RESEARCH ARTICLE

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# The Impact of Intraoperative High Flow Nasal Cannula (HFNC) on Elderly Patient's Outcomes Undergoing Hip Fracture Surgery under Spinal Anesthesia: A Randomized Study

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## ABSTRACT

**Background:** High flow nasal cannula is a noninvasive ventilator technique, uses a heated and humidified oxygen with high flow rates exceed the traditional airway devices like low flow nasal cannula and face mask in goals of enhance ventilation, reduce work of breathing and recruits the lungs.

**Objectives:** The study aims to evaluate the influence of intraoperative HFNC on elderly patient's outcomes undergoing hip surgery under spinal anesthesia.

**Method:** A randomized controlled study included seventy patients aged ≥ 65 years enrolled for hip fracture repair under spinal anesthesia in orthopedic department of Sahloul Teaching Hospital over 6 months. Patients were randomly allocated for two groups of thirty-five patients; the Intervention group (I) and control group (C).

**Results:** The total 70 patients were comparable regarding socio-demographic characteristics and baseline data. A significant variance between interventional group (I) and control group (C) regarding postoperative complications ($p=0.023$) regarding length of hospital stay, p-value showed a significant between two groups ($p=0.03$), there was no in hospital mortality in both groups.

**Conclusion:** Application of HFNC intraoperative for traumatic hip fracture elderly patient may decrease the incidence of respiratory complications after surgery and reduces the time of hospital stay.

**Keywords:** High Flow Nasal Cannula, HFNC, Hip Fracture Surgery, Elderly Patient and Spinal Anesthesia.

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## INTRODUCTION

Non-invasive ventilatory support has become obvious for managing patients preoperatively or in the intensive care unit to reduce respiratory complications and improve recovery outcomes [1-4]. Furthermore, it is widely accepted as non-invasive method to manage post-operative respiratory complications, which can have a roll in prevention of post-operative respiratory deterioration such as hypoxia and Acute Respiratory Failure (ARF), reduce the incidence of re-intubation, and reduce in hospital stay time[5-7]. On the other hand, its application before anesthesia and surgery can improve pre-oxygenation before intubation for ICU patients in critical conditions, prevent obesity patients from exercising in the operating room[8-10], and reduce mortality rates in some patient groups[11,12]. As one of the current non-invasive oxygen techniques, HFNC can induce multiple clinical benefits that mostly related to less respiratory effort, more removing of $CO_2$ form the upper airway, increasing of end expiratory volume and creating a CPAP effect of 2-3 cm $H_2O$ in the upper airways. Postoperative Pulmonary Complications (PPCs), the term generally encompasses any complication that impacts the respiratory system and has a negative impact on the patient's clinical progress following anesthesia and surgery[8,9]. These complications are described as common, serious, expensive and represent the common cause of postoperative morbidity and mortality[10,11]. The commonly included in Postoperative Respiratory Complications (PPCs) encompass respiratory failure, inability of trachea reintubation within 48 hours, failure of ventilatory weaning, atelectasis, bronchospasm, pneumonia, exacerbation of COPD condition, pleural effusion, pneumothorax, and upper airway obstruction[9,12]. In comparison with non-cardiac surgery, postoperative cardiac complications are less common than pulmonary complications[9,11]. Anesthesia, surgery and postoperative pain are well defined risk factors for postoperative respiratory complications[13-15]. The American College of Physicians (ACP) guideline on risk assessment identified advanced age, poor health status, and surgery near the diaphragm as important predictors for Postoperative Pulmonary Complications (PPCs)[16]. Hip fractures present a significant healthcare concern, posing challenges and burdens with direct effects on the patients and healthcare systems, as well as the society at large. As the global population of geriatrics continues to increase, the total percentage of hip fractures is also increasing rapidly. The majority of traumatic hip fractures are treated primarily by surgical intervention[17-21] . Our study goals were concern on evaluation the effects of the high-flow nasal cannula on elderly outcomes when undergo hip fracture surgery under spinal anesthesia as a prophylactic intraoperative technique to limit the incidence of postoperative respiratory complications, in hospital stay length and incidence of in hospital morbidity and mortality.

## METHODS

This a randomized, controlled, single-blind study, signed as approved by the CHU of ethics committee of Sahloul teaching hospital in Sousse, Tunisia on April 2023 and carried out in orthopedic operating room over a 6 months' duration. After getting the patient consent, 70 patients aged 65 years or more, with isolated hip fracture introduced for hip fracture repair under spinal anesthesia. Patient contraindicated to spinal anesthesia, refused spinal anesthesia and/or HFNC and who converted to general anesthesia, were excluded. In HFNC group, an (AIRVO™ 2; Fisher and Paykel Healthcare, Auckland, New Zealand). The rate of oxygen flow and the fraction of inspired oxygen were respectively 35 l/min and 0.4. In Control group, patients didn't get any respiratory support during surgery. All patients in both groups were randomly allocated to 35 patients for each group. In interventional group (I), patients had HFNC closely after intrathecal anesthetic injection and continued till the surgery had completed, an anesthesiologist, who was not considered a participant in the clinical trial, prepares a random sequence for the purpose of arranging the application of the material used in the study, randomization assessed on two groups with a 1:1 ratio. Intervention Group (I) with HFNC, and Control group (C) with no respiratory support device. The researcher, medical staff, and participants were not responsible to choose which patient must get a HFNC device. At the time of assigning study participants, each participant assigned a private information form, and numbered with the serial number assigned to study type.

In anesthesia theatre, an appropriate size intravenous cannula (usually 18-gauge) was inserted in cephalic vein, an oxygen saturation monitoring with pulse oxymetry, ECG leads, and automated Non-Invasive Blood Pressure (NIBP) are connected. With sitting position, a 25G pencil point spinal needle was inserted in space between L3/L4 vertebra, and when correct intrathecal position confirmed by observing clear outflow of CSF, 2 ml of (0.5%) hyperbaric bupivacaine and sufentanil (2.5 $\mu$g) was injected. Patient was then put in supine position. Patient data included Sociodemographic characteristics (Age, gender, BMI and ASA score), history of medical comorbidities, Perioperative Respiratory and circulatory parameters (Peripheral Arterial Oxygenation ($SPO_2$), Respiratory Rate (RR), Heart Rate (HR), Arterial Blood Pressure (PA)), intraoperative related data (surgery duration, sensitive level, complications related to HFNC use), Patients were randomly allocated into two groups (group intervention and group control) of 35 patients each. In group intervention, patients had had HFNC during the intraoperative period, started closely after spinal anesthesia and stopped when surgery completed, Patients outcomes (PPC, ICU admission, LOS, inhospital mortality) and patient, surgeon, anesthesiologist satisfaction assessed by a 5 point Likert scale. IBM SPSS Statistics software was used for analyzing the raw data. On the other hand, Chi-square test was suitable to investigate the categorical variables, and t-Student test to

compare between numerical variables. The results were considered significant if P-value was 0.05 or less. The main Primary goal was the incidence of postoperative pulmonary complications. Secondary goals were in hospital stay time, need for postoperative oxygen support, ICU admission, and inhospitable mortality.

## RESULTS

**Socio-demographic characteristics:** 70 Patient encountered the inclusion criteria, both the intervention group (I) and the control group (C) were compared regarding Scio-demographic characteristic. No significance was obtained regarding age, gender, BMI and ASA classes. The mean age was 77.23±8.9 and 77.77 ± 9.87 in group(C) and group (I) respectively (p = 0.81) Figure 1.

The mean gender ratio was 0.84 and 0.52 in group (C) and group (I) respectively (p = 0.32) Figure 2.

The mean BMI was 26.30±4.83 in group I and 25.44±4.12 in group C (p = 0.66) Figure 3.

Regarding ASA status, ASA II in intervention group was 24 (68.57), and in control group was 19 (54.28), ASA III in intervention group was 11 (31.42), and in control group was 16 (45.71) with no significance (p =0.22) Figure 4.

**Non-Demographic Characteristics:** Regarding main chronic disease between two groups in the studied

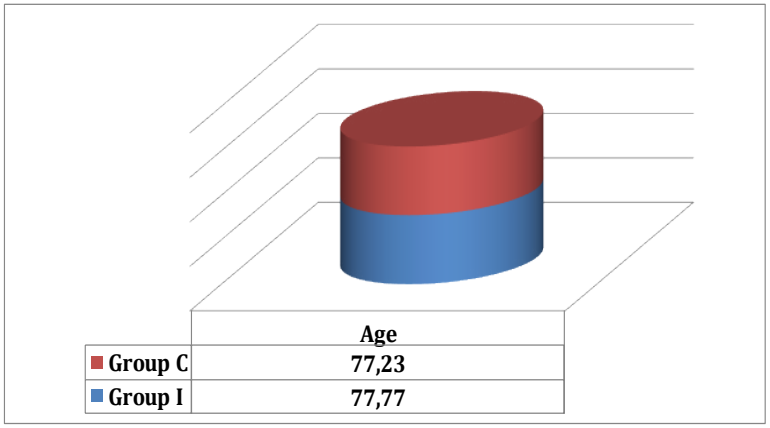


**Figure 1:** Comparison between groups regarding age.

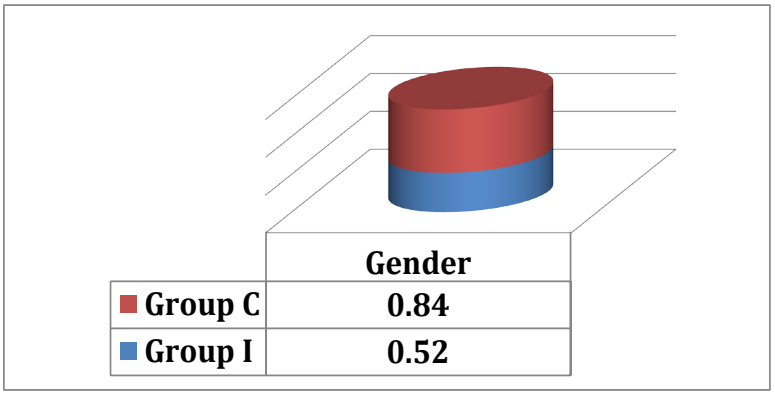


**Figure 2:** Comparison between groups regarding Gender.

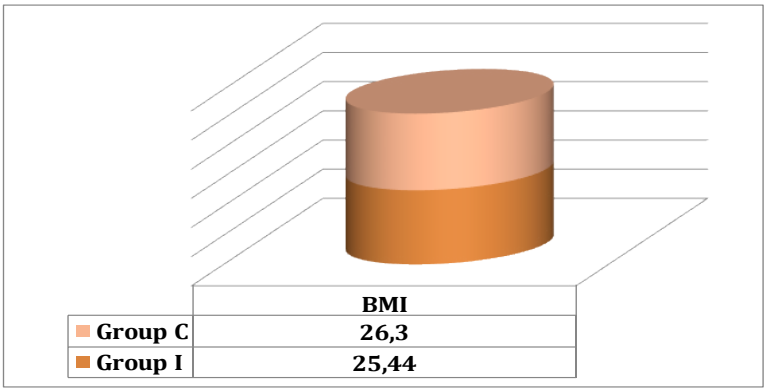


**Figure 3:** Comparison between groups regarding BMI.

population, no significance value was observed between both HFNC patients and control patients. Regarding diabetes (p-value = 0.77), hypertension (p-value = 0.77) congestive heart failure (p = 0.45) coronary disease (p = 0.42) sleep apnea (p = 0.74) COPD/chronic bronchitis and Tobacco smoking Figure 5.

Regarding hemodynamic characteristics, Heart Rate (HR) was significantly higher in control group at 15 minutes (95.31±17.65 *vs* 85±18.79; p=0.02), 30 minutes (93.43±16.68 *vs* 83.17±16.79; p=0.01), 45 minutes (95.40±17.11 *vs* 80.37±18.47; p=0.001) and 60 minutes (94.76±18.40 *vs* 84.18±18.71; p=0.02) Figure 6.

Regarding respiratory parameters, RR was significantly higher in Intervention group at 15 minutes (16.40±2.48; *vs* 17.97±3.40; p=0.03) Figure 7.

Regarding Postoperative Pulmonary Complications (PPCs), A significant difference between both groups was observed (p=0.023).

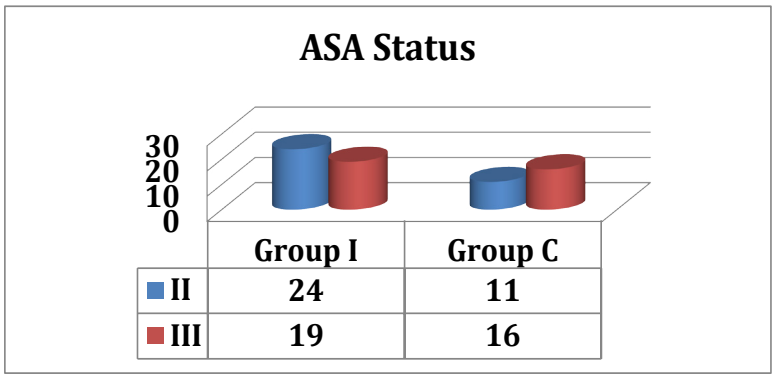


**Figure 4:** Comparison between groups regarding ASA classification.

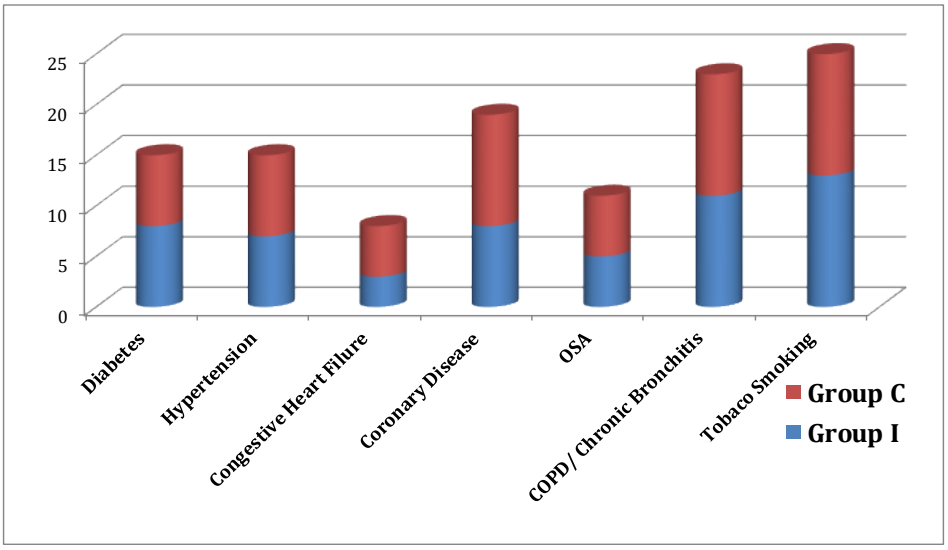


**Figure 5:** Comparison between groups regarding Chronic diseases.

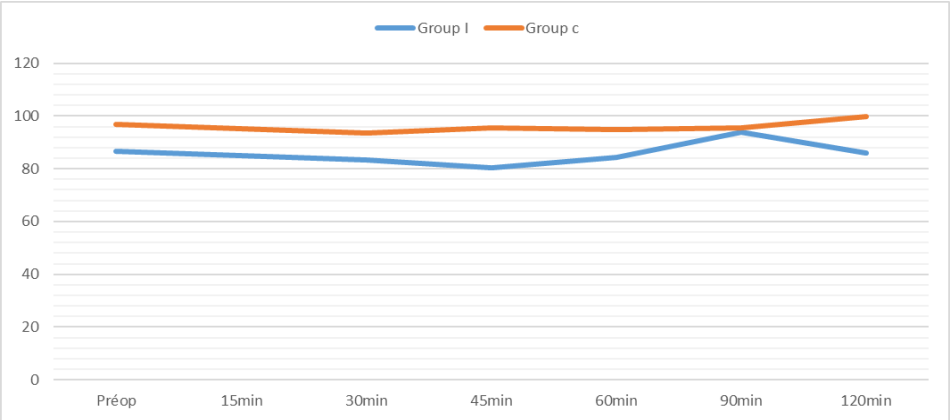


**Figure 6:** Comparison between groups regarding Heart Rate (HR).

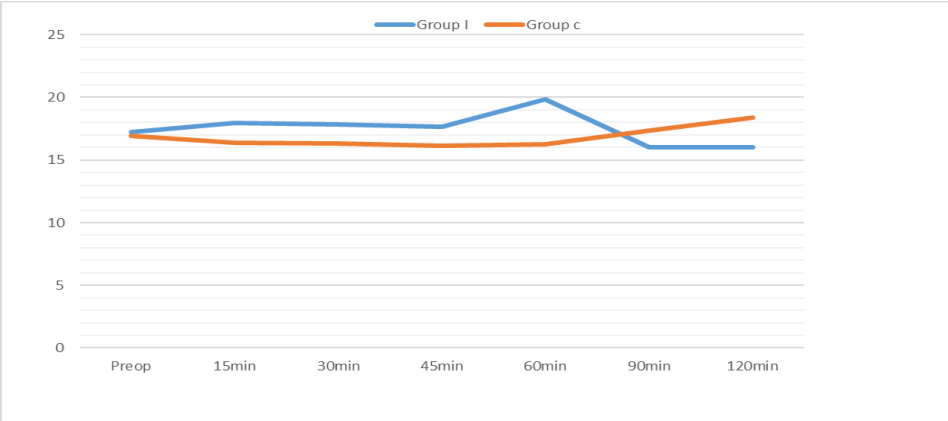


**Figure 7:** Comparison between groups regarding RR.

No patient was admitted in intensive care units. No patient developed intraoperative complication related to the HFNC use. The mean length of hospital stay was 8.83±2.92 in group I and 10.49±3.39 in group C with a significant difference (p-value=0.03) in hospital mortality in both groups was zero.

## DISCUSSION

Many clinical studies regarding postoperative complications, suggested that aging is an important risk factor which may increase postoperative morbidity and mortality[12,13,22]. Multiple trials suggested the benefits of noninvasive ventilation in intensive therapy units[23], and operating theatre which may include enhancing lungs ventilation and increasing alveolar recruitments[24], to manage or prevent respiratory complications. High flow nasal cannula has reported to improve preoxygenation before intubation especially in patients with airway problems in emergency area and in intensive care theatre. It also suggested enhancing patient's oxygenation post cardiac and thoracic procedures and reducing the re-intubation risk[25]. Seungwon Lee et al. 2023 used to apply a HFNC for sedated patients undergoing minor surgical procedures with adequate oxygen saturation and patient's satisfaction [26]. Dong Liu et al. showed in a new study of HFNC during recovery time that this type of noninvasive ventilation can reduce postoperative recovery time, decrease the occurrence of agitation and improve gas exchange [27]. Actually applying of HFNC intraoperatively in awake patients has not yet been assessed. The current study is conducted to evaluate the impact of intraoperative HFNC on outcomes of elderly patients undergoing hip fracture repair who are suspected with higher risk of PPCs. According to Ping Yi et al (2018) HFNC application was safe and effective in patients undergoing awake craniotomy[28]. According to Taeil Lee et al 2023 HFNC is a safe non-invasive oxygenation method that has the ability and efficiency to oxygenate pregnant patients and manage acute respiratory failure[29]. The intraoperative use HFNC technique in hypoxemic patients seems to be reported by Neeraj Kumar et al 2022 in an elderly patient with pneumonia undergoing lower limb orthopedic surgery under spinal anesthesia. In this case, HFNC decreased work of breathing and a respiratory effort, induced better patient comfort, and was associated with a good respiratory outcome[28]. Like these results were mentioned by other studies regarding the use of non-invasive ventilation intraoperative. Patients improvement was explained by the enhancement of diaphragmatic excursion and overall respiratory function[6]. However, patients' compliance seems to be better with HFNC. Concerning to our trial, use of HFNC may improve intraoperative lung ventilation and oxygen saturation; lower the frequency of postoperative complications and the in hospital time of stay. These promising results should be analyzed considering some limitations. In fact, the definition of PPC was not consensual. In addition, the CT scan, as the more efficient exam in respiratory complication screening, was not possible to perform in all cases. Finally, medium and long-term outcomes were not assessed.

## CONCLUSION

The intraoperative use of HFNC may enhance patient oxygenation intraoperative by decreasing respiratory rate, increasing oxygen saturation and as a result decreasing the work of breathing, decrease postoperative respiratory complications and lower the in hospital stay time. Actually we may suggest to consider a HFNC as a preventive strategy mainly in patients at higher risk, but its early be consensus without multiple clinical trials and large population which may support or results and suggestions about that.

### ETHICAL APPROVAL & PATIENT CONSENT

The study received approval from the ethics committee, and participants provided informed consent before enrollment.

## CONFLICT OF INTEREST

The authors declare no financial or non-financial conflicts of interest in this research article.

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