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Sedation and Anesthesia in Interventional Radiology: Experience of the Mohamed VI University Hospital of Marrakech

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Abstract **Original Research Article**

Sedation in interventional radiology has become in recent years a concern of the anesthetist by the development of radiological acts either diagnostic or therapeutic which can be painful and complex requiring sedation and deep analgesia using anesthetic agents adapted to the gesture and the terrain of the patient. Patient with close monitoring to avoid disastrous complications. We report our studies through experiences in interventional radiology service with complete satisfaction to recall this aspect of anesthesia.

Keywords: Sedation, anesthesia, interventional radiology.

INTRODUCTION

Over the past decade there has been a proliferation in the number of interventional radiology procedures, which in turn are becoming increasingly complex and require greater patient cooperation. Diagnostic and therapeutic radiological procedures can be stressful and painful, even more many patients will require analgesia and sedation or anesthesia to minimize discomfort, improve their experience and reduce the risk of complications, by improving cooperation, immobility and security of procedures by a well-executed and appropriate sedation and analgesia [1].

Appropriate use of anesthetic agents improves patient satisfaction, reduces procedural time, and stabilizes hemodynamic status, but improper drug administration or inadequate patient monitoring can precipitate disastrous complications.

The objective of our study was to recall a component of sedation and anesthesia in interventional radiology through our collected experience and data from the existing literature.

MATERIAL AND METHODS

This was a randomized prospective monocentric study, carried out at the vital emergency reception service (SAUV) of the Mohamed VI university hospital of Marrakech. All patients included were scheduled for an interventional radiology procedure requiring anesthesia, over a period of 6 months.

All the patients benefited from a pre-anesthetic consultation, with pre-medication in some cases. All procedures were performed under either local, locoregional, general anesthesia or sedation with non-invasive monitoring per procedure. The RAMSAY scores were used during sedation and visual analogue scale (VAS) for the evaluation of postoperative pain, which were the main criteria of judgment.

RESULT

For 6 months (November 2020 to April 2021), 44 patients were included, 72,7% males and 23,3% females, the average age is 51 years old, 43,18% benefited from chemoembolization, 25% arteriography, 22,73% biliary drainage, 4,54% radiofrequency, 2,27% cure for catheter migration and 2,27% biliary diversion (figure 1).

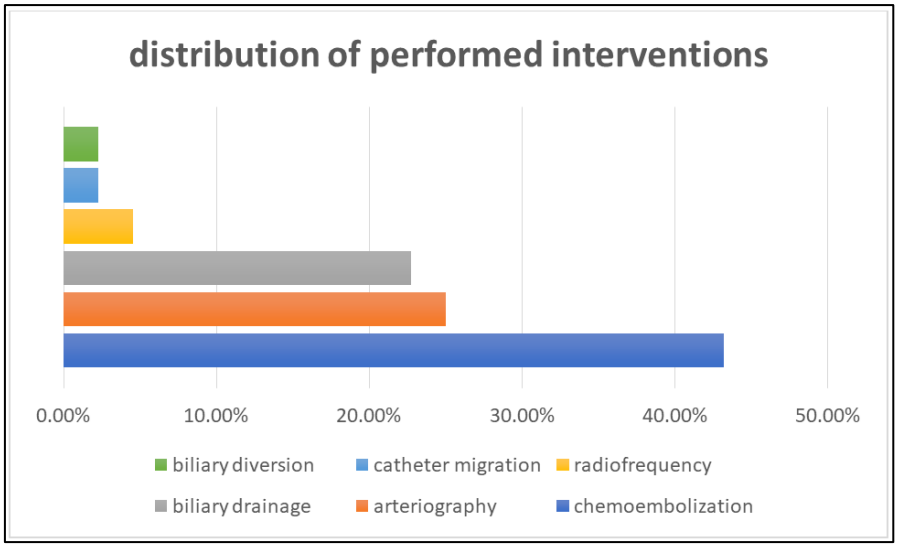

Figure 1: Distribution of performed interventions

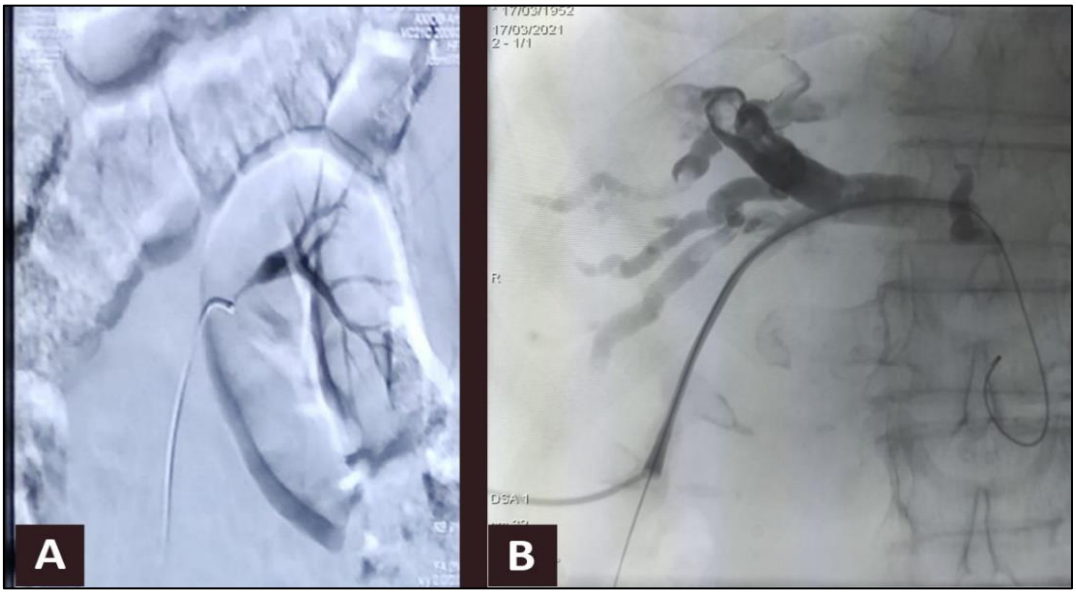

Figure 2: Two examples of performed intervention, A: Arteriography for a stenosis of renal artery, B: Chemoembolization

All patients received a pre-anesthetic consultation, with 70,45 % ASA 1, 25% ASA 2 and 4,54% ASA 3, none of the included patients has presented any predictive element of intubation or difficult airways. Only 13,63% received a hydroxyzine based premedication. The average duration of the gesture was 68 minutes (+/- 19mn), 88,66% under sedation 4,54% under locoregional anesthesia and 6,19% under general anesthesia (figure 3).

Balanced general anesthesia was performed in three cases, one for a child of X years old with a migration of catheter, in view of the difficulties of cooperation of the pediatric patients, and two cases of radiofrequency, in view of the need for total immobility and the painful nature of this intervention. The performed balanced general anesthesia includes the use of fentanyl as morphinic, propofol as hypnotic and rocuronium as curare, in patients who have fasted for more than 6 hours. Whereas sedation was provided by fentanyl and propofol titration at induction, and maintenance by sevoflurane and fentanyl re-injection especially in prolonged or painful interventions.

The prevention of vomiting has been ensured by ondasetron, particularly in risk interventions such as chemoembolization. Post-operative analgesia has been multimodal, based on paracetamol, non-steroidal anti-inflammatory drugs, morphine and tramadol, depending on the intensity of the pain, following the contra indications, and following the patient's medical history and their comorbidities. The most painful interventions were liver chemoembolization with an average EVA of 8.5.

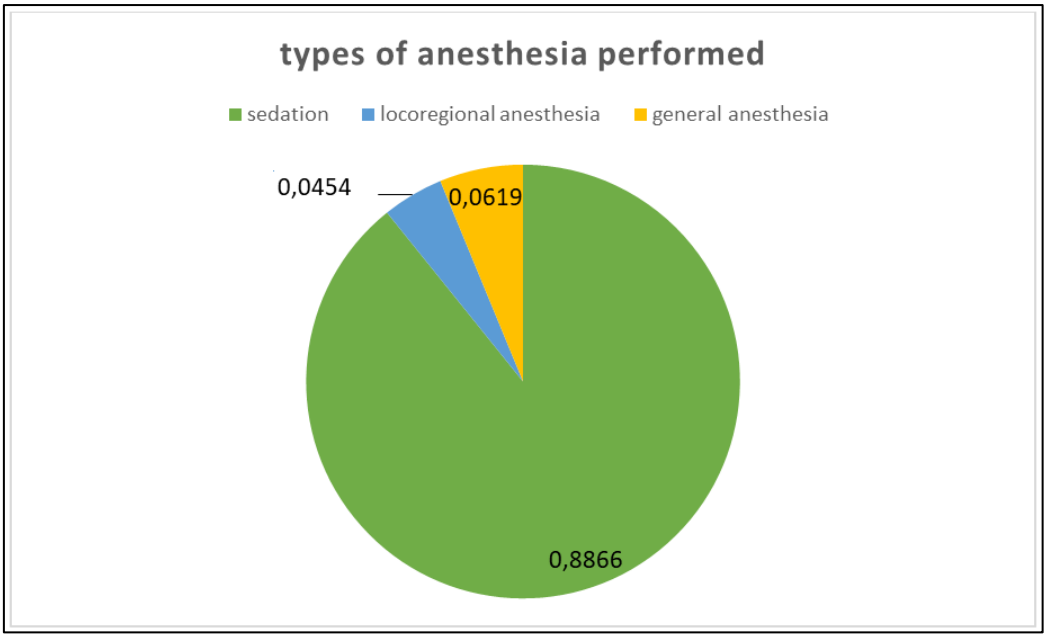

Figure 3: Types of performed anesthesia

RAMSAY score was between 4 and 6, with an average EVA of two, complications related to the gesture in 3 patients two patients presented with minimal bleeding, and one case of migration of biological glue caused mesenteric ischemia (figure 4). Anesthesia related complications were noted in 2 patient's type of agitation.

Figure 4: Preoperative view of a mesenteric ischemia due to migration of biological glue during the cure aneurysm of X

DISCUSSION

Sedation is defined as the use of pharmacological and non-pharmacological means to depress the central nervous system, allowing the implementation of the treatment and reducing the patient's anxiety and irritability. The depth of sedation has been quantified by the Ramsay scale and, in interventional radiology, minimal and moderate sedation are the most frequently used.

There are several levels of sedation whose higher functions are modified in different ways [1], minimal sedation (anxiolysis) is a drug-induced state in which patients respond normally to verbal commands, although cognitive functions and coordination may be impaired, respiratory and cardiovascular functions are not affected [2]. Moderate sedation (conscious sedation) is a drug-induced depression of consciousness in which patients deliberately respond to verbal commands, alone or accompanied by mild tactile stimulation, no intervention is necessary to maintain spontaneous ventilation [3]. Deep sedation is a drug-induced depression of consciousness in which patients cannot be easily awakened, but respond voluntarily after repeated or painful stimulation, spontaneous ventilation may be inadequate and patients may require respiratory support [4]. General anesthesia is a drug-induced loss of consciousness during which patients cannot be awakened, even by painful stimulation, they require respiratory and ventilation assistance, cardiovascular function may also be compromised.

Evaluation before the Procedure

Several factors come into consideration for the choice of the techniques used. The degree of sedation necessary must be established according to the nature of the gesture and the cooperation of the patient, hence the interest of a pre-anesthetic evaluation of the patient's state of health, his comorbidities, in particular hepatic, renal, respiratory, cardiac and the notion of allergies, are to be taken into consideration and classified according to the ASA.

The pre-gesture consent process should include a discussion of risks, benefits, and alternatives. A consent form can be signed during the pre-assessment or on the day of the procedure. The proposed use of sedation should be explained to the patient and clearly identified on the consent form.

For pre-gesture fasting the ASA recommends 6 to 8 hours without oral intake for solids and unclear liquids, and 3 hours for clear liquids in adults and children over 36 months. In urgent cases in which the recommended pre-procedure fasting has not occurred, care should be taken to protect against aspiration by limiting the depth of sedation, delaying the procedure, or arranging an anesthesia consultation considering endotracheal intubation [1, 2].

Focused history and physical examination should include an assessment of the patient's airway adequacy looking for macroglossia, short neck, prognathism, retrognathism, thyroid-chin distance, mouth-openness, Mallampati classification is used to determine the adequacy of the respiratory tract, of which a class 3 or 4 indicates a high risk. Patients who have criteria for difficult ventilations should be considered at higher risk of airway obstruction during sedation, they potentially have difficult to manage intubations if ventilatory support becomes necessary.

As a general rule, all routine medications, except antidiabetic medications and blood thinners, should be taken as usual on the day of the procedure [5]. It is recommended to stop warfarin and clopidogrel 5 days in advance and aspirin 3 days in advance [6]. High-risk patients can be managed with low molecular weight heparin therapy (LMWH) [6].

In total, a real anesthesia consultation must be carried out because sedation is an anesthetic act which can eventually turn into general anesthesia if it is insufficient [7].

Several means are used in anesthesia for interventional radiology, whether pharmacological means or not. Non-pharmacological means are considered as a set of non-pharmacological measures that improve patient comfort and the quality of sedation by reducing the demand for sedative agents [8].

Verbal and non-verbal communication with the patient is the first link in this therapy, it must be both reassuring and empathetic. Several Cochrane reviews have demonstrated the effectiveness of distraction and hypnosis techniques in reducing anxiety during anesthetic induction or vein placement, including music therapy, clowning, use of videos or even games on touchpads for children. The challenge is to guide the patient’s attention during the stressful or painful event.

The principle of hypnosis techniques is based on verbal suggestions, in particular on sensory elements, made by the professional, which creates a modified state of consciousness. Studies have shown that hypnotic processes alter internal (self-awareness) and external (environmental awareness) brain networks similarly to intravenous sedation [9].

Patients with high anxiety states and chronic narcotic use generally require higher drug doses. Reducing the state of anxiety through supportive non-pharmacological measures can be very helpful in reducing anxiety levels. The use of empathic attention, relaxation training, guided imagery, and hypnosis have increasingly been used before and during interventional procedures [1, 10, 11].

Pharmacological means:

Among the drugs available, the one or those that are best suited to the desired depth of sedation, to the patient's medical history and state of health at the time of the procedure, and also to his fasting state, will be chosen. It should be noted that combinations of molecules (especially more than 3 molecules), and in particular those with a long half-life, are not

recommended because they increase the risk of occurrence of adverse effects [12].

Intravenous Sedative Agents:

Benzodiazepines are the most commonly used sedative drugs in the radiology department and are considered safe, with minimal respiratory and cardiovascular effects. However, in the presence of other central nervous system depressants, particularly alcohol, they can cause severe respiratory depression. Caution should also be taken when used in the elderly, children, and critically ill patients, as they may cause apnea [13].

The most commonly used benzodiazepines are midazolam, diazepam and lorazepam. Midazolam is used by more than 90% of interventional radiologists [1, 14].

Propofol is a sedative-hypnotic agent administered intravenously as a continuous or bolus infusion of 10 to 20 mg for the induction or maintenance of anesthesia or sedation. It is recommended that anesthesiologists administer propofol since its onset is 40 seconds and its effects last 3-5 minutes (half-life is 1-3 minutes) [10, 15].

Ketamine is a fast-acting, non-narcotic, non-barbiturate agent characterized by its profound analgesia, maintenance of normal respiratory reflexes, mild cardiac stimulation, and mild respiratory depression.It has been particularly useful in patients chronically dependent on narcotics and in pediatric patients. It is not commonly used in interventional radiology suites and an anesthesia consultation is generally recommended prior to its use [16-18].

Sedation by Inhalation Agents

Sevoflurane is a halogenated agent of intermediate fat solubility and potency. given its low irritant nature for the respiratory tract, it can be used for induction in both adults and children. Its kinetic properties and its hemodynamic tolerance close to that of isoflurane explain the major clinical advantage for induction in children. Spontaneous ventilation is better preserved [19].

Analgesic Agents and Pain Management:

Several means can be proposed, but according to a rational choice, with regard to the expected benefit, the desired level of analgesia, but also in spite of the potential side effects.

Simple painkillers include nonsteroidal anti-inflammatory drugs and paracetamol. Most simple pain relievers are taken orally, but can also be given rectally.

Nonsteroidal anti-inflammatory drugs have analgesic, antipyretic, and anti-inflammatory effects resulting from their inhibition of cyclooxygenase 1 and 2 enzymes, these agents should be avoided in patients with active peptic ulcer disease, gastrointestinal bleeding, or a history of bronchospasm, they should be used with caution in patients with renal or hepatic failure and on diuretics.

Paracetamol has analgesic and antipyretic effects, but its exact mechanism of action is poorly understood. Its recommended oral dose is 500 to 1000 mg every 4 to 6 hours, with a maximum oral dose of 4g.

Opioids are generally chosen when adequate analgesia cannot be obtained by local anesthetics alone and when better control of autonomic reflexes is required. Their side effects profile includes: nausea and vomiting, dysphoria, pruritus and rash, but most concerning, cardiovascular and respiratory depression [20, 21].

Opioids, in addition to their analgesic properties, also have sedative effects and care should be taken when administering with benzodiazepines as they act synergistically [22].

Fentanyl is a short-acting opioid with an onset of action of 2 to 3 min and duration of action of 30 to 60 minutes. In high doses, it can cause dizziness and apnea. It is usually administered intravenously, but can be administered orally and transdermally. Careful monitoring of ventilation and oxygenation should continue during the postoperative period because the respiratory depressant effect may last up to 4 h longer than its analgesic effect. Fentanyl is the opioid of choice for over 50% of radiologists due to its rapid onset and short duration of action.

Alfentanyl is a very short-acting opioid with an onset of action of 1-3 min and only 10-20 minutes as the duration of action. It is ideal for short procedures, but offers little postoperative pain relief.

Morphine is a long-acting opioid with an onset of action of 5 to 20 min and duration of action of 4 to 8h. The active metabolite, morphine-6-glucuronide, accumulates in patients with renal failure, causing prolonged sedation and respiratory depression. Morphine is rarely used in the radiology department.

Pethidine can also be used intravenously at a dose of 25 to 100 mg. It has a time of action similar to that of morphine, but a somewhat shorter duration of action.

Monitoring during the Gesture and Equipment:

A trained anesthetist should be present to monitor patients during anesthesia and interventional procedures. Oxygen saturation, heart rate and rhythm, blood pressure, respiratory rate, and responsiveness are continuously monitored and should be recorded at least

every 15 minutes or when there are significant or symptomatic changes.

The level of pain is also monitored before, during and after the procedure. Capnography is the continuous analysis and recording of end-tidal CO. Capnography may be able to detect hypoventilation before pulse oximetry detects oxygen saturation. Monitoring it during moderate sedation has been advocated by some, but there are currently no guidelines requiring it outside of deep sedation.

Oxygen, anesthesia respirator, suction equipment, nasal cannulas, intubation equipment and a valve mask must be in the operating room, also anesthetic drugs. The procedure room must be equipped with a cardiac monitor, an automatic blood pressure cuff and a pulse oximeter. A basic cart with emergency resuscitation equipment and advanced cardiac resuscitation drugs should be readily available [1, 10, 23].

CONCLUSION

Knowledge of sedative and analgesic agents, experience and training in the administration of these drugs, preoperative assessment and planning and careful independent monitoring of sedated patients during and after interventional radiological procedures will allow a safe execution of the interventional procedures and a better satisfaction.

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