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Research Article

# Incidence and Predictors of Moderate to Severe Post-Orthopedic Surgery Pain and Patients' Satisfaction with Treatment in a Namibian Teaching Hospital: A Prospective Observational Study

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## ABSTRACT

**Background:** Orthopedic surgeries are synonymous with high pain scores, especially within the first 24 hours. Our objective was to determine the incidence and predictors of moderate to severe post-orthopedic surgery pain, investigate the influence of the type of anesthesia employed as well as evaluate patients' satisfaction with treatment.

**Methods:** A prospective observational study was carried out on all patients 18 years and above, who had orthopedic surgeries between February and May 2023 under General Anesthesia (GA), Peripheral Nerve Block (PNB), Spinal Bupivacaine-Morphine (SpB-M) and Spinal Bupivacaine-Fentanyl (SpB-F). Pain was measured using the Numerical Rating Scale (NRS) in the Post-Anesthesia Care Unit (PACU), 4 h and 24 h. We defined NRS ≥ 4/10 as moderate to severe pain. Logistic regression was employed to identify predictors of moderate to severe pain

**Results:** We studied 289 patients. The overall incidence of moderate to severe pain was 61%, in the PACU (17%), 4 h (36%) and 24 h (35%). The pain scores for PNB and SpB-M patients were significantly lower than GA patients in the PACU and 4 h (p=0.001). The mean time to first request for analgesics in the PNB patients was 602.6 ± 335 min versus 279.7 ± 293 for GA patients, p=0.001. GA was an independent predictor while SpB-M was significantly protective in the PACU and 4 h (P=0.020).

**Conclusion:** We found a low incidence of moderate to severe pain in the PACU while the overall incidence was comparable with other studies. GA was an independent predictor; SpB-M offered significant protection.

**Keywords:** Post-orthopedic surgery; Moderate to severe pain; Predictors; Patient satisfaction

## INTRODUCTION

### Background/rationale

Orthopedic surgeries are synonymous with high pain scores especially within the first 24 hours. This knowledge should inform the setting up of appropriate analgesic strategies [1-3]. Despite advances in pain research, pharmaceuticals and therapeutic modalities, treating postoperative pain has remained a challenge worldwide. According to Correll et al., there is no evidence of real progress in managing acute pain using scientometric analyses from 1993-2012 [4]. The incidence of moderate to severe pain ranges from 14-60% in first world countries and 70-95% in less affluent nations [1,5]. It can be safely said that there is a global inequality of pain treatment partly due to ineffective drug policies and unreliable supply chain in third world countries.

Suboptimal postoperative pain treatment is associated with delayed ambulation which increases the risk of thromboembolic events and cardiorespiratory complications. Unmitigated pain has been shown to cause a switch from peripheral to central

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sensitization thereby rewiring the brain to increase noxious stimuli transmission, reduce the effectiveness of analgesics and engender the development of chronic pain [1,2,6,7].

### Objectives

The objective of this study was to evaluate the effectiveness of post-orthopedic surgery pain management in our center by examining the incidence and predictors of moderate to severe pain, investigate the influence of the type of anesthesia employed as well as evaluate patients' satisfaction with treatment.

## MATERIALS AND METHODS

### Study design

We conducted a prospective observational study on all patients 18 years and above, who had in-patient orthopedic surgeries from 1st February to 31st May 2023.

### Setting

This study was conducted at Katutura State Hospital (a university teaching hospital) in Windhoek, Namibia, which has two dedicated operating rooms for orthopedic and trauma surgeries daily. The hospital has approximately 840 beds, about 162 serve orthopedic cases.

### Participants' inclusion and exclusion criteria

All consenting patients 18 years and above who had in-patient orthopedic procedures were recruited for the study. We excluded day case surgeries, patients who required admission into the High Dependency Unit/Intensive Care Unit (HDU/ICU) after surgery, patients with documented psychiatric illnesses and communication/language difficulties.

### Variables, data source and measurements

Each patient was instructed preoperatively in the 11-point NRS *viz.*, 0=no pain, 1-3=mild pain, 4-6 moderate pain and 7-10=severe pain. We defined NRS ≥ 4/10 as moderate to severe pain. Satisfaction was measured using a 5-point Likert scale: Excellent, very good, good, fair and poor. A questionnaire was designed for the research and data collection was done by an experienced research assistant. The questionnaire was pretested on a cohort of orthopedic patients (not included in this study) before being adopted. Data collected included patient's age, gender, type of surgery and anesthesia, duration of surgery, analgesic treatment, time to first request for analgesic after surgery and the postoperative Numerical Rating Scale (NRS) pain scores at three time points after surgery: In the Post-Anesthesia Care Unit (PACU), 4 h and 24 h.

### Bias

There was no randomization or recruitment of patients into the 4 groups based on the anesthetic techniques employed *viz.*, General Anesthesia (GA), Peripheral Nerve Block (PNB), Spinal Bupivacaine-Morphine (SpB-M) and Spinal Bupivacaine-Fentanyl (SpB-F). The choice of the anesthetic was determined by the attending anesthesia provider in consultation with the individual patient and surgeon. A standard GA comprised intravenous fentanyl 100 mcg and propofol or ketamine at induction. Prior to skin incision, intravenous morphine 3 mg (0.05 mg/kg) was administered along with paracetamol 1 g and diclofenac 75 mg. For maintenance, sevoflurane and rocuronium or atracurium for muscle relaxation, if required. For spinal anesthesia, hyperbaric bupivacaine (10-15 mg) with either fentanyl (15 mcg) or preservative-free morphine (100 mcg) was injected intrathecally. Our team introduced the use of preservative-free morphine for spinal anesthesia in the last 24 months, fentanyl was the only adjuvant administered before then. The PNBs were interscalene, supraclavicular or axillary approaches depending on the area of surgical interest under ultrasound-guidance, typically 0.5% bupivacaine 20 ml+8 mg dexamethasone was administered. Patients who had shoulder operations had combined intermediate cervical plexus and interscalene blocks. For all patients, the 24 h postoperative multimodal analgesic consisted of intramuscular pethidine (1-2 mg/kg 8 hourly pro re nata), diclofenac (75 mg 12 hourly) and paracetamol (1 g 6 hourly).

### Statistical analysis

All data were collected manually, cleaned, coded and entered into SPSS for windows (IBM Corp. Released 2013. IBM SPSS Statistics for Windows, Version 29.0. IBM Corporation, Armonk, NY, USA) and analyzed. The participants' demographic and clinical characteristics were summarized using descriptive statistics: Continuous variables were expresses as mean, standard deviation and range while categorical variables were summarized using frequencies and proportions. The Analysis of Variance (ANOVA) was employed to determine the differences between groups at the 3-measurement points. We employed multivariate logistic regression model to identify the risk factors for moderate to severe pain. For all the analyses, statistical significance was set at a p-value of <0.05.

### Ethical consideration

Approval to conduct this study was obtained from the Research Ethical Committee of the Namibian Ministry of Health and Social Security.

## RESULTS

### Participants

Overall, 385 patients had orthopedic surgeries during the study period. We excluded 94 children and 2 adults who were admitted to HDU, leaving 289 participants.

### Descriptive data

The participants' mean age was 42.3 ± 17 years; 186 (64.4%) were males and 103 (36%) were females. Most of the patients were ASA 1 58% (161/289). The demographic data of the participants are summarized in Table 1.

**Table 1:** Demographic characteristics the study participants.

| **Variable** | |
|---|---|
| Age (years), mean ± SD, range | 42.3 ± 17; 18-90 |
| Weight (kg), mean ± SD, range | 68.2 ± 16; 41-170 |
| Height (cm), mean ± SD, range | 170 ± 9; 150-195 |
| BMI (kg/m$^2$), mean ± SD, range | 23.4 ± 4.7; 13.9-48.4 |
| **Gender n** (%) | |
| Male | 186 (64.4) |
| Female | 103 (35.6) |
| **ASA n** (%) | |
| 1 | 161 (55.7) |
| 2 | 104 (36.0) |
| 3 | 22 (8.3) |
| **Type of anesthesia n** (%) | |
| General anesthesia | 92 (31.8) |
| Spinal bupivacaine-fentanyl | 35 (12.1) |
| Spinal bupivacaine-morphine | 108 (37.8) |
| Peripheral nerve block | 54 (18.7) |
| **Upper extremity blocks n** (%) | |
| Interscalene/Supraclavicular/Intermediate cervical | 31 (57) |
| Axillary block | 23 (43) |

There were more lower extremity surgeries 171 (59.2%) than upper limbs 117 (40.5%) and one patient had both extremities operated upon. A smaller proportion of patients (31%) had their injuries ≤ 7 days before the surgical interventions. The anesthetic technique was dominated by Regional Anesthesia (RA) (68%) over GA (32%). Of the RA for lower extremity surgeries, SpB-M (38%) was preferred to SpB-F (12%). Of the 117 upper extremity surgeries, 46% (54/117) had PNBs: 57% (31/54) were above the clavicle (interscalene/supraclavicular/intermediate cervical plexus blocks) and 43% (23/54) were axillary brachial plexus blocks.

## Incidence of moderate to severe post-orthopedic surgery pain

The overall incidence of moderate to severe pain was 61.2% (112/289). However, the incidence in the PACU, 4 h and 24 h time intervals were 17% (49/289), 36% (105/289) and 35% (102/289) respectively. In the PACU, most of these patients, 83.7% (41/49) had GA for their procedures. At the 4 h measurement point, the GA cases accounted for 47.6% (49/103) followed by SpB-M patients, 33% (34/103). At the 24 h mark, the patients who had SpB-M were highest, 38.2% (39/102) followed by GA, 26.5% (27/102). Figure 1 showed the incidence of post-orthopedic surgery pain in PACU, 4 h and 24 h.

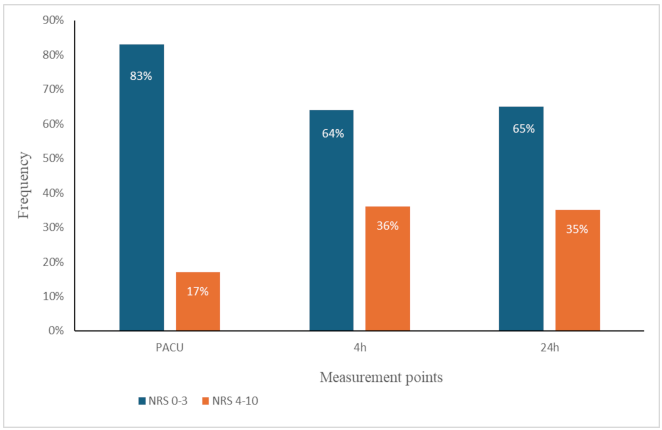


**Figure 1:** Incidence of post-orthopedic surgery pain in PACU, 4 h and 24 h.

## Anesthesia type and the severity of pain

At the PACU, the mean NRS pain scores for PNB patients were 0.17 ± 0.6 and for SpB-M and SpB-F patients were 0.35 ± 1.2 and 0.66 ± 1.8 respectively. There was a significant difference for GA patients 3.17 ± 3.1, (p=0.001). At the 4 h measurement point, the mean NRS for the PNB and SpB-M were 1.41 ± 2.2 and 2.30 ± 2.5 respectively compared to 3.95 ± 3.1 for GA patients, a significant difference was found (p=0.001). Although, the pain score for SpB-F (2.89 ± 2.7) groups was lower than the GA, the difference was not significant. At the 24 h point, no significant difference was detected; however, the highest mean NRS was noted in the SpB-F patients.

## Time to first request for analgesics

The mean time to first request for analgesics in the PNB patients was 602.6 ± 335 min, about twice as long as the time for GA patients (279.7 ± 293) followed by SpB-M patients 535.4 ± 371 min, this difference was significant (p=0.001). This difference was highlighted in Figure 2.

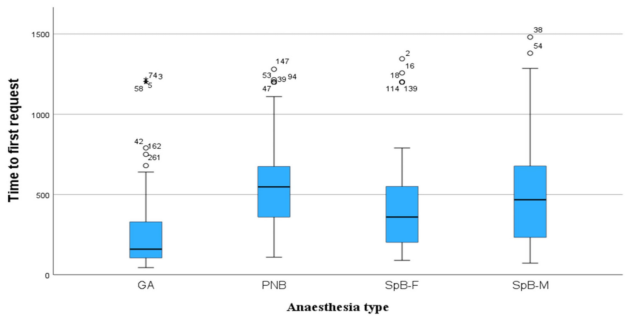


**Figure 2:** Means plots for the time to first request for analgesics (in minutes) according to anesthesia type.

## Total opioid consumption in the 24 h postoperative period

The mean total opioid (pethidine) consumption in 24 h was highest in GA patients 152.5 ± 105 mg compared to PNB patients 104.8 ± 98 mg; this difference was significant (p=0.041). This was highlighted in Figure 3.

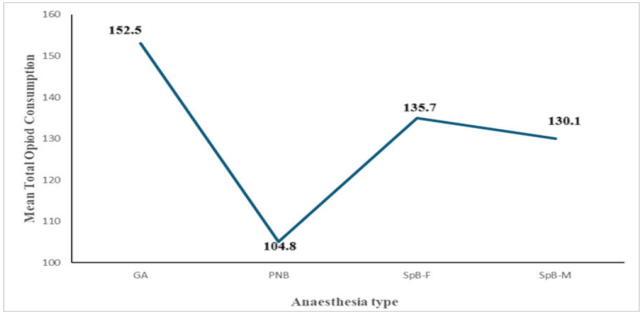


**Figure 3:** Means plots for the total opioid consumption in 24 h postoperative period (in min) according to anesthesia type.

## Factors associated with moderate to severe post-orthopedic surgical pain

Multivariate binary logistic regression (Table 2) showed that GA was an independent predictor of moderate to severe pain while SpB-M was significantly protective in the PACU (OR=0.10, 95% CI=0.03, 0.36, P=0.000) and at 4 h (OR=0.34, 95% CI=0.14, 0.84, P=0.020). However, at 24 h, SpB-F was the only significant risk factor compared to SpB-M (OR=2.54, 95% CI=1.07-5.99, P=0.034).

**Table 2:** Multivariate logistic regression of factors associated with moderate to severe pain at PACU and 24 h post operation.

| Variable* | Variable category | PACU | | | 24 h | | |
|---|---|---|---|---|---|---|---|
| | | P-value | Odds ratio | 95% CI | P-value | Odds ratio | 95% CI |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Age | | 0.205 | 0.98 | 0.95-1.01 | 0.265 | 0.99 | 0.97-1.01 |
| Gender | Male | 0.061 | 0.46 | 0.20-1.04 | 0.291 | 1.36 | 0.77-2.4 |
| | Female | | 1 | | | 1 | |
| Surgical type | Bone | 0.226 | 2.02 | 0.65-6.33 | 0.145 | 0.54 | 0.23-1.24 |
| | Tendon | | 1 | | 1 | | |
| Anesthesia type | GA | 0 | 9.6 | 2.75-33.6 | 0.451 | 0.699 | 0.28-1.77 |
| | PNB | 0.997 | 0 | | 0.928 | 1.062 | 0.29-3.89 |
| | SpB-F | 0.39 | 1.97 | 0.42-9.24 | 0.034 | 2.54 | 1.07-5.99 |
| | SpB-M | 1 | 1 | | | 1 | 1 |

**Note:** *Variables in the model include age, gender, BMI, injury time before operation, operation site surgical type pre-op fear sedation and anesthesia type

### Patient satisfaction with pain management

Of the 289 patients, 76.7% (222/289) expressed satisfaction with the quality of pain management (good, very good and excellent). Only 3.8% (11/289) ranked the pain control as poor.

## DISCUSSION

This study was our attempt at an optimal pain intervention in our teaching hospital against the background that major orthopaedic surgeries are associated with moderate to severe pain [1-3]. According to this study, the overall incidence of moderate to severe pain was 61%, in the PACU (17%), 4 h (36%) and 24 h (35%). Our finding of 61% was comparable with 60% from a Norwegian study on orthopedic surgery [8]. This incidence, though high, falls within the range of 20-80% from different parts of the world. Higher rates were reported in the USA (75%), Tanzania (73%) and Ethiopia (71%), to mention just a few [1,9-11]. The high incidence of acute postoperative pain, even in advanced countries, indicates that our present strategies are at best suboptimal. One UK study in 2014 recorded a 56% incidence which the authors stated had not changed since 1990. Notwithstanding, The Royal College of Anaesthetists proposed a 5% target for severe postoperative pain as an audit standard intended to drive local efforts at improving pain services [4,12,13].

Our incidence of 17% in the PACU was lower than the 37% reported by Arefayne et al in Ethiopia at the 2 h measurement point [10]. Edgley et al., reported a three-fold increased incidence (56%) in the PACU in a cohort of orthopedic patients in Australia [14]. Our lower incidence compared to the above referenced studies in the immediate postoperative interval could have been impacted by the anesthesia practice in which 68% of our patients had regional blocks in contrast to 25% and 29% respectively. It is recognized that regional anesthesia provides profound analgesia in the immediate postoperative period until the effect of the local anesthetic agent wears off. Our findings of a higher proportion of GA operated patients reporting moderate to severe pain in the PACU and 4 h time intervals are hardly surprising. Our anesthesia providers are medical officers of varying years of experience, registrars undergoing residency training and specialist anesthesiologists. Their opioid choice and dosing are affected by prejudices and concerns about respiratory depression and delayed awakening. The practice of administrating 100 mcg fentanyl at induction followed by an average of 0.05 mg/kg morphine at surgical skin incision to every adult surgical patient amount to underdosing at best on the part of our anesthesia providers. Our results showed that a greater proportion of cases (69%) were not fresh injuries (≤ 1 week) which could portend more extensive surgeries, making the analgesic requirements much higher than the conservative opioid regimen employed. In contrast to GA, studies have shown that neuraxial and peripheral nerve blocks are protective while such blocks last [2,14-17].

Our study found that the mean pain scores for PNB and SpB-M patients were significantly lower than GA patients in the PACU and 4 h (p=0.001). However, at the 4 h point there was no significant difference in the pain scores between SpB-F versus the GA groups. At the 24 h mark, the mean highest pain score was noted in the SpB-F group. This finding with SpB-F beyond the 4 h mark is hardly surprising as the analgesic effect of intrathecal fentanyl at 15 mcg used in this study should last an average of 2-4 hours. This is consistent with fentanyl's pharmacokinetic profile of relatively higher lipophilicity and rapid clearance from the cerebrospinal fluid compared to morphine [18,19]. The higher pain scores experienced by these SpB-F patients showed that timely and adequate analgesic medications were not administered when the blocks resolved.

On the time to first request for analgesics and the 24 h pethidine consumption (in mg), our results showed that the postoperative period that the PNB and SpB-M patients did not require rescue opioid medication was twice as long as the GA patients. Furthermore, the mean total pethidine consumption in 24 h was significantly higher in GA patients than PNB patients.

It does appear that a relationship exists between pain scores and analgesic requirements but given the fact that the pain experience is largely subjective, we are cautious about making such a conclusion [20,21].

Multivariate binary logistic regression showed that SpB-M was significantly protective compared to GA at PACU and 4 h postoperatively. This finding about GA is congruous with other studies [1,17,22,23]. However, at 24 h, SpB-F was the only significant risk factor compared to SpB-M. The reason we adduce for this is that single-shot spinal with intrathecal fentanyl being short-acting (4-6 hours) would be complicated by severe acute pain, if timely and adequate analgesia is not instituted before the block wore off.

One limitation of our study is the heterogenous nature of the patients operated on and the orthopedic procedures performed, which unarguably posed different pain experiences for the patients. These could have confounded the interpretation of our findings as per the duration of analgesia and the analgesic requirements. Notwithstanding, we believe that the results from this observational study can be used to develop a randomized clinical study to assess the impact of regional techniques as an adjunct to GA.

## CONCLUSION

In conclusion, we found a low incidence of moderate to severe pain in the PACU while the overall incidence was comparable with other studies. The independent predictor was the anaesthesia type employed; intrathecal morphine offered significant protection. A high proportion of participants were satisfied with their pain management.

**What is known about this topic**

- Suboptimal postoperative pain treatment subsists despite innovations in research, pharmaceuticals and drug delivery mechanisms.
- Moderate to severe pain has remained a challenge post-orthopedic surgery worldwide.

**What this study adds**

- GA was an independent predictor of moderate to severe pain in the PACU and 4 h, intrathecal morphine (SpB-M) offered significant protection.
- At 24 h, intrathecal fentanyl (SpB-F) was a significant risk factor for moderate to severe pain.
- When anesthesia service providers administer low opioid doses during general anesthesia out of prejudice or concerns, the effect is undertreatment of postoperative pain.

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## COMPETING INTERESTS

The authors declared they have no conflicts of interest.

## AUTHOR CONTRIBUTIONS

The requirement for authorship has been met in this work. This study was conceived and designed by Rukewe A, and Akande A. All authors participated in material preparation and analysis. The first draft was jointly written by Rukewe A and Akande A, comments were received from the others. All authors read and approved the final manuscript.

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