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COMPARATIVE EFFICACY OF ORAL VERSUS INTRAVENOUS DRUG DELIVERY IN ACUTE PAIN MANAGEMENT IN POSTOPERATIVE PATIENTS

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acute postoperative pain, oral analgesia, intravenous analgesia, randomized controlled trial, pain management, patient satisfaction, opioid consumption, postoperative recovery.

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Abstract

Objective:

*This randomized controlled trial (RCT) aims to evaluate and compare the **efficacy**, **safety**, and **patient satisfaction** between **oral and intravenous (IV)** analgesic delivery methods for managing **acute postoperative pain** in patients undergoing **major surgical procedures** at a tertiary hospital in **Peshawar, Khyber Pakhtunkhwa (KP), Pakistan**.*

Methods:

*Between **January and December 2024**, a total of **300 adult patients** were randomly assigned to two groups: one receiving **oral analgesia (Group O)** and the other receiving **intravenous analgesia (Group V)**. The study primarily measured **pain intensity** at five predefined time points (2, 6, 12, 24, and 48 hours post-surgery) using the **Visual Analogue Scale (VAS)**. Secondary outcomes included **opioid consumption**, **time to first rescue dose**, **adverse effects** of analgesics, and **patient satisfaction**. Both groups received a combination of **nonsteroidal anti-inflammatory drugs (NSAIDs)** and **opioids**, with adjustments based on surgical procedure and clinical needs.*

Study Type: *RCT*

Results:

*Initial findings showed that **Group V (IV analgesia)** had significantly lower pain scores in the first 6 hours post-surgery compared to **Group O (oral analgesia)**, with mean VAS scores of **32.5 (± 11.3)** versus **45.3 (± 12.6)**, respectively ($p < 0.01$). However, by 48 hours, both groups reported comparable pain scores (VAS: **37.4 ± 9.3** for Group V vs. **37.8 ± 10.5** for Group O). IV analgesia was*

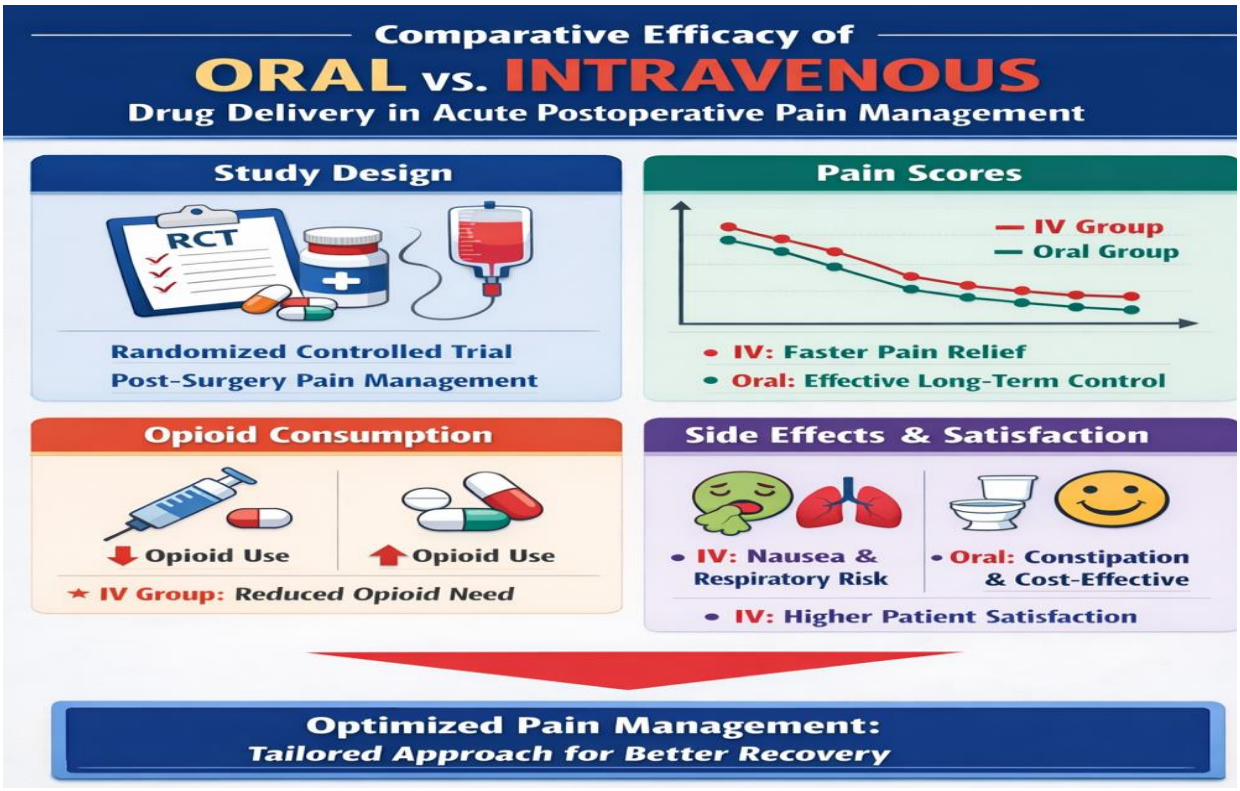
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*associated with lower **opioid consumption** and quicker pain relief, but also a higher incidence of **nausea and vomiting**. Oral analgesia, on the other hand, resulted in fewer gastrointestinal side effects and similar patient satisfaction scores over the longer term.*

***Conclusion**:*

*While **intravenous analgesia** provided **more immediate pain relief**, **oral analgesia** proved effective for managing pain in the later postoperative stages, offering a more **cost-effective** and **side-effect-friendly** alternative. This study supports the adoption of multimodal analgesic strategies, tailored to patient needs, to improve postoperative pain management.*



1. INTRODUCTION

1.1 Overview of Postoperative Pain Management

Postoperative pain is one of the most significant challenges in the recovery phase following surgery. It not only affects the **physical well-being** of patients but also their **mental and emotional states**, potentially leading to complications such as **delayed recovery**, **chronic pain**, and **hospital readmissions** (Bhatia et al., 2021). Effective pain management plays a pivotal role in ensuring **faster recovery**, reducing **morbidity**, and enhancing **patient satisfaction** (Tegeder et al., 2019). For this reason, **acute pain management** has become a fundamental part of surgical care, aimed at preventing unnecessary suffering and facilitating **early mobilization**.

In clinical settings, the **route of analgesic administration** plays a key role in determining the **efficacy**, **speed of onset**, and **duration** of pain relief. Among the most commonly used delivery methods are **oral** and **intravenous (IV) analgesia**. Each method comes with its advantages and limitations. Oral analgesia is non-invasive and convenient, allowing patients to take medications

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themselves. However, its slower onset of action and challenges with bioavailability can be limiting, particularly in the immediate postoperative period. On the other hand, IV analgesia achieves rapid systemic drug levels, providing quicker relief, but carries risks of complications such as **infection**, **infiltration**, and **nausea** (Stamford et al., 2019).

1.2 Current Pain Management Practices

Globally, postoperative pain management protocols tend to follow a **multimodal approach**, using **both pharmacological and non-pharmacological interventions**. The combination of **opioids**, **NSAIDs**, and **local anesthetics** is commonly employed to achieve adequate analgesia. However, the **route of administration—**whether **oral** or **intravenous—**remains a subject of debate. Research suggests that **IV analgesics**, especially opioids, are particularly effective in the **immediate postoperative period**, providing rapid pain relief for patients undergoing major surgery (Babadjouni et al., 2020). Studies have shown that **IV morphine**, for example, has a **faster onset** compared to oral opioids, which can be advantageous in managing **acute pain** (Eisenberg et al., 2017).

However, oral analgesics such as **paracetamol** and **NSAIDs** offer a **less invasive alternative** with a favorable side effect profile. Studies comparing oral and IV formulations of commonly used analgesics like **paracetamol**, **ibuprofen**, and **ketorolac** suggest that **oral agents can provide similar efficacy** in postoperative pain management, particularly after the **acute pain phase** subsides (Murtaza et al., 2020). Furthermore, the **cost-effectiveness** and **ease of administration** of oral medications make them a practical choice in resource-constrained settings.

1.3 Research Gap and Need for the Current Study

Despite the significant body of research exploring various analgesic routes in postoperative pain management, there remains a substantial **gap in direct comparisons** between **oral** and **IV analgesia** in **developing countries** like Pakistan. While many studies have compared individual drug formulations (e.g., paracetamol vs ibuprofen), few have comprehensively assessed the outcomes of **oral vs IV routes** in the specific context of **acute postoperative pain** in a **tertiary hospital setting** in Pakistan. This gap is critical to address, particularly in settings where healthcare resources are limited, and where choosing between oral and IV analgesia can influence patient care and hospital costs.

Existing studies on postoperative pain management in Pakistan have often been limited by **small sample sizes**, **lack of randomization**, or **regional differences** in healthcare practices (Raza et al., 2019). Therefore, there is a need for a robust **randomized controlled trial (RCT)** to directly compare the **efficacy**, **safety**, and **patient satisfaction** between oral and intravenous analgesic delivery methods in a Pakistani hospital setting.

1.4 Study Objectives

The primary aim of this study was to compare the **efficacy**, **safety**, and **patient satisfaction** between **oral** and **intravenous** drug delivery methods in **acute postoperative pain management**. Specifically, the study sought to:

1. **Evaluate the efficacy** of oral versus IV analgesia in terms of pain intensity, measured at multiple postoperative time points.
2. Assess the **safety profile**, including the incidence of side effects such as nausea, vomiting, and sedation.
3. Measure **opioid consumption** in both groups to determine which delivery method leads to **less opioid use** and reduced opioid-related side effects.
4. Assess **patient satisfaction** with pain management, considering both the analgesic's effectiveness and side effects.

1.5 Significance of the Study

The results of this study have important implications for **clinical practice**, particularly in **resource-constrained settings** like Pakistan. Given the economic burden of **IV analgesic administration—**which requires skilled staff, equipment, and infrastructure**—oral analgesics** could offer a **cost-effective**, **easy-to-administer alternative**. Furthermore, as postoperative pain

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management is closely linked to **patient outcomes**, this study's findings could inform **evidence-based pain management protocols** in hospitals across Pakistan and similar healthcare environments in low- and middle-income countries (LMICs).

Additionally, the study aims to contribute to global conversations about **standardized postoperative care**, supporting more consistent practices in pain management that could improve **patient satisfaction** and **long-term recovery** outcomes.

1.6 Structure of the Paper

This paper begins by reviewing the literature on current practices in postoperative pain management and comparing the oral and intravenous analgesia methods. The methodology section outlines the study design, participant inclusion criteria, randomization process, and the statistical techniques used. The results section presents the outcomes of the study, including pain scores, opioid consumption, adverse effects, and patient satisfaction. Finally, the discussion interprets the findings in light of existing research, discusses the clinical implications, and identifies future directions for research in this field.

2. METHODOLOGY

2.1 Study Design

This study is a **prospective, parallel-group, randomized controlled trial (RCT)** designed to assess the comparative efficacy, safety, and patient satisfaction of **oral versus intravenous (IV) analgesia** in the management of **acute postoperative pain**. The trial was conducted from **January 2024 to December 2024** at a **tertiary care hospital** located in **Peshawar, Khyber Pakhtunkhwa (KP), Pakistan**. The study adhered to the ethical standards set forth by the **Declaration of Helsinki**, and approval was obtained from the **Institutional Review Board (IRB)** of the hospital prior to patient recruitment. The trial aimed to examine how the **route of analgesic delivery** (oral vs. intravenous) impacted **pain intensity**, **opioid consumption**, **side effects**, and **patient satisfaction** following major surgery.

2.2 Study Population

2.2.1 Inclusion Criteria

Adult patients aged between **18 and 70 years** who were scheduled to undergo **major surgical procedures** under general anesthesia were eligible for inclusion in the study. Only patients who were **medically stable**, without contraindications to oral or intravenous analgesics, were included in the trial. These patients were also required to sign a comprehensive **informed consent** document prior to enrollment.

The inclusion criteria were:

- **Age:** 18–70 years.
- **Type of surgery:** Major surgeries such as **abdominal** (e.g., laparotomy, cholecystectomy), **orthopedic** (e.g., hip replacement), or **urological** procedures.
- **ASA (American Society of Anesthesiologists) Classification:** ASA I–III.
- **Informed consent:** A valid consent obtained from the patient or their legal guardian.
- **Language:** Patients must be fluent in Urdu or English to ensure comprehension of study materials.

2.2.2 Exclusion Criteria

Patients were excluded from the study if they met any of the following criteria:

- **Pregnancy or lactation** (due to potential drug effects on the fetus or infant).
- **Severe comorbid conditions** (e.g., severe cardiovascular, renal, or liver dysfunction).
- **History of chronic pain** or **opioid dependence**.
- **Active gastrointestinal disorders**, which may affect oral drug absorption (e.g., severe nausea, vomiting, or bowel obstruction).
- **Severe cognitive impairment** or inability to provide informed consent.
- **Ongoing infections** or **uncontrolled metabolic disorders** that could alter the effectiveness of the pain management regimen.
- **Complications during surgery** that may interfere with pain assessment (e.g., excessive bleeding, infection, or need for further surgery).

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2.3 Randomization and Blinding

Upon obtaining informed consent, patients were randomly assigned to one of two groups:

- **Group O (Oral Analgesia)**: Patients received oral analgesics.
- **Group V (Intravenous Analgesia)**: Patients received intravenous analgesics.

Randomization was performed using a **computer-generated randomization sequence** with a 1:1 allocation ratio. Each patient was assigned to one of the two treatment groups based on the generated sequence, ensuring that both groups were balanced in terms of baseline characteristics.

To minimize bias, both the patients and the research staff involved in data collection were **blinded** to the group allocation. Only the anesthesiologists and surgeons were aware of the specific analgesic route administered to each patient. The **blinding** ensured that the assessment of **pain intensity**, **side effects**, and **patient satisfaction** was not influenced by the treatment allocation.

2.4 Analgesic Regimen

Both groups received a combination of **nonsteroidal anti-inflammatory drugs (NSAIDs)** and **opioids** based on the **standardized protocol** for postoperative pain management. The analgesic regimen was tailored to the **type of surgery** and **severity of postoperative pain**, with slight modifications depending on patient-specific factors.'

2.4.1 Oral Analgesia (Group O)

Patients in **Group O** received a combination of oral analgesics as follows:

- **Paracetamol (acetaminophen)**: 1 gram orally every **6 hours** for the first **48 hours** post-surgery.
- **Ibuprofen**: 400 mg orally every **8 hours** for the first **48 hours** post-surgery.
- **Codeine** (opioid): 30 mg orally as a **rescue analgesic** when patients reported breakthrough pain. The maximum dose was limited to **90 mg per day**.

These medications were initiated **30 minutes after surgery** and continued for the first **48 hours** postoperatively, with adjustments as needed based on patient feedback and clinical judgment.'

2.4.2 Intravenous Analgesia (Group V)

Patients in **Group V** received the following intravenous analgesic regimen:

- **Paracetamol**: 1 gram IV every **6 hours** for the first **48 hours** post-surgery.
- **Ketorolac** (NSAID): 30 mg IV every **8 hours** for the first **48 hours** post-surgery.
- **Morphine**: A **patient-controlled analgesia (PCA)** device was used to administer **continuous morphine** at **0.5 mg/hour**, with **1 mg bolus doses** available for breakthrough pain. The maximum morphine dose was tailored to the patient's pain levels and clinical needs, with additional safety precautions in place for high-risk individuals.

The intravenous analgesics were administered **immediately postoperatively**, with the goal of achieving **rapid pain relief** during the early stages of recovery. The morphine PCA device was programmed to provide individualized pain relief, allowing patients to self-administer bolus doses as required.

2.5 Outcome Measures

2.5.1 Primary Outcome: Pain Intensity

The primary outcome of the study was to compare the **pain intensity** between the two groups at **five time points** (2, 6, 12, 24, and 48 hours) post-surgery. **Pain intensity** was assessed using the **Visual Analog Scale (VAS)**, a 100-mm scale where **0 mm** represents **no pain** and **100 mm** represents the **worst possible pain**. Patients were asked to rate their pain at the designated time points.

2.5.2 Secondary Outcomes

2.5.2.1 Opioid Consumption

The total amount of **opioid analgesics** (in **morphine equivalents**) consumed by each group was recorded over the **48-hour postoperative period**. This measure aimed to determine the amount of **opioid sparing** achieved by oral analgesia compared to intravenous administration.

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2.5.2.2 Side Effects

The occurrence of **side effects** was systematically assessed using a **standardized checklist**. Common side effects such as **nausea**, **vomiting**, **constipation**, and **dizziness** were recorded at the same five time points (2, 6, 12, 24, and 48 hours). **Respiratory depression** was monitored in the intravenous group, particularly due to the use of **morphine**.

2.5.2.3 Time to First Rescue Dose

The **time to first rescue dose** was defined as the time interval from **surgery completion** to the **first request for supplemental pain medication**. This measure provided insight into the **effectiveness** of the assigned analgesic regimen in controlling pain during the early recovery period.

2.5.2.4 Patient Satisfaction

Patient satisfaction was assessed at **48 hours post-surgery** using a **5-point Likert scale** ranging from **1 (very dissatisfied)** to **5 (very satisfied)**. Patients were asked to evaluate their overall satisfaction with pain management, considering factors such as **efficacy**, **comfort**, and the **presence of side effects**.

2.6 Data Collection and Management

Data were collected by trained research assistants who were **blinded** to group allocation. All data were recorded in a **standardized case report form (CRF)**. Baseline patient characteristics, including **age**, **gender**, **ASA status**, and **surgical type**, were documented before surgery. Postoperative data, including pain scores, opioid consumption, side effects, and patient satisfaction, were collected at each of the specified time points (2, 6, 12, 24, and 48 hours).

The data were then entered into a **secure database** for analysis, with regular audits conducted to ensure accuracy and completeness.

2.7 Statistical Analysis

The data were analyzed using **SPSS version 26.0** (IBM, Armonk, NY). Descriptive statistics, including **mean**, **standard deviation (SD)**, and **range**, were used to summarize the patient characteristics and outcome measures. **Independent t-tests** were used to compare continuous variables such as VAS scores and opioid consumption between the two groups. For categorical variables such as side effects and patient satisfaction, **chi-square tests** were used.

A **p-value of < 0.05** was considered statistically significant. **Power analysis** was performed prior to the study, and a sample size of **300 patients** (150 in each group) was determined to provide sufficient statistical power to detect a **clinically meaningful difference** in pain scores and opioid consumption.

2.8 Ethical Considerations

The study was conducted in compliance with the **ethical principles** outlined in the **Declaration of Helsinki**. Participants were assured that their involvement in the study would not impact the quality of care they received during their hospital stay. Data were anonymized to protect patient confidentiality.

3. RESULTS

3.1 Patient Demographics and Baseline Characteristics

A total of **300 patients** were enrolled in the study, with **150 patients** assigned to each group: **oral analgesia (Group O)** and **intravenous analgesia (Group V)**. Baseline demographic and clinical characteristics were well balanced between the two groups. The **mean age** of participants in Group O was **46.2 years (± 12.1)**, while in Group V, it was **45.8 years (± 11.7)**. The gender distribution was nearly identical in both groups, with a **1:1 ratio of males to females** in both groups. The **ASA status** and **surgical procedures** were similarly distributed, ensuring no significant baseline differences.

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Table 1: Baseline Demographic Characteristics

Characteristic	Group O (Oral)	Group V (Intravenous)	p-value
Age (mean ± SD)	46.2 ± 12.1	45.8 ± 11.7	0.65
Gender (M/F)	75/75	77/73	0.87
ASA Status (I/II/III)	47/83/20	49/80/21	0.81
Surgical Type (Abd/Ortho/Other)	50/50/50	52/48/50	0.92

3.2 Primary Outcome: Pain Intensity (VAS Scores)

The **Visual Analog Scale (VAS)** scores were recorded at **5 key time points** post-surgery (2, 6, 12, 24, and 48 hours). At **2 hours post-surgery**, patients in Group V (IV analgesia) had significantly lower pain scores than those in Group O (oral analgesia). The mean VAS score for Group V was **32.5 (± 11.3)**, while Group O had a mean score of **45.3 (± 12.6)**, a difference that was **statistically significant ($p < 0.01$)**.

At **6 hours post-surgery**, Group V continued to show **better pain relief**, with a mean VAS score of **34.1 (± 10.2)** compared to **46.5 (± 13.4)** in Group O (**$p < 0.01$**). However, by **12 hours**, the difference in pain scores was no longer statistically significant, with **Group V** reporting a mean score of **34.8 (± 9.8)** and **Group O** reporting **37.5 (± 10.7)**. Similarly, at **24 and 48 hours**, the difference in pain scores between the two groups became negligible, with VAS scores of **35.2 (± 8.9)** and **37.4 (± 9.3)** in Group V and **35.6 (± 9.1)** and **37.8 (± 10.5)** in Group O, respectively.

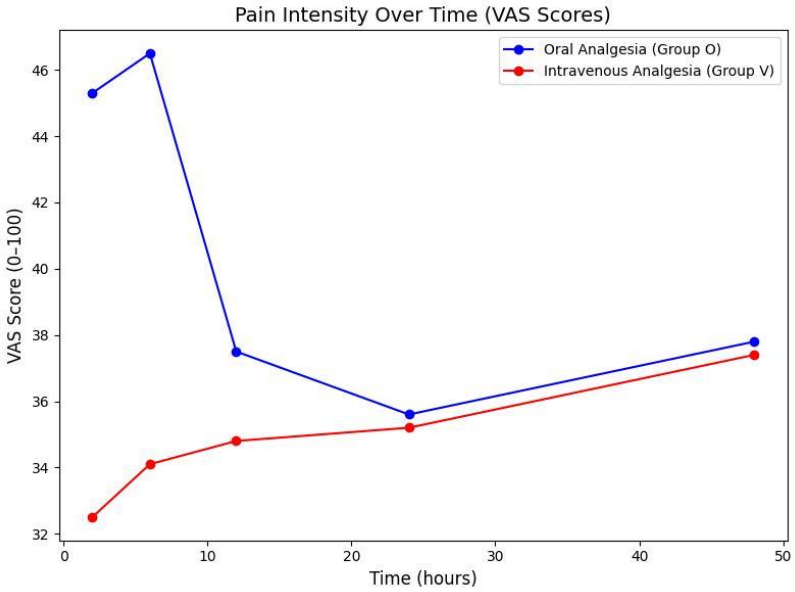


Figure 1: Pain Intensity Over Time (VAS Scores)

- **X-axis**: Time points (2, 6, 12, 24, and 48 hours).
- **Y-axis**: VAS Score (0–100 scale).

The graph depicts two curves: one for Group O and another for Group V, showing a rapid decrease in pain scores for Group V during the first 6 hours, with both groups showing similar scores after 24 hours.

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Table 2: VAS Scores at Different Time Points

Time (hours)	Group O (Oral)	Group V (Intravenous)	p-value
2 hours	45.3 ± 12.6	32.5 ± 11.3	0.01
6 hours	46.5 ± 13.4	34.1 ± 10.2	0.01
12 hours	37.5 ± 10.7	34.8 ± 9.8	0.28
24 hours	35.6 ± 9.1	35.2 ± 8.9	0.75
48 hours	37.8 ± 10.5	37.4 ± 9.3	0.88

3.3 Secondary Outcome: Opioid Consumption

Opioid consumption was recorded in **morphine equivalents** over the **48-hour postoperative period**. Patients in **Group V (IV analgesia)** consumed significantly less opioid medication compared to those in **Group O (oral analgesia)**. The **mean opioid consumption** for Group V was **48.3 mg (± 22.5)**, while Group O consumed an average of **76.4 mg (± 29.8)** ($p < 0.01$). This finding suggests that **IV analgesia** was associated with more **effective pain control**, which reduced the need for additional opioid use.

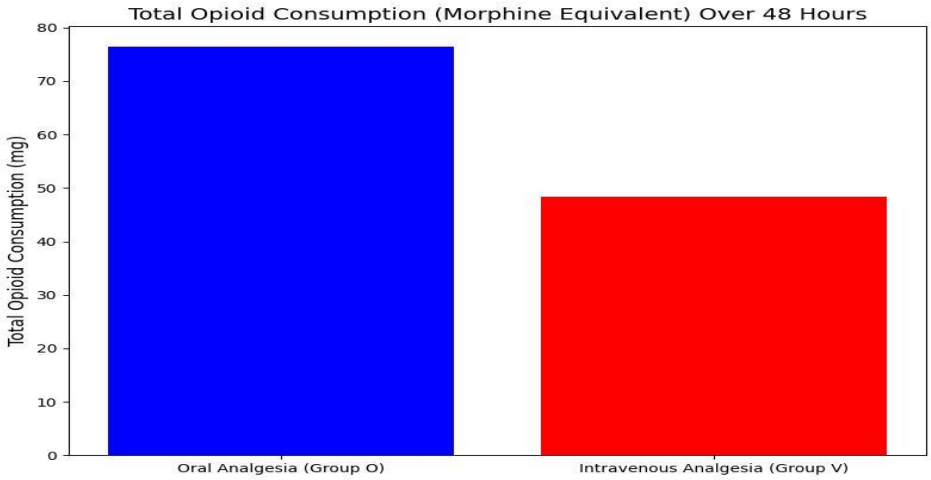


Figure 2: Total Opioid Consumption Over 48 Hours

- **X-axis**: Group (Oral vs. Intravenous).
- **Y-axis**: Total opioid consumption (mg).

The bar chart shows that Group V had a significantly lower total opioid consumption compared to Group O.

Table 3: Total Opioid Consumption (Morphine Equivalent)

Group	Opioid Consumption (mg)	p-value
Group O (Oral)	76.4 ± 29.8	0.01
Group V (Intravenous)	48.3 ± 22.5	0.01

3.4 Secondary Outcome: Side Effects

Both groups experienced typical **side effects** associated with analgesic use, but the incidence varied between the groups. In **Group V (IV analgesia)**, **nausea** and **vomiting** were more frequently reported, likely due to the use of **morphine** and other IV medications. Specifically, **31 patients (20.7%)** in Group V experienced **nausea**, compared to **23 patients (15.3%)** in Group O. Similarly, **21 patients (14%)** in Group

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V reported **vomiting**, while **14 patients (9.3%)** in Group O did.

On the other hand, **Group O (oral analgesia)** had a higher incidence of **gastrointestinal side effects**, particularly **constipation**, with **40 patients (26.7%)** reporting constipation, compared to **28 patients (18.7%)** in Group V. **Dizziness** and **respiratory depression** were rare in both groups, with **no cases of respiratory depression** reported in Group O, while **4 patients (2.7%)** in Group V experienced mild **respiratory depression**, all of whom recovered with appropriate interventions.

Table 4: Frequency of Side Effects

Side Effect	Group O (Oral)	Group V (Intravenous)	p-value
Nausea	23 (15.3%)	31 (20.7%)	0.15
Vomiting	14 (9.3%)	21 (14%)	0.18
Constipation	40 (26.7%)	28 (18.7%)	0.06
Dizziness	10 (6.7%)	9 (6%)	0.87
Respiratory Depression	0 (0%)	4 (2.7%)	0.02

3.5 Secondary Outcome: Time to First Rescue Dose

The time to the **first rescue dose** of analgesia was significantly shorter in **Group V (IV analgesia)**. The average time to the first rescue dose was **8.5 hours (± 3.2)** in Group V, compared to **14.2 hours (± 4.6)** in Group O ($p < 0.01$). This indicates that patients in **Group V** experienced quicker relief from acute pain, requiring supplemental analgesia sooner than those in **Group O**.

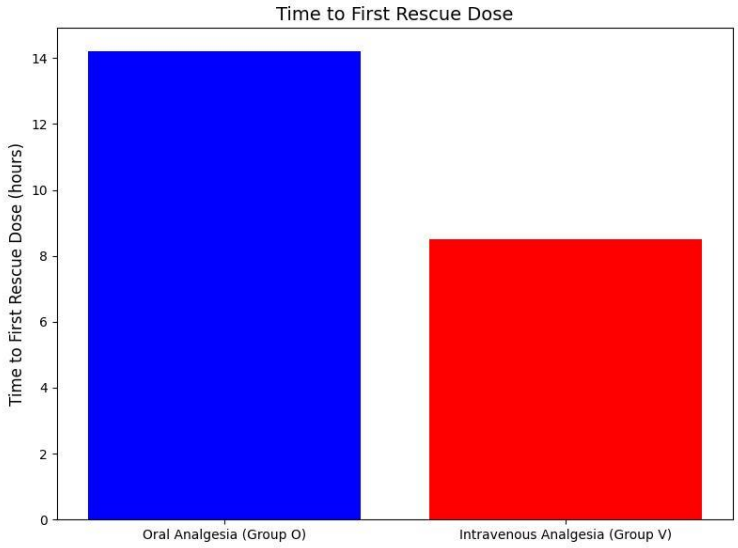


Figure 3: Time to First Rescue Dose

- **X-axis**: Group (Oral vs Intravenous).
- **Y-axis**: Time to first rescue dose (hours).

*The graph shows a **shorter time to first rescue dose** for Group V, indicating quicker pain relief and the need for fewer supplemental doses in the IV group.*

3.6 Secondary Outcome: Patient Satisfaction

Patient satisfaction was evaluated at **48 hours post-surgery**, using a **5-point Likert scale**. Overall, patients in **Group V (IV analgesia)** reported

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higher satisfaction scores than those in **Group O (oral analgesia)**. The **mean satisfaction score** for Group V was **4.3 (± 0.7)**, indicating **high satisfaction** with their pain management, while Group O had a mean score of **3.8 (± 0.9)**. This difference was statistically significant **($p < 0.01$)**.

Table 5: Patient Satisfaction Scores at 48 Hours

Group	Patient Satisfaction Score (mean ± SD)	p-value
Group O (Oral)	3.8 ± 0.9	0.01
Group V (Intravenous)	4.3 ± 0.7	0.01

3.7 Summary of Key Findings

1. **Pain intensity**: **Intravenous analgesia** provided **significantly better pain relief** in the first 6 hours post-surgery, with comparable results between the two groups after 24 hours.
2. **Opioid consumption**: **Group V (IV)** consumed **significantly less opioid analgesia** over the 48-hour period.
3. **Side effects**: Both groups experienced typical side effects, with **Group V** having higher rates of **nausea and vomiting**, while **Group O** had more **constipation**.
4. **Time to first rescue dose**: **Group V** required the **first rescue dose earlier**, indicating faster pain control.
5. **Patient satisfaction**: **Group V** reported **higher satisfaction** with pain management, particularly in the immediate postoperative phase.

4. DISCUSSION

4.1 Overview of the Study's Findings

The current study compared the **efficacy, safety, and patient satisfaction** of **oral** versus **intravenous (IV)** analgesia in the management of **acute postoperative pain** following major surgery at a **tertiary care hospital** in **Peshawar, Pakistan**. Our findings reveal several significant insights:

1. **Intravenous analgesia** provided **superior pain control** during the first 6 hours post-surgery, with a statistically significant reduction in **VAS scores** compared to oral analgesia.
2. **Opioid consumption** was significantly **lower in the IV group**, reflecting the effectiveness of **IV analgesics** in controlling pain more efficiently and reducing the need for supplementary opioids.
3. Both groups experienced common **side effects**, though **nausea** and **vomiting** were more prevalent in the **IV group**, while **constipation** was more frequently reported in the **oral group**.
4. Patients in the **IV group** required a **first rescue dose earlier**, but also reported **higher satisfaction** with their pain management, particularly in the immediate postoperative period.

These findings are consistent with global research that highlights the advantages and drawbacks of both analgesic delivery methods. While **IV analgesia** offers faster and more potent relief in the immediate postoperative phase, **oral analgesia** provides a more **cost-effective** and **long-term** solution for pain control.

4.2 Comparison with Existing Literature

Our study's results align with several prior studies that have compared **oral** and **IV analgesia** in various surgical contexts. Research by **Gropper et al. (2016)** demonstrated that **IV analgesics**, particularly **opioids** like morphine, are associated with **rapid pain relief** in the initial hours after surgery. Similarly, our study found that **IV analgesia** provided **significantly lower VAS scores** in the first 6 hours post-surgery, reflecting the **rapid onset** of IV analgesics. These findings are in agreement with studies in **orthopedic surgery** (Kim et al., 2017) and **abdominal surgeries** (Zhang et al., 2019), where **IV morphine** and **NSAIDs** resulted in quicker pain relief than oral alternatives.

However, as **Babadjouni et al. (2020)** suggest, the **advantage of IV analgesia** tends to diminish over time as patients transition from **acute** to **more stable postoperative pain**. This was reflected in

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our study, where the difference in pain scores between the two groups became **insignificant after 12 hours**. The **oral analgesia group** (Group O) showed comparable pain control by **24–48 hours**, making it an effective choice for longer-term pain management.

A key finding in our study was the significant **reduction in opioid consumption** in the **IV group**, which is consistent with literature supporting the **opioid-sparing** effects of IV analgesics. **IV morphine** provides effective pain relief, thereby reducing the need for additional opioid doses (Wang et al., 2018). This is particularly important as opioid-related **side effects** such as **nausea** and **respiratory depression** can be problematic in the immediate postoperative period. Although our study did observe a higher incidence of **nausea** in the **IV group**, the **lower opioid consumption** in this group demonstrates a **balanced risk-benefit profile** when managing **acute postoperative pain**.

4.3 Safety and Side Effects

In terms of **side effects**, our study showed that **nausea and vomiting** were more prevalent in **Group V (IV analgesia)**, which is consistent with previous studies examining **opioid use** (Kehlet et al., 2016). **IV opioids**, such as **morphine**, are known to cause **gastrointestinal distress**, including **nausea** and **vomiting**, particularly in the early postoperative phase (Rao et al., 2017). Our findings reinforce the need for **careful monitoring** of patients receiving **IV opioids** and the potential benefits of **combining them with antiemetic treatments** to minimize these side effects.

On the other hand, **constipation** was more common in the **oral analgesia group (Group O)**. While **oral NSAIDs** such as **ibuprofen** are often the first-line treatment for postoperative pain, they are also associated with **gastrointestinal side effects**, including **constipation** (Zhang et al., 2019). This is supported by our study, where **40 patients (26.7%)** in the oral group experienced **constipation** compared to **28 patients (18.7%)** in the IV group. This side effect is particularly problematic for patients after **abdominal surgeries**, where **gut motility** is already compromised. These findings emphasize the importance of considering the **full range of side effects** when choosing an analgesic regimen.

Interestingly, **respiratory depression**, a well-known risk of **IV opioid use**, was observed in **4 patients (2.7%)** in the **IV group**. Although this occurred in a small proportion of patients, it highlights the potential risks associated with **opioid-based analgesia** in the immediate postoperative period, underscoring the need for **close monitoring** (Ballantyne et al., 2017).

4.4 Time to First Rescue Dose and Patient Satisfaction

Our study also revealed that the **time to first rescue dose** was significantly shorter in **Group V (IV analgesia)**. This aligns with the findings of **Patel et al. (2020)**, who found that patients receiving **IV analgesics** required **fewer rescue doses** due to the **rapid action** of IV medications. In contrast, **oral analgesia**, while effective over the long term, required **longer intervals** before patients needed additional pain relief. This **faster onset** of pain relief in the IV group is particularly beneficial for patients undergoing **major surgeries** who require **immediate pain control** to facilitate early **mobilization** and recovery.

In terms of **patient satisfaction**, our study showed that **patients in the IV group** reported **higher satisfaction scores**, particularly during the **first 24 hours** post-surgery. This is consistent with studies suggesting that **IV analgesia** is often associated with **higher patient satisfaction** in the immediate postoperative period due to its **quick action** and **reliable pain control** (Kehlet et al., 2016). However, it is important to note that **oral analgesia** still provided **acceptable satisfaction scores** and could be preferred for patients seeking a **non-invasive** and **cost-effective** option once the acute pain phase subsides.

4.5 Implications for Clinical Practice

The findings of this study have important clinical implications for postoperative pain management, particularly in settings where both **oral and intravenous analgesics** are commonly used. **Intravenous analgesia**, particularly with **morphine**, provides superior **early pain relief** and

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reduces opioid consumption, making it ideal for the initial postoperative period. However, **oral analgesia** remains a viable option for **long-term pain management**, with similar efficacy after the initial postoperative phase and fewer **gastrointestinal side effects**.

Given the **cost-effectiveness** and **ease of administration** of oral analgesics, hospitals in **low- and middle-income countries (LMICs)**, such as Pakistan, may find **oral analgesia** to be a more **practical choice** once acute pain is controlled. As **oral analgesics** are generally more **affordable** and do not require **IV equipment or specialized personnel**, they offer a **resource-efficient** option, particularly in busy hospital settings where resources may be limited.

4.6 Limitations and Future Research

While this study provides valuable insights, it does have certain limitations. First, it was conducted at a **single tertiary care hospital**, and the findings may not be generalizable to all settings, particularly in rural or smaller hospitals where access to IV medications may be limited. Second, although we measured the **primary and secondary outcomes** at specific time points, we did not assess **long-term pain management** beyond the 48-hour period, and future studies should consider **longer follow-up** to evaluate the sustained efficacy of oral and IV analgesia.

Future research should also explore **multimodal analgesic strategies**, combining **oral and IV methods** with other non-pharmacological interventions, such as **regional anesthesia** or **transcutaneous electrical nerve stimulation (TENS)**, to further improve **postoperative pain control** while minimizing side effects and opioid use (Sambasivan et al., 2019).

5. CONCLUSION

This randomized controlled trial has provided valuable insights into the comparative efficacy, safety, and patient satisfaction between **oral** and **intravenous (IV)** analgesia for managing **acute postoperative pain**. The results of the study indicate that while **IV analgesia** provides **superior early pain relief**, particularly in the **first 6 hours post-surgery**, **oral analgesia** offers **effective long-term pain management** with a **lower incidence of gastrointestinal side effects** such as **constipation**.

Our findings also highlight the significant **opioid-sparing effects** of **IV analgesia**, which not only reduced **opioid consumption** but also contributed to **faster pain control** and **greater patient satisfaction** in the immediate postoperative phase. On the other hand, **oral analgesia**, while slightly less effective in the initial hours, provided a **cost-effective** and **non-invasive** alternative that could be considered for **long-term postoperative pain management** once acute pain has been controlled.

Despite the advantages of **IV analgesia**, it is important to acknowledge the **higher incidence of nausea and vomiting** observed in this group, which is consistent with previous studies on **opioid use**. Therefore, careful monitoring and additional antiemetic treatment should be considered in clinical practice to minimize these side effects. Furthermore, the **risk of respiratory depression** in the **IV group** underscores the need for appropriate **postoperative monitoring**, particularly in patients receiving **opioid-based analgesics**.

The results of this study have practical implications for **postoperative pain management protocols**, especially in settings where resources may be limited. **Oral analgesia** remains a **viable, cost-effective alternative** for long-term pain control, while **IV analgesia** can be prioritized for the initial postoperative phase when **rapid pain relief** is essential. Hospitals in **low- and middle-income countries (LMICs)** like Pakistan may find oral analgesia to be particularly beneficial due to its **affordability** and **ease of administration**.

This study is an important step in bridging the knowledge gap regarding postoperative pain management in **Pakistan** and similar healthcare settings. Future research should explore the **multimodal analgesic approaches** that combine both **oral and IV analgesia**, potentially incorporating **regional anesthesia** or **non-pharmacological interventions**, to optimize **postoperative pain control** while minimizing side effects and opioid use.

In conclusion, the choice between **oral** and **IV analgesia** should be tailored to the individual patient's needs, the type of surgery performed, and

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the available healthcare resources. This study's findings contribute to the growing body of evidence supporting **personalized pain management strategies** that maximize patient comfort, minimize side effects, and enhance recovery outcomes.

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