

# Chapter one

## 1-Introduction

MRI is new modality used for scan different parts of the body, we may need to use anesthesia in this modality to fix the patient and reduce motion artifact. There are different types of MRI machine used, but in KAC we used only one type for all patients. MRI imaging require anesthesia but not all patient need it, there are certain cases for using anesthesia like pediatric which cannot stay stable or adult which they have claustrophobia and psychiatric patient. This study aimed to evaluate anesthesia and sedation for pediatric in MRI. (Sally Daoud Mohammed, 2007).

Scans require the patient to be completely still to ensure adequate quality of the scans, especially pediatric patient they should still relaxed until the procedure finished. Scans last for 45 minutes to 2hours depending on the areas to be scanned. Therefore, many children and even some adults require sedation even though the procedure does not cause any pain. The need for sedation is assessed by nurses and physicians. (Sally Daoud Mohammed ,2007)

This study will provide more information about MRI pediatric and the use of sedation and anesthesia used in MRI department. In this research we are going to describe the need and use of anesthesia and sedation for pediatric in MRI and will going to compare between the use of anesthesia in Sudan and other developed countries if we achieved the ideal pediatric MRI department to make children forget their fear the anesthesia will be unneeded. In Sudan the MRI machine that used for adult is also used for children. The big department

and loud voice scared the children that make them UN controlled and move during the scan. Care of patient during the procedure and the exam is become more frequently part of a technologist responsibility. Royal College of Surgeons of Edinburgh, 1993 found that Intravenous sedation is hazardous in children as the therapeutic margin between sedation and anesthesia is very narrow. In view of this it should be administered only under very special circumstances Even through this care is of a temporary character and short duration for any particular patient, lack of knowledge can result in complication which may occur very quickly. So the technologist must understand the complications which are able to occur.

### **1.1 Problem of the study:**

In most magnetic resonance imaging department in Khartoum state there is less awaring about the need of the anesthesia and sedation.

### **1.2 Objective of the study:**

#### **1.2.1The general objective**

To evaluate the usage of anesthesia and sedation and ideal protocol that must achieved in magnetic resonance imaging department in Khartoum state.

#### **1.2.2 Specific objectives:**

- 1- To identify the anesthesia and sedation protocol to followed in the magnetic resonance imaging department.
- 2- To compare the ideal pediatric MRI department in Khartoum state and other developmental countries.

3- To identify the anesthesia that has the minimum risk and complication.

### **1-3 Importance of the study:**

Pediatric are sensitive class they must be fixed during the procedure , so they must take a proper amount of dose of sedation .

### **1-4 Overview of the study:**

Chapter one: general introduction, which consist of an introduction, and methodology of research. Chapter two: is a literature review which consists of anesthesia , drugs used in anesthesia , types of anesthesia , sedation, drugs used for sedation, types of sedation , complication, MRI basic principle and instrumentation, exams which need use of anesthesia and sedation , chloral hydrate, sedation in pediatric MRI. Chapter three: deals with methodology. Chapter four: contain the result of the study. Chapter five includes the Discussion , conclusion and recommendation. Also there is the reference at the end of the study.

## **Chapter two**

### **2-Literature review**

#### **2.1Anesthesia**

The word ‘anesthesia’ comes from a Greek word that means absence or loss of sensation. Local anesthesia blocks pain by stopping pain signals being carried by nerves to the brain. The degree, depth and duration of altered consciousness may vary from drowsiness to brain death and coma or unconsciousness is best defined as an inability to obey commands, utter recognizable words, or open eyes.( Stephen chapman ,2001)

The goal of anesthesia is to provide unconscious, amnesia, analgesia and usually muscle relaxation.( Stephen chapman ,2001)

The first public demonstration of general anesthesia was in 1842 by a Boston dentist named William T.G. Morton at the Massachusetts General Hospital. Dr. Morton gave an ether anesthetic for the removal of a neck tumor by surgeon John Collins Warren (the first editor of the New England Journal of Medicine and dean of Harvard Medical School).(Royal Colleges of Anesthetists and Radiologists, London).

##### **2.1.1 Drugs used in anesthesia:**

Inhalation agent which all provide varying degrees of unconsciousness like isoflurane , halothane and nitrous oxide , nitrous oxide. Intravenous agent like narcotic, hypnotics, ketamine .( Sahyoun ,2012).

**2.1.2 types of anesthesia:** Local anesthesia : are categorized into two groups . Esters include tetracaine , procaine, cocaine and chlorprocaine . Amides include lidocaine , mepivacaine , bupivacaine and etidocaine .( Sahyoun ,et al 2012)

**2-1-3 Mechanism of action:**

**2.1-3-1 local anesthesia:** work by diffusing through the nerve plasma membrane and causing blockade of sodium channels. The nerve cell is unable to depolarize, and axonic conduction is inhibited. ( Sahyoun, 2012)

-local tissue acidosis causes local anesthetic molecules to become positively charged and less able to diffuse into the neuron. This slows the onset and decreases the intensity of analgesia, toxicity {dose dependent except for allergic reaction, central nervous system include mental status Changes, dizziness, perioral numbness, metallic taste, tinnitus, visual disturbance, and seizures. Seizures resulting from inadvertent intravascular Injection usually last only minutes. Continuous infusion of local anesthetic may result in high plasma levels and prolonged seizures. Treatment involves airway support and ventilation with 100% oxygen, which should always be available prolonged seizures, may require administration of benzodiazepines Intubation may be required to ensure adequate ventilation. ( Sahyoun, 2012)

Cardiovascular rang from decreased cardiac output to hypotension and cardiovascular collapse. Most local anesthetics cause central nervous system (CNS) toxicity before cardiovascular toxicity. Bupivacaine is an exception and its intravascular injection can result in severe cardiac compromise. Hypersensitivity reaction .although rare, have been described with ester-based local anesthetics and are attributed to the paminobenzoic acid. True amide-based local anesthetic is questionable. It is range from mild to life threatening. ( Sahyoun, 2012)

These include urticaria ,bronchospasm , hypotension ,and anaphylactic shock. The treatment is similar to that for hypersensitivity reaction from other etiologies. Urticaria responds to diaphenhy dramine . Bronchospasm is treated with inhaled bronchodilators and oxygen . Hypotension is treated with fluid resuscitation and vasopressors . ( Sahyoun, 2012)

Epinephrine is mixed with local anesthetic solution to prolong the duration of neural blockade and reduce systemic drug absorption.

Its use is contraindicated in areas where arterial spasm would lead to tissue necrosis (e.g, nose,ears,fingers,toes) .( Sahyoun, 2012)

**2.1-3-2 regional anesthesia:** The extent and duration of the procedure must be appreciated by the anesthesiologist so that the appropriate area and duration of analgesia can be achieved. Various degrees of failure may occur because of inexperience or adverse anatomy so intravenous sedation using short-acting benzodiazepines. narcotic barbiturates,or propofol can also be helpful. (Sahyoun, 2012)

The types of regional anesthesia : **spinal anesthesia** involves the injection of small volumes of local anesthetic solution into subarachnoid space at the level of the lumbar spine using sterile technique, and after local anesthetic infiltration of the skin and subcutaneous tissue .( Sahyoun, 2012)

The specific characteristics of the local anesthetic used and the total dose injected are, the primary determinants of onset and duration of action the epinephrine added to the solution increases the duration of analgesia which its length ranging from as little as 30 minutes to up to 6 hours. ( Sahyoun, 2012)

Complication of regional anesthesia, hypotension, were high spinal blockade, headache, central nervous system (CNS) infection, permanent nerve injury and urinary retention with bladder over distention.( Sahyoun, 2012)

**Epidural anesthesia** by inserting an epidural needle not advanced through the dura. Develops more slowly than spinal anesthesia.

local anesthetic infiltration useful during wound debridement. central venous catheter placement ,or repair of minor lacerations.

The agent of choice is lidocaine 1-2% due to quick onset and Low toxicity. The area at interest should be injected liberally. Frequent aspiration helps to avoid intravascular Injection should be repeated as necessary. ( Sahyoun, 2012)

**2.1-3-3 general anesthesia:** refers to the suppression of activity in the central nervous system, resulting in unconsciousness and total lack of sensation. There are a number of general anesthetic drugs - some are gases or vapours inhaled through a breathing mask or tube and others are medications introduced through

a vein. intravenous agent are most widely used for induction of general anesthesia owing to rapid onset and ease of administration e.g thiopental. propofol. etomidate or ketamine.(Stephen ,2001)

Complication of general anesthesia: malignant hyperthermia,laryngospasm, nausea and vomiting ,urinary retention. Hypothermia and nerve injury.

Treatment: This is symptomatic and includes adequate oxygenation. (Sahyoun, 2012)

## **2.2 Sedation:**

Sedation can be defined as induction of depression in the central nervous system by means of drugs.

The goal of sedation is to relieve patient anxiety and avoid potentially detrimental hemodynamic sequelae during invasive procedures or diagnostic tests. ( Sahyoun, 2012)

### **2.2-1 Drugs used for sedation:**

All medications should be titrated, with adequate time between doses to judge clinical effects. The end result should be a calm, easily aroused, cooperative patient.(Sahyoun,2012)

1-Benzodiazepines like midazolam (versed) which provide Sedation only.

2-Narcotics like meperidine or demerol and fentanyl which provide analgesia with unpredictable sedative effects.



3-Propofol or diprivan which may cause hypotension, especially with boluses.  
(cathrin,1999)

Anesthesia state: Have several components such as unconsciousness, Loss of reflex(muscle relaxation) ,Analgesia(cathrin,1999)

**2.2-2 Types of sedation:** intravenous route, oral route, epidural route.  
(Sahyoun, 2012)

### **2.2-3 Complication of sedation:**

Over sedation may result in hypoventilation, airway obstruction, or disinhibition, apnea, hypotension, bradycardia, nausea and vomiting. The side effects that result from benzodiazepine administration include over sedation, respiratory depression, depressed airway reflexes and seizures.(sahyoun,2012)

Oxygen should be supplied by nasal cannula or face mask when sedation is given. When benzodiazepines and narcotics are combined, even healthy patients breathing room air may become hypoxic. (Sahyoun,2012)

### **2.3 Sedation in MRI:**

#### **2.3-1 Exams which need use of anesthesia and sedation:-**

1-Percutaneous vertebral biopsy

2-Children under the age of 4 years will usually need sedation in MRI.

3-Some MRI patients find the interior of the scanner a very disconcerting environment and report claustrophobic and even acute anxiety symptoms so to decrease the number of scans aborted the patient may be sedated.

4-Drainge.

5-To reduce patient movements. (Cathrin, 1999)

### **2.3-2 Sedation of children:-**

Sedation may be defined as the use of a drug or drugs to produce a state of depression of central nervous system that enables treatment to be carried out but during which verbal contact with the patient is maintained throughout the period of sedation.

However most radiological procedures on children requiring sedation cannot be performed as defined and children may require sedation of degree which borders on rendering them unconscious.(Sahyoun,2012).

Sedation in department of MRI should be carried out under the supervision of a suitably trained radiologist and primary care of the patient should be under the direct supervision of an anesthetist.(Sahyoun,2012)

Ideally, when drugs are used which are likely to result in loss of consciousness the primary care of the patient should be under the direct supervision of an anesthetist. More commonly, sedation will be undertaken by a radiologist trained in resuscitative techniques supported by rapid availability of anesthetic and resuscitative help. A nurse, experienced in the care of sedated children, should be present.(Sahyoun,2012)

Each child should be assessed. In most circumstances parents should be encouraged to stay with the child and with patience and encouragement the need for sedation may be avoided in some cases.(Cathrin,1999)

Suitable vein preferably chosen by the radiologist at the time of administration of the sedation or prior insertion of a venous cannula if venous access will be necessary during the procedure.(Cathrin,1999)

### **2.3-2-1 Chloral hydrate:**

For many years chloral hydrate has been the mainstay for sedation of young children for a variety of procedures. However, the commonly recommended dose (50 mg/kg) is unpredictable in terms of time to onset of action and the depth and duration of sedation. This is particularly important where failure to adequately sedate a patient may result in postponement of the investigation. (Sahyoun, 2012) MRI scanning creates a particular problem due to the noise of the scanner which creates a clear stimulus to the child to wake up. The following recommendations are made as being suitable for the majority of patients, in respect of both safety and efficacy. It is recognized that, for certain patients deviation from this guide lines will be appropriate on clinical or weigh grounds and some situations where this may be appropriate. (Sahyoun, 2012)

Some children of 4 or 5 years of age will be cooperative and not require sedation or anaesthesia.(Sahyoun,2012).

Chloral hydrate should be administered as 1g in 5ml syrup in order to reduce the dose volume to a minimum Droperidol is available as 5mg in 5ml solution or 10mg tablets.(Sally Daoud,2007)

Drugs used for sedation of children 100% of whole sample size of magnetic resonance imaging departments use chloral hydrate.(Sally Daoud-2007).

There is 60% development of complication related to the drug used for sedation in magnetic resonance imaging departments (Sally Daoud -2007).

In 100% of them there is life saving drugs in case developing of complication related to the drugs used for sedation (Sally Daoud-2007).

All children will require individual assessment.

AGE/WEIGHT"	SEDATION	DOSE
1 month	Feed only	_____
1 month old but less than 5kg	Chloral hydrate	50-70mg/kg
5-10kg	Chloral hydrate	75mg/kg with further 25mg/kg if a sleep in 30min

Less than 10kg- 4years	Chloral hydrate	100mg/kg Max2g
More than 4 years	+droperidol	10-20kg :2.5mg 20kg:5mg
_____	+procyclidine	10-20kg:2.5mg 20kg:5mg

Table (2-1) the dosage of sedation according to age (Sally Daoud, 2007).

### 2.3-2-2 Reaction of chloral hydrate:

**2.3-2-2-1 Vomiting:** chloral hydrate is a mucosal irritant and vomiting is common. If the child vomits the dose of chloral hydrate or droperidol or procyclidine within 15 minutes of administration the dose may be repeated. (Sahyoun, 2012)

**2.3-2-2-2 URTI:** chloral hydrate may make rhinitis and catarrhal symptoms worse. Consideration should be given to postponing the scan X the child presents with a cold or URTI. (Hugnes, 1990)

**2.3-2-2-3 Liver disease:** chloral hydrate is metabolized by alcohol dehydrogenase, a hepatic enzyme which reaches full adult activity at 5 years of age. It is also metabolized by enzymes present on erythrocytes. On the basis that its metabolism would be impaired, it should be avoided in patients with end-stage liver failure, although there is little evidence to support this advice. The majority of the drugs are excreted in bile as glucuronides of chloral and the active metabolite, trichloroethanol. It should therefore also be used with caution

in cholestasis , although it is likely that renal excretion would increase if biliary excretion is impaired. Children who are not jaundiced, or after liver transplant, would be expected to metabolized chloral hydrate normally and can receive the recommended dose. Some children especially after liver transplantation are very difficult to sedate and may require intravenous midazolam. Patients receiving hepatic enzyme inducers, e.g: phenobarbitone or phenytion. These may be expected to reduce the effectiveness of chloral and dose escalation may be considered. (Sahyoun, 2012)

**2.3-2-2-4 Neurological impairment:** lower doses may be considered in such patients.

**2.3-2-2-5 Renal impairment:** dose reduction should be considered due to the risk of accumulation of renally excreted, active metabolites.

**2.3-2-2-6 Warfarin:** patients anticoagulated with warfarin are at risk of hemorrhage due to displacement of warfarin from plasma protein binding sites.

**2.3-2-2-7 Toxicity:** there has been concern recently about possible toxicity. Chloral hydrate is a metabolite of an extremely toxic carcinogen, trichloroethylene. Carcinogenicity associated with chloral hydrate has not been described in humans. (Sahyoun, 2012)

Midazolam hydrochloride is a newer benzodiazepine with sedative, anxiolytic, and amnestic properties. It has a rapid onset and short duration of action, making it particularly well suited for use in the children undergoing radiographic studies and it has gained widespread popularity, although some practitioners

report high failure rates. Because of its lack of analgesic effect, pentobarbital sodium is used commonly for radiographic procedures.

Sleep doses in children unlike in adults rarely result in apnea but hypotension can occur, Careful patient selection and monitoring. (Cathrin, 1999).

ketamine was used as sedative. In 8282 cases an overall risk of airway problems for ketamine of 3.9% was reported. Risk factors for these problems were age below 2 and over 13 years, high intravenous dosing, co-administration of anti-cholinergics or benzodiazepines.

Vardy et al. compared ketamine with midazolam and propofol for procedural sedation. In this investigation there was a similar overall complication rate, but in the case of ketamine more hyper toxicity, hypertension Andre-emerge phenomena occurred .This characterizes the special attribute of this drug that distinguishes it from most other sedatives. In conclusion, ketamine used alone May be useful for sedation in patients with respiratory risk factors (Cathrin, 1999).

### **2.3-2-3 Recovery:-**

The child is considered to have recovered from the sedation when they have been able to take a drink and/or have returned to their state prior to sedation. Complex procedures on children or very uncooperative patients will be performed under general anesthesia. (Cathrin, 1999)

### **2.3-2-4 Sedation in pediatric MRI:-**

Previous study by D pilling, L abernethy.Nwright and H Carty was done in the sedation, safety and magnetic resonance imaging. Sedation in pediatrics is very commonly used and its safety has recently come under close scrutiny with low complication rates emphasizing the importance of patient selection and careful monitoring during the exam. As significant complications are uncommon, the size of any randomized study would need to be so large that it would probably not be practicable. Try to keep the child a wake for as long as possible in the time leading up to the scan. (Cathrin, 1999)

No snaps are allowed on the journey to the hospital. This will ensure that the child is already tired prior to administration of the sedation. Children need not be starved prior to sedation /scanning but should take a light diet only on the day of the scan and nothing in the hour preceding the scan, For example, cereal, milk or toast and drink for a morning scan or a snack lunch for an afternoon appointment. Babies may receive milk feeds up to 2hours prior to the scan and clear fluids up to 1 hour. Also mother should avoid crisps and fuzzy drink. (Cathrin, 1999).

## **2.4 MRI equipment:**

### **2.4-1 type of MRI machine:**

**Closed MRI Machine:** Is a large tube that a patient lays in. This style of scanner almost always produces images that are of very high quality .The small



tube that a patient must lay in can cause a patient who is claustrophobic to panic.(Hugnes,1990)

**Open MRI Machine:** It keep claustrophobic patients more comfortable and to allow obese patients to be scanned. (Hugnes, 1990)



A



B

**Figure (2-1):A,B Open and close MRI machines**

**Standing and Sitting Machine:** The desire to increase comfort lead to the development of MRI machines that allow patients to stand or sit. While these machines help with patient comfort, they currently don't provide a good image quality. (Hugnes, 1990)

## **2.4-2 the main component of MRI machine:**

**2.4-2-1 The Magnet:** The most important component of the MRI scanner is the magnet there are three types of magnets used in MRI systems:

**Resistive magnets:** A type of magnet that utilizes the principles of electromagnetism to generate the magnetic field.

**Permanent magnets:** composed of one or more pieces of iron or magnetic alloy carefully formed into a shape designed to establish a homogeneous magnetic field over the region to being wire.

**Super conducting magnets:** (the most commonly used type in MRI scanners) Superconducting magnets achieve high fields without prohibitive power consumption and cooling requirements, and are the most common clinical design. In addition to the main magnet; the MRI machine also contains three gradient magnets. These magnets have a much lower magnetic field and are used to create a variable field.

**2.4-2-2The coils:** The coils are immersed in a vessel containing liquid helium; this reduces the temperature to a level that makes them superconductive.

**Gradient coil :**To select the orientation of the MR scan plane, and to spatially localize the MR signals within each slice, a series of (gradient) magnetic fields

are applied during the imaging sequence. These fields are called gradients because they vary linearly in space.

**Radio-Frequency Coils:** In MRI scanners, radio-frequency (RF) transmit coils are used to transmit electromagnetic waves into a sample, creating the B1 magnetic field needed to excite the nuclear spins.



Figure (2-2) radiofrequency coils (MRI in practice).

**2.4-2-3 Radio frequency Transmitters:** The term transmitter refers to the assembly of electronic components in an MRI scanner which provides an electrical signal to the transmitter coil to excite the nuclear spins.

**2.4-2-4 Radio-Frequency Receiver:** After nuclear spins in a sample have been excited by RF pulses, they precess in the main magnetic field as they relax back to equilibrium. This precession induces very small voltages in the receiver coil.

**2.4-2-5 Data pipeline:** The data pipeline is a matter of being able to use technology to its fullest extent to deliver more image quality and optimize application.

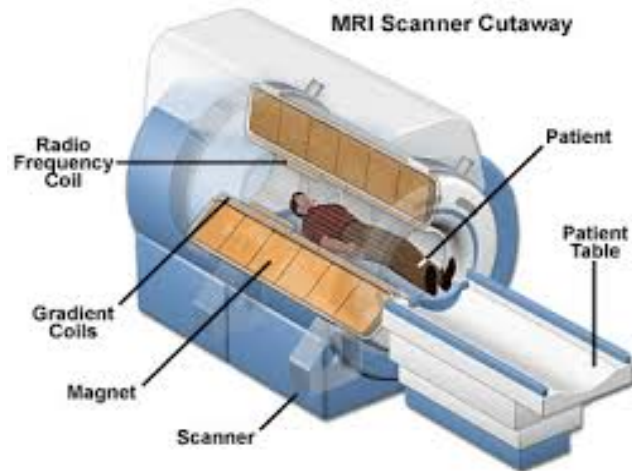
**2.4-2-6 Computer System:** A computer system consists of both hardware and information stored on hardware. Information stored on computer hardware is often called software. The hardware components of a computer system are the electronic and mechanical parts, the software components of a computer system are the data and the computer programs. The major hardware components of a computer system are: Processor, Main memory, Secondary memory, Input devices and Output devices.



Figure (2-3) MRI console (DICOM).



Figure (2-4) monitoring device(DICOM).



**Figure (2-5) main component of the MRI machine (DICOM)**

### **2.4-3 Equipment use for anesthesia and sedation:**

#### **2.4-3-1 Monitoring equipment:**



**Figure (2-6) monitoring equipment (DICOM).**

**2.4-3-1-1 Electrocardiogram and heart rate:** Monitoring the patient's electrocardiogram (ECG) in the MRI environment is particularly challenging because of the inherent distortion of the ECG waveform that occurs using MR systems operating at high field strengths. This effect is observed as blood, a conductive fluid and flows through the large vascular structures in the presence of the static magnetic field of the MR system. Electrocardiogram and Heart Rate. ( Buckwalter, 2003)

**2.4-3-1-2Respiratory Rate and Apnea:** Respiratory rate monitoring can be performed during MRI procedures by various techniques. The impedance method that utilizes chest leads and electrodes (similar to those used to record the ECG) can be used to monitor respiratory rate. This technique of recording respiratory rate measures a difference in electrical impedance induced between the leads that correspond to changes in respiratory movements. Unfortunately,



the electrical impedance method of assessing respiratory rate may be inaccurate in pediatric patients because of the small volumes and associated motions of the relatively small thorax. ( Buckwalter, 2003).

**2.4-3-2 Oxygen saturation:** A crucial variable to measure in sedated and anesthetized patients. This physiologic parameter is measured using pulse oximetry, a monitoring technique that assesses the oxygenation of tissue. Because oxygen saturated blood absorbs differing quantities of light compared with unsaturated blood, the amount of light that is absorbed by the blood can be readily used to calculate the ratio of oxygenated hemoglobin to total hemoglobin and displayed as the oxygen saturation. .( Buckwalter, 2003).

**2.4-3-3 Ventilation:** Because of the magnet depth, nearly 2m, it is often virtually impossible to visualize the patient's face and chest for adequacy of ventilation during scanning. .( Buckwalter, 2003)

**2.4-3-4 Temperature:** During MRI, body temperature may increase from heating caused by RF within the magnetic field or decrease from the cool environment necessary to protect superconductors. .( Buckwalter, 2003)

**2.4-3-5 Blood pressure:** MR-approved monitoring systems use automated oscillometric blood pressure monitoring, which, because it is based on pneumatic principles, avoids electromagnetic interference. For invasive blood pressure monitoring, conventional disposable transducers may function adequately outside the gauss line, but should be approved by a biomedical engineer. Disposable transducers have a predictably high natural frequency, so

tubing added to distance them from the patient is unlikely to cause damping. ( Buckwalter, 2003)

**2.4-3-6 Immobilization device:** To avoid pediatric movement during procedure and avoid the use of anesthesia.



Figure (2-7): using of immobilizations device

**2.4-3-7 Other Equipment needs for sedation :** appropriately sized large-bore suction catheters, smaller catheters for nasal or endotracheal suctioning, functional vacuum apparatus; Oxygen adequate supply, functioning flow meters; Airway equipment appropriately sized masks, self-inflating or anesthesia BVM systems, nasopharyngeal and oropharyngeal airways, laryngeal mask airways, laryngoscope blades and handles, endotracheal tubes, Pharmacy sedative analgesic medications, reversal agents, emergency resuscitation and airway medications.( Buckwalter, 2003).

#### **2-4-4 MRI basic principle and instrumentation:**

Radiography and medical imaging had been developed very quickly. Physics of MRI had been known from 1939 and used for analytical chemistry but Rabi is the first one who gain chemical spectrum by mean of magnetic field. In 1946 Bloch and Purcell take a Nobel Prize. (Sally Daoud, 2007).

In 1972 Lauterbur advice to use MR for medical imaging because the radiofrequency can penetrates the human body. In 1977 Damadian develop superconductivity. (Cathrin, 1999)

Magnetic resonance imaging is mean of imaging human body using magnetic field and radio frequency and it include several steps: patient put on the magnet, radio frequency waves sent, radio frequency waves turn off, the signal received from the patient. (Cathrin, 1999)

Several processes must be completed in order to produce magnetic resonance images. These processes include nuclear alignment, radiofrequency excitation, spatial encoding and image formation. The magnetic resonance imagings exams are take long time to be achieved so the use of sedation or anesthesia is common. (Cathrin, 1999)

#### **2.5 previous studies:**

-Intravenous sedation is hazardous in children as the therapeutic margin between sedation and anesthesia is very narrow. In view of this it should be administered only under very special circumstances. (The Royal College of Surgeons of Edinburgh, 1993).

-Sedating children in order to carry out MRI scans is dangerous and inappropriate and general anesthesia is the only (safe) choice. This article will attempt to determine whether this view can be sustained and will assess the information regarding deep sedation in children undergoing magnetic resonance imaging (MRI) without repeating the arguments put forward in the previous article, which are taken as read. (Bray RJ, personal communication, 1995).

-Advantages may be achieved by using general anesthesia instead of deep sedation. There should be fewer failures and there may be a faster turn round. However data are not available to determine whether it is a safer than deep sedation. The disadvantages of general anesthesia include the need for dedicated anesthetic equipment and a greater availability of pediatric anesthesiologists. Indeed, it could be argued that children could have significant delays in gaining results from important investigations through long waiting lists for procedures carried out under general anesthesia rather than sedation. This in turn might lead to an adverse outcome, which might have been avoided by a more timely investigation done under sedation. (Alderfer RJ, 1994).

-For some time pediatric have sought the optimal method to reduce the level of consciousness either to allow a procedure to be performed or to avoid the psychological sequelae of a painful or unpleasant procedure. With increasing emphasis on evidence based practice and risk management it was clearly important that this subject was approached with these factors in mind. Which focused on the issues of efficacy and safety.( Stephen Murphy,1997).

## **Chapter three**

### **3-Material and Method**

#### **3.1 Study method:**

##### **3.1-1 Type of study:**

It is descriptive observational.

##### **3.1-2 Study area:**

Magnetic resonance imaging department at Khartoum Advance Center.

##### **3.1-3 duration of the study:**

{June-July} 2014.

#### **3.2 materials**

The type of MRI machine is closed MRI Machine

1-MRI machine (Philps ) use magnetic power of 1.5 tesla.

2-The coils: Body coil, Head coil, knee coil, surface coil

3-Control consol

4-computer system

5-respiratory rate and Apnea

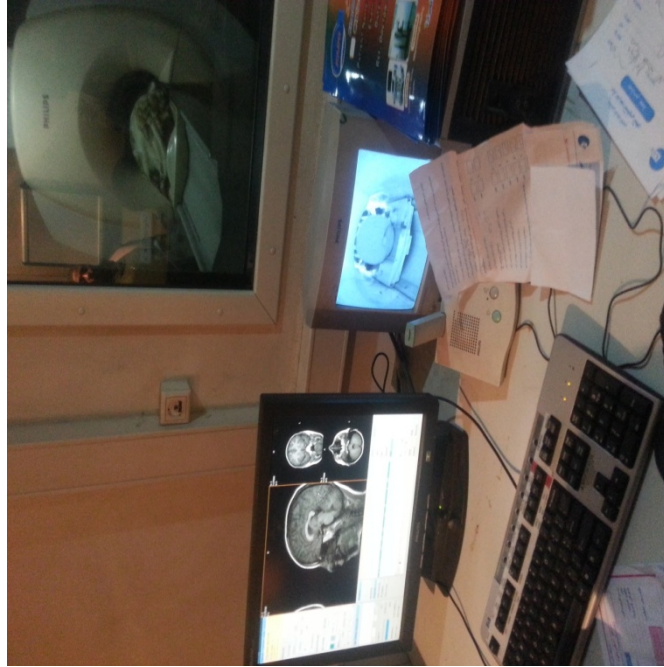
6-Blood pressure

7-Monitoring device (Television camera)

8-materials need for sedation: sedation agent (sybenton, ketamine, medazolam), cannula, oxygen tube.



**Figure (3-1): MRI machine**



**Figure (3-2) computer system**



**Figure (3-3) television camera**





**Figure (3-4) materials need for sedation**

### **3.3 The method:**

The sedation is injected intravenously by the anesthetist, the child take about 10 seconds to sleep , if sybenton is use the activity of sedation is finished after 15 minutes, if medazolam is use the child wake-up after 30 minutes Patient introduced through the gantry ,and start the procedure .

## **Chapter Four**

### **4-1Results :**

The following tables and figures presented the data obtained from 29 pediatric patients came to Khartoum Advanced Center (KAC)and examined for different MRI examinations all were examined by giving sedation, The application of Sedation dose were evaluated and also the type of dose .

Table 4.1 the gender frequency and percentages

<b>Gender</b>	<b>Frequency</b>	<b>Percentages</b>
<b>Males</b>	16	55.2%
<b>Females</b>	13	44.8%

Table 4.2 the mean and standard deviation of age and weight

	<b>Mean</b>	<b>STDV</b>
<b>Pediatric Age/month</b>	29.5	±28.8
<b>Pediatric Weight/Kg</b>	9.3	±5.2

Table 4.3 The Sedation Type, Application and complications

<b>Type</b>	<b>Application</b>	<b>Complication</b>
<b>Ketamine</b>	4(13.8%)	0%
<b>Medazolam</b>	2(6.8%)	0%
<b>Sybenton</b>	23(79.3%)	1%

Table 4.4 the presence of precautions before the sedation application

<b>Precaution</b>	<b>Application</b>
<b>Pulse Oximeter</b>	Present 29(100%)
<b>Respiratory Trigger</b>	Present 29(100%)



Figure 4.1 Scatter plot diagram shows the linear relation between the pediatric weight/Kg and the sedation dose. As the weight increased the dose increased by 5.1 starting from 3.2



Figure 4.2 Scatter plot diagram shows the linear relation between the pediatric age/month and the sedation dose. As the age increased the dose decreased by 0.5 starting from 5.3

#### **4.2 Discussion**

The study was carried out and determined the usage of sedation and anesthesia in magnetic resonance imaging department.

There is no ECG monitors exists for sedation in Khartoum Advanced Medical Centre, no immobilization device this disagree with Stephen Murphy, 1997. He stated that there must be a complete safe life device and immobilization device to make pediatric stable if he move during procedure.

## **Chapter five**

### **Conclusion and Recommendations**

#### **5-1 Conclusion:**

The main aim of the study is to evaluate the usage of sedation and anesthesia in and magnetic resonance imaging departments in Khartoum state.

In the department there is lack-of the tools regarding the sedation and anesthesia like the presence of the ideal recovery room.

The most common sedation use in KAC is Sybenton, ketamine is also use, medazolam is used in case of psychiatric patient.

The amount of dose used linearly increase with the pediatric weight.

The pediatric that receive sedation in KAC start from age of 1 month to 72 months, claustrophobic pediatric older than this age may receive sedation also.

The precaution exist at KAC is pulse oximeter and respiratory trigger.

#### **5-2 Recommendations:**

This study evaluates the presence of the facilities regarding sedation, drugs used for sedation and the co-ordination between MRI department in Sudan and developed countries.

1-all monitory device such as ECG monitor should be exist in the MRI department to avoid any chance of reaction.

2-The care of the patient before and after the sedation is very important so the presence of the ideal recovery room should be one the basics of magnetic resonance imaging departments.

3-Any one induce or deal with sedated patient should be aware about the complication related to sedation drugs and the accidents may happen to the sedated patients.

4- Monitoring of the patient during the exam to detect the

Complications which are similar to those related to the contrast media.

5-The presence the life saving drugs are very important.

6-Any magnetic resonance imaging department should have to have clear

Sedation protocol.

7-the type that must use in pediatric MRI is open MRI machine to avoid the fear and worrying.

8-communication with the child is very important because it can remove his/her fear.

9-Design of MRI pediatric machine should be color to avoid movement during the scan.



Figure (5-2) ideal MRI pediatric machine





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