

The same statistically significant change was seen for both primary parameters, mean arterial pressure (MAP) as well as heart rate ($p < 0.0001$) (Table-II). The difference between both groups was more marked at the time of the prick and gradually decreased as time post-procedure increased. However, pain scale, MAP, and heart rate all remained significantly stable and better in the Ketamine group.

While analyzing the secondary variables, all 55(100%) patients successfully underwent DLC in the Ketamine group. However, the success rate in the Lignocaine-only group was 52(94.5%). The failure was attributed to severe agitation by patients, resulting in abandonment of the procedure.

No complications were seen in 51(92.7%) patients in the Ketamine group. Accidental arterial puncture was observed in 03(5.5%) patients. 01(1.8%) patient experienced dissociation due to Ketamine and was detained in the recovery room till complete reversal. In contrast, no complications were seen in 46(83.6%) patients in the Lignocaine-only group. Arterial puncture was seen in 07(12.7%) patients, with the incidence of hematoma formation seen in 02(3.6%) patients.

DISCUSSION

The study was carried out at a tertiary care setup where emergency DLC insertion is done very frequently for urgent hemodialysis of patients. Most of these patients are weak, emaciated, and severely agitated either due to psychological disturbances or physical complications like fluid overload, causing considerable distress.¹¹ This causes difficulty during the procedure and results in complications since most of these patients cannot even lie supine due to breathing difficulties as well.¹²

The use of Ketamine as procedural sedation in these patients is recommended as an adjunct to local anesthesia for the procedure, to achieve sedation, patient comfort and compliance, and post-procedure amelioration of pain, as well as to work as an anxiolytic.¹³ This can all be achieved with a good hemodynamic stability profile of ketamine, with maintenance of blood pressure and heart rate during the procedure within favorable limits.¹⁰

A study carried out by Davis et al., also aimed to find out the efficacy of Ketamine in the ER setting as a procedural sedation and analgesic option. They concluded that Ketamine in low doses can be a safe adjunct to manage acute pain in this setting.¹⁴ They

also reported that New guidelines were published in July 2018 by the American Society of Regional Anesthesia and Pain Medicine, the American Academy of Pain Medicine, and the American Society of Anesthesiologists that provide a framework for identifying patients who are likely to benefit from the use of Ketamine in an acute pain setting. Another study done by Barrett et al., also concluded that Ketamine should be considered as a versatile agent for emergency room sedation, with pain scores decreasing as much as 1 on the visual analog scale, with a baseline pain score of 6-7 on presentation. Ketamine is regaining popularity in the field of anesthesia and beyond due to its potential role in reducing pain in both acute and chronic severe pain conditions.¹⁵ This was also recommended by Ghojzadeh et al., in his study comparing the efficacy of Ketamine for pain and procedural sedation in the ER.¹⁶ This all was also supported in our study as well with respect to pain scores and hemodynamic stability findings of the study.

While talking about the incidence of drug-related adverse effects due to Ketamine, dissociative anesthesia remains the single concern deterring its widespread use. The review by Nichols et al., highlights the history and mechanism of ketamine as well as addressing the use of the different dosing ranges of ketamine.¹⁷ However, Gitlin et al., reported that at low doses (<0.5 mg/kg), adverse effects of drugs can be reduced by administration of Midazolam.¹⁸

The study validates that Ketamine is an effective adjunct as an analgesic and sedative for brief emergency department procedures in hemodynamically compromised patients. Its use may reduce anxiety and improve patient comfort.

LIMITATION OF STUDY

This single-center trial limits generalizability because institutional protocols, operator experience, and emergency department volumes vary and may introduce site-specific bias. Its small, demographically homogeneous sample also reduces power to detect rare adverse events and limits applicability to diverse populations. Multicenter randomized controlled trials are needed to validate these findings across varied emergency care settings.

CONCLUSION

It is concluded that Ketamine is an effective adjunct to local anesthesia for DLC insertion in the ER in ESKD patients, resulting in low pain scores, hemodynamic stability, and improved success of the procedure.

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Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

SMHK & MNASM: Data acquisition, data analysis, critical review, approval of the final version to be published.

MMTS & HMM: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

HMA: Conception, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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