chapter one

Introduction:

Magnetic Resonance Imaging (MRI) is the one of the diagnostic machines based on the induce of transition between energies, states by absorption and transfer of energies.(Schlid 1939)
The MRI is available technology with safety advantages over other modalities, but has disadvantages in some way ; MRI has strong magnetic field that we can't feel or see it .(Christina Triantafyllou, 2006, Martinos Imaging Center at McGovern Institute) .
MRI machine uses combination of a large magnet, gradients magnetic filed radiofrequencies cooling gas, and a computer to produce detailed images of organs and structures within the body.

Loose objects are very hazardous in static magnetic fields as they will become projectiles when they interact with the magnetic field, all items such as keys, cell phones, should not be in MRI suite .(Christina Triantafyllou, 2006, Martinos Imaging Center at McGovern Institute)

Metallic objects in the body can also have dangerous effects when placed in a magnetic field. Ferromagnetic metal implants or fragments may twist or move, causing internal injury. Even non-ferromagnetic metal (including metal on clothing) can heat up during scanning, and cause burns or discomfort. Many of the Athinoula A. Martinos Imaging Center's subject screening criteria are aimed at avoiding these hazards. In addition, metal in or near the body (such as dental implants) can produce artifacts, which adversely effect image quality.

Every one entering the magnetic field (Patients, Family members, AND Hospital Staff) will ALL be screened with the MRI SAFE SCANNER (a ferro-magnetic detector) before entering the room.

Gradient Magnetic Fields another concern in MR Imaging is related, not to the strength of the static magnetic field, but to the transient application of magnetic field gradients that can induce current in conductive materials, including biologic tissue. The induced current is greater in peripheral tissue because the amplitude of the gradient is highest farther away from the magnet's isocenter. Mild skin sensations and involuntary muscle contractions, which are thought to be the result of direct neural stimulation, have been reported rarely during echo planar

imaging (EPI). This can usually be alleviated by simply repositioning the subject in the scanner.Radiofrequency (RF) pulse (a short burst of an electromagnetic wave originating from the RF coils) is used in MRI to "excite" tissue protons by an exchange of energy. This absorption of RF energy can potentially cause heating of the tissue. Absorption of RF power by the tissue is described in terms of Specific Absorption Rate, the actual increase in tissue temperature caused by exposure to RF radiation is dependent on the subjects' thermoregulatory system (*e.g.* tissue perfusion, etc.). risk of exposing subjects with compromised thermoregulatory function .
MRI machines are cooled by a super cooling fluid (liquid helium) called liquid cryogens this gas is very dangerous and killer .(Christina Triantafyllou, 2006, Martinos Imaging Center at McGovern Institute)

1.1 Problem of the study :

As MRI is safer than other modalities but dangerous in other phase, the safety of any people in contact with room's magnetic must know the kind of this force and how to deal with it, Metallic objects in the body can also have dangerous effects when placed in a magnetic field , the transient application of magnetic field gradients that can induce current in conductive materials including biologic tissue and the noise produced as current is passed through the gradient coils during image acquisition and tissue heating by RF pulse in "excite" tissue protons by an exchange of energy and RF fields can cause burns by producing electrical currents in conductive loops.(Christina Triantafyllou, 2006, Martinos Imaging Center at McGovern Institute)

1.2 Objective :

the general objective of this study was to MRI safety in Khartoum health centers for (patient ,co patient, House workers and technologist) and protection from high intensity flux of energy by:

- survey of MRI safety procedure in Khartoum state services .
- TO investigate safety in Khartoum state and aware less of MRI safety .
- Compare MRI safety procedure in Sudan and international .

1.3 Important of this study :

The important of this study to Know if the international safety of MRI is applied in Khartoum Health centers and who is responsible of the

accident (patient , co patient ,House workers or technologist) and the kind of it and how happened .

1.4 Thesis lay out:

This content six chapters, chapter one introduction ,chapter two back ground ,chapter three methodology , chapter four results , chapter five discussion , chapter six conclusion .

Chapter two

Literature Review

2.1 Magnets:

2.1.1 Permanent magnets:

Permanent magnets consist of ferromagnetic substances that have magnetic susceptibility greater than 1. They are easily magnetized and retain this magnetization. Examples of substances used are iron, cobalt and nickel. The most common material used is an alloy of aluminium, nickel and cobalt, known as Alnico.(Black well ,1988,MRI at a Glance).

Advantages

• They have open design; children, obese and claustrophobic patients are scanned with ease. Interventional and dynamic procedures arepossible.

• They require no power supply and are therefore low in operatingcosts.

• The magnetic field created by a permanent magnet has lines of flux running vertically, keeping the magnetic field virtually confined within the boundaries of the scan room.

Disadvantages

• They are excessively heavy; only low fixed field-strengths (0.2– 0.3 T) can be achieved.

• Longer scan times are needed, due to lower field strengths.

2.1.2 Electromagnets:

Electromagnets utilize the laws of electromagnetic induction by passing an electrical current through a series of wires to produce a magnetic field. This physical phenomenon is utilized to produce RF coils and the static magnetic field.

Resistive magnets

The magnetic field strength in a resistive magnet is dependent upon the current that passes through its coils of wire. The direction of the main magnetic field in a resistive magnet follows the right-hand thumb rule and produces lines of flux running horizontally from the head to the foot of the magnet.(Black well ,1988,MRI at a Glance).

Advantages

- They are lighter in weight than permanent magnets.
- Capital costs are low.

Disadvantages

- The operational costs of the resistive magnet are quite high due to the large quantities of power required to maintain the magnetic field.
- The maximum field strength in a system of this type is less than 0.3T due to its excessive power requirements. Therefore scan times are longer.
- The resistive system is relatively safe as the field can be turned off instantaneously. However, this type of magnet does create significant stray fringe magnetic fields.

2.1.3 Superconducting electromagnets:

The resistance of the coils of wire is dependent upon the material of which the loops of wire are made, the length of the wire in the loop, the cross-sectional area of the wire and temperature. The latter can be controlled so that resistance is minimized.

As resistance decreases, the current dissipation also decreases. Therefore if the resistance is reduced, the energy required to maintain the magnetic field is decreased. As temperature decreases, resistance also decreases. As absolute zero of temperature (minus 273°C or 4°K) is approached, resistance is virtually absent, so that a high magnetic field can be maintained with no input power or driving voltage required.

This is the basis of the function of the supercooled, superconducting magnet. The direction of the main magnetic field runs horizontally like that of the resistive system, from the head to the foot of the magnet.

Initially, current is passed through the loops of wire to create the magnetic field or bring the field up to strength (ramping). Then the wires are supercooled with substances known as cryogens (usually liquid helium [He] or liquid nitrogen [N]), to eliminate resistance. Since He and N are stable, they can be placed in a vacuum so that they do not rapidly boil off or return to their gaseous state. This is called a cryogenbath and it actually surrounds the coils of wire and is housed in the system between insulated vacuums.(Black well ,1988,MRI at a Glance).

.2.2The component of MRI equipment :

Figure (2.1) MRI SERVICE

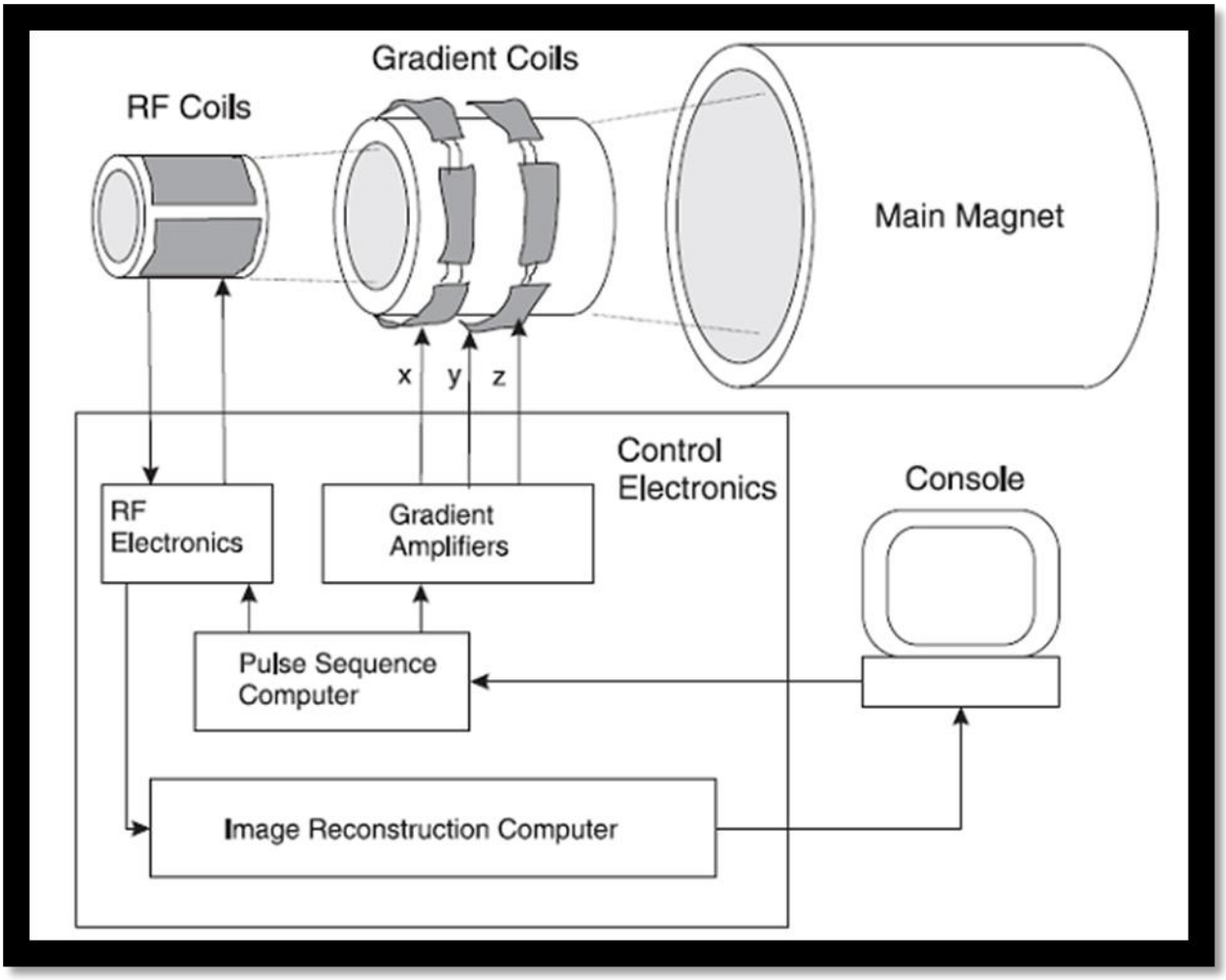


Figure (2.2) component of MRI service

-RF coil : coil that transmits RF at the resonant of hydrogen to excite nuclei and more move them in to a high energy state.

- gradient coil : coils of wire that alter the magnetic field strength in a linear fashion when a current is passed thought them .

-main magnate : types of magnet {0.2- 4 T}.

-RF electronics : RF amplifier supplies power to the RF transmitter coils .

-gradient amplifier : supplies power to the gradient coils .

-pulse sequence : a series of RF pulses , gradients applications and intervening time periods ; used to control contrast.

- Image reconstruction computer:

- console :control unite .

2.3 HAZARDS OF MRI :-

MRIis often described as a safe imaging technique , and indeed it is much less hazardous than methods involving ionizing radiation . there are five areas to be considered for MRI safety : the large main magnetic field , the gradient field which are switched at low frequencies ,the radio-frequency radiation ,the sound of gantry and the gases in gantry (westbrook c ,kaut c,1993,MRI In Practice).

The Food and Drug Administration (FDA) in the USA and the National Radiological Protection Board (NRPB) in the UK have issued guidelines for the safe use of diagnostic MRI ; although these are not statutory limits for practical purposes standard clinical scanner do comply with them. The Medical Devices Agency (MDA) of the Department of Health and the International Electrotechnical Commission (IEC)have produced extended safety guidelines for best practice , and in addition every MR unit should have local safety rules . it is strongly recommended that all radiologists and radiographers working in MRI should be familiar with all these document . (westbrook c ,kaut c,1993,MRI In Practice).

2.3.1 Main Magnetic Field :

Figure (2.3)magnet attractive

The field strength of the main magnetic field (B0) ranges from 0.2T to 3T in most clinical system .It is generally accepted that field of up to 2T produce no harmful bio-effect , including no chromosomal effect . In higher field , effects are related to the induction of currents in the body (which is a conductor) when it moves though the field . these may

cause visual sensations (magnetophossphenes),nausea , vertigo and a metallic taste However ,these effects are short term , usually disappearing when the body is no longer in the magnetic field .Although the main field is not intrinsically hazardous , its powerful effect on ferromagnetic object constitutes a major problem . magnetic bodies with in 0.1 mT fringe field experience an attractive force towards the center of the magnet . If they are free to move , they can acquire high velocities and cause significant damage to equipment and persons in their path . (westbrook c ,kaut c,1993,MRI In Practice).

The strength of the force and thus the resulting acceleration depend on several factors , including distance from the field center , mass of the object and its magnetic properties . it is essential therefore that all potential projectiles are kept out side the magnetic field . the list of such object is extensive , and includes keys , scissors, paper clips , stethoscopes , gas cylinders , drip stands , wheelchair etc .Apart from being a potential hazard and causing personal injury or damage to the equipment , small metal objects with in the bore of the magnet will also cause image artifacts .Medically or accidentally implant objects in the patient's body may also be ferromagnetic . The degree of hazard depends both on the type of implant and its location .of particular concern are intra-orbital foreign bodies , which are generally not fixed by scar tissue , and aneurysm clips . In these cases movement of the implant can cause blindness or fatal hemorrhage respectively .

Other items may not become missiles but will be damaged by the magnetic field and should be removed .example include analogue watches and cards with magnetic strips . various magnetically activated devices also fall in to this category such as cochlear implants and cardiac pacemakers.(westbrook c ,kaut c,1993,MRI In Practice).

2.3.2 Gradient Fields :

When gradient fields are switched on and off , they may induce currents in the body . the size of the current will depend , among other factors , on the maximum gradient field strength and on the switching time ; it is important to remember that the gradient fields increase away from the center of the magnet , so the area for concern is not necessarily the part being scanned . induced currents may be large enough to stimulate nerves , muscle fibers or cardiac tissue ; effects may include magnetophosphenes , muscle twitches , tingling or pain or in the worst case ventricular fibrillation . theoretical calculation and experimental evidence indicate that such effect will be avoided if the gradient switching is kept below 20T s^{-1}. most existing clinical scanners are well below this limit , but as scans become faster and technology improves the capabilities of the gradient sets , it is important that this hazard is carefully monitored .(Kanalemanual , 2004,ACR white paper on Magnetic Resonances (MR) Safety).

2.3.3 RF Field :

Radiofrequency waves contain both electric and magnetic field oscillating at MHz frequencies . At these rates , the induction of circulation current in the body is minimal , as there are high resistive losses . Most of the RFpower is therefore convert to heart in the body , the bio-effects and safety limits are considered accordingly . in healthy tissues , a local temperature rise caused by RF power deposition will trigger the thermoregulatory mechanism of increased perfusion to dissipate the heat around the rest of the body . If the rate of power deposition is very high , or the thermoregulation system is impaired in some way , heat will accumulate locally , eventually causing tissue

damage . some areas of the body are particularly heat sensitive , for example the eyes , the testes and the embryo , and extra care should be taken . the safety limits are some what complex ,as they depend on the duration of the exposure and the area under consideration , but basically they are designed to the limit temperature rise of the body to 1^{o}C.(Kanalemanual , 2004,ACR white paper on Magnetic Resonances (MR) Safety).

2.3.4 sound of gantry:

Noise Acoustic noise is generated as a result of rapidly changing gradients.

Hearing Protection must be used by patients and others in the magnetic field during image some Petain fraud to sound so must hearing some music .

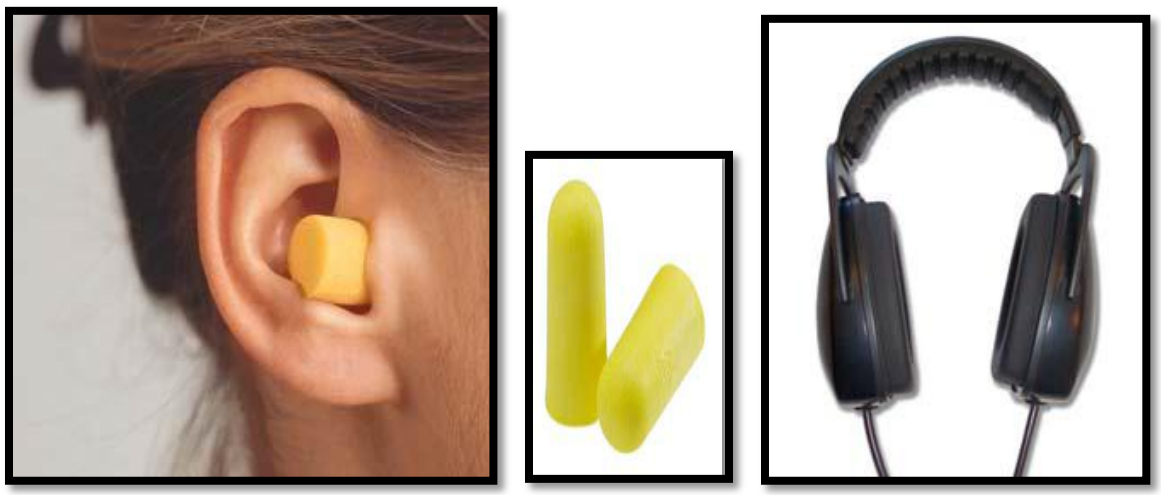


Figure (2.4)hearing protection

2.3.5 Gases in gantry (QUENCHING):

MRI machines are cooled by a supercooling fluid (liquid helium). The release of the super-cooling fluid into the atmosphere is called quenching, and unintentional and intended magnet quenching can be catastrophic. Most clinical machines have a 700 to 1,000 liter-volume of this cryogenic. Its venting will cause oxygen in the MRI magnet room to condense around the vent pipe and accumulate in the MRI machine, posing a code red fire hazard. Quenching is normally associated with de-energizing the machine, which is safer then a quenching during a scanning procedure. However, the room will still be subject to increased levels of oxygen near the machine. Not only should the patient be removed as quickly as possible during the de-energizing process, but any sources of possible ignition near the machine should be minimized. Room exhaust ventilation should be activated. Another risk is a quench vent pipe breech, which could flood the room with cryogenic fluids. This creates an asphyxiation hazard for the patient and attending staff. If an emergency should arise in the MRI machine room, all staff and respondents must be aware of the potential risks of translational and torque induced effectson the patient. All code blue equipment must be located outside the five-gauss line to maintain an MRI-safe environment. Both code red and code blue situations will require preplanning with hospital medical staff and emergency response teams. Municipal firefighters should not be allowed into the room until the MRI is proven to be de-energized or they are MRI-safe – with magnetic equipment and clothing removed.(Kanalemanual , 2004,ACR white paper on Magnetic Resonances (MR) Safety).

The objects are very hazardous to MRI as they will become projectiles when they interact with the magnetic field.

Figure (2.5)interacts things

All items such as keys, change, cell phones,shouldnot be brought in to the suite.(Kanalemanual , 2004,ACR white paper on Magnetic Resonances (MR) Safety).

So the MRI suite is cleaning byobjects are made of plastic, rubber, wood or other non-magnetic and non-metallic materials .

Figure(2.6) cleaning things

2.4 The previous study related tothis research:

E. Kanal, 1996 Magnetic Resonance Imaging (including spectroscopy, conventional, and fast imaging techniques) have been in use for over a decade and are viewed as medical procedures associated with acceptable and well controlled risks. Technological advances in MRI (higher static fields, faster gradients, stronger RF transmitters) have occurred rapidly, and many questions regarding the safety of these developments remain unanswered. This study provides an introduction to some of the safety concerns associated with MRI,The most immediate danger associated magnet with the environment is the attraction between the magnet and ferromagnetic metal objects. Ferromagnetic metal objects can become airborne projectiles when placed in a strong magnetic field. The strength of the field increases superlinearly withdistance from the magnet bore, and even hand-held objects can be jerked free very suddenly as the holder moves closer to the magnet (Small objects, such as paper clips and hairpins, have a terminal velocity of 40 mph when pulled into a 1.5T magnet). In addition to the possibility of severely injuring someone, it is not good for the magnet to be bombarded with difficult to remove small metal ‘missiles’. Remember, even when you are not scanning, the magnet is not "off". NEVER bring any metal objects into the scanner rooms.

They found the dangers effects in (Metal in the Body,Gradient Magnetic Fields,Acoustic Noise,Radiofrequency (RF) Electromagnetic Fields,Electrical Burns,Pregnancy).

Gould,2008:A comprehensive MRI safety for any health careProvide with a zero tolerance for MRI errors. The study was built on three basic steps:(Assess the hazards, Establish best practices inMRI suite safety and patient care, Educate and train all physicians, clinic and hospital staff workingin theMRI suite)Maintain an operator's manual for the suite's MRImachines in the control room. The manual shouldinclude all manufacturers' bulletins and advisoryinformation as well as a log sheet to documentupdates for equipment and software.Maintain an MRI safety manual for operations andprotocols in the control room. Include all safetytraining documentation for MRI staff and attendingphysicians, noting MRI safety education levels anddates of certification and acceptance by MRIdirector or radiologist.

MRI suites should be designed to restrictaccess and limit exposure to static magneticfields. Commonly, MRI suites restrict accessby zone(1)

Open to general public access, Zone (I)presethe least exposure to patients, visitors,attending physicians, fellows and medicalstudents, and hospital staff ,Zone (2)This is the first interaction site for patient,visitor, attending physician and others with the technologist and nursing staff in the MRIsuite,Zone (3) is the entry zone to the MRI machine room,Zone (4)The MRI room should have a clear demarcation of the five-gauss linetaped or painted on the MRI suite floor indicating the area beyondwhich requires MRI-safe (for the distance and tesla rating of theMRI) or MRI-conditional equipment or instrumentation.

All MRI staff must take responsibility for providingan MRI-safe environment for staff and patient alike.

Chapter three

Methodology

In this chapter we shall discussed the ways and tools that use in the study:

3-1 Materials:

- The Asia's center MRI serves :

Figure(3.1)MRI Asia center Service Zone(4)

The service was (GE) General Electricdesign , open magnet , 0.2 Tesla and was under serves from 2005 .

- The Advanced Khartoum diagnostic center MRI center :

Figure(3.2) of MRI service in The Advanced Khartoum diagnostic center Zone (4)

The service was (GE) General Electric design ,close magnet ,1.5Tesla and was under serves from 2009.

- The AL-nillien Center MRI service :

Figure (3.3) of MRI service in AL-nillien Center
Zone (4)

The service was SIEMENS design , open magnet , 3.5 Tesla and was under serves from 2008.

- Questioner were taken from patient ,Managers ,House worker and technologist.(see appendices).

Figure(3.4) Warning signs on the doorat The Advanced Khartoum diagnostic center

Figure(3.5) Zone (2) at The Advanced Khartoum diagnostic center

Figure(3.6) Zone (3) at The Advanced Khartoum diagnostic center

see the The international design departs in method .

3.2 Methods:

The study was applied in three centers in Khartoum (Asia center , AL-nillein center and The Advanced Khartoum Diagnostic center) . First we visited the centers at working time to look for the warning signs of the MRI and it's place { reception wall and door} In an obvious place , and then compare the Design of MRI department with international design .

The international design departs to five zone :-

Zone 1:reception and waiting area

Zone 2 : patient putoff clothes and prescreening .

Zone 3 : MRI control room Technologist station .

Zone 4 : service MRI {screening} .

Zone 5 : Equipment room .

Secondly Questioners was given people whom contact with the MRI environment , so people departs to four groups { 36 patients , 5 House workers , 15 Technologists and 6 manages }.(see appendence)

The data was taken by Random Sample at the centers , some of Questions were Yes OR No Questions others were answer by rating {good , v.good ,excellent } to know the knowledge of people and the last type of Question were answer by { No body , some time and I don't know } . (see appendence)

In Question No (2) for House worker was about How they cleaning up device . (see appendence)

A . By broom and Damp .{rating by good}

B . A + took off the iron out side .{ rating by v.good }

C . B + took on code and wear cloves .{ rating excellent }

In Question No (3) for House worker about the procedures when they interring room .(see appendence)

A . The iron out .{ rating by good }

B . A + mobile phone out .{ rating by v.good }

C . B + wearing the code .{ rating by Excellent }

In Question No (4) for House worker about the skills off them . (see appendence)

A .for my perfect works . { rating by good }

B . A + can speak Arabic .{ rating by v.good }

C . B + can read and write . {rating by excellent }

In Question No (5) for House worker about the knowledge of the warning signs of MRI and it'smeaning .

A .dangenous .{ rating by good }

B . A+ iron out .{ rating by v.good }

C . B + attractive power and don't stop .{rating by excellent }

In Question No (6) for House worker about what do they do in accident .(see appendence)

A .tell the receptionist . { rating by good }

B .tell the technologist . { rating by v.good }

C .tell my boss and turn off the alarm bell .{ rating by excellent }

In Question No (9) for House worker about the hazer of MRI attractive properties .

A .if the device turn on it will kill by attractive provice { rating by good }

B .if turn on or off it well kill by attractive power .{ rating by v.good }

C .to the kind of MRI power (Tesla) . { rating by excellent }

In Question No (8) for technologist about the leakage gas and the applicant .(see appendence)

A .tell the securrety .{ rating by good }

B . A + turn on the alarm bell .{ rating by v.good }

C . B + help people to go out of the room .{ rating by Excellent }

In Question No (1) for manger about the knowledge of MRI device (see appendence) .

A .dangerous device .{ rating by good }

B . A + attractive properties .{ rating by v.good }

C . B + contain lethal gas .{ rating by Excellent }

After that the data was analysis by Excel program , classify and made percentage data for it .

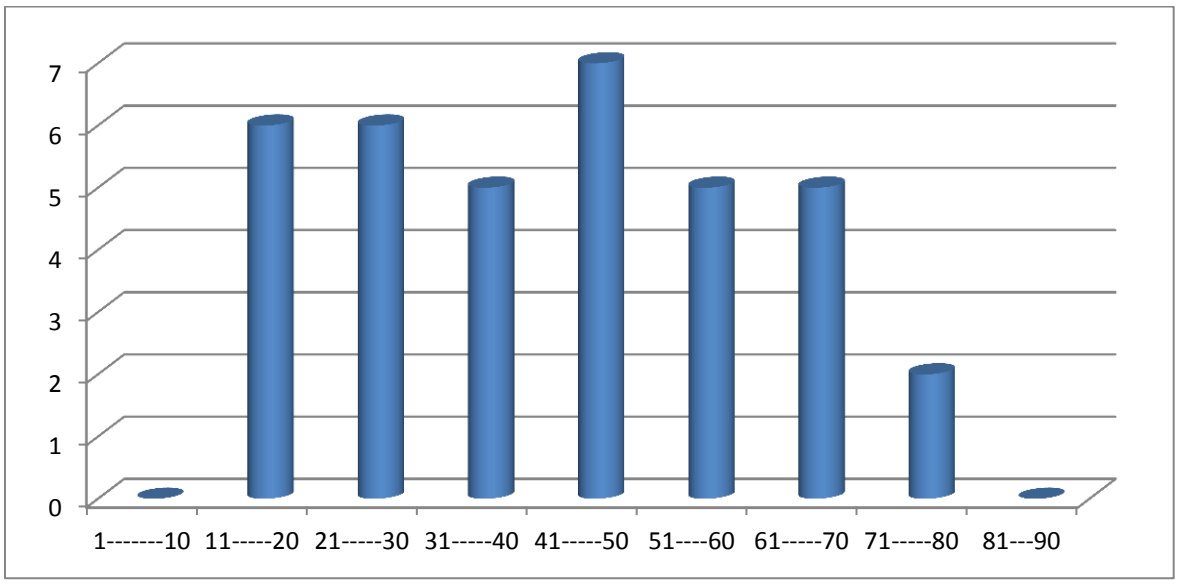
CHAPTER FOUR

Results

In thischapter collected data were presented in the following tables.

Table (4.1): Show frequency of Age distribution for patients:

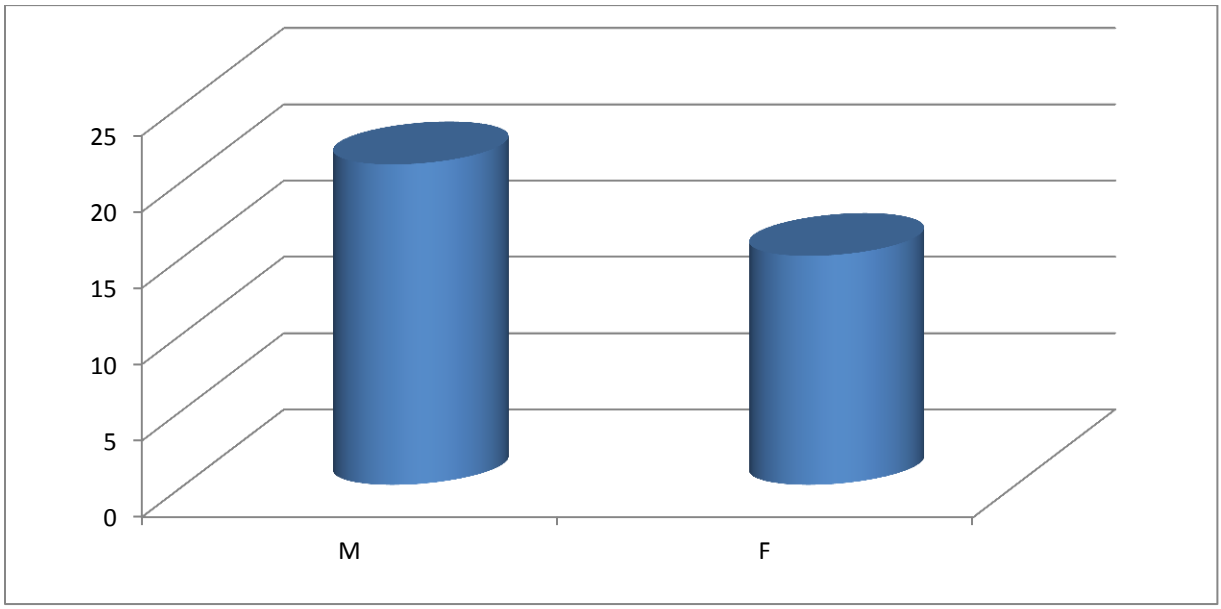
age	Frequency	%
1-10	0	0
11-20	6	16.7
21-30	6	16.7
31-40	5	13.9
41-50	7	19.4
51-60	5	13.9
61-70	5	13.9
71-80	2	5.6
81-90	0	0
Total	36	100



Figures (4.1): Show frequency of Age distribution for patient

Table (4.2) Show frequency of patients gender distribution:

Gender	Frequency	%
Male	21	63.9
Female	15	36.1
Total	36	100.0



Figures (4.2) Show frequency of patients gender distribution

Table (4.3) Show frequency of patients filled theQuestionnaire in right way :

Valid	Frequency	%
Yes	27	75
NO	0	0
NO ANSER	**9**	**25**
Total	**36**	**100.0**

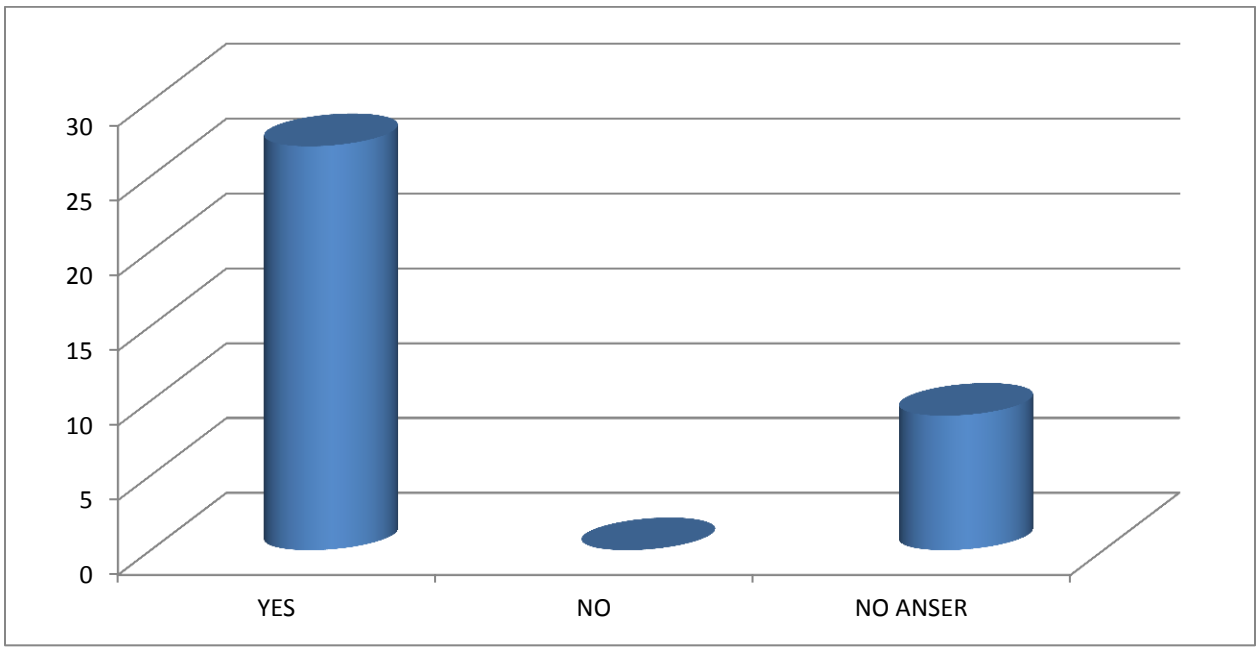


Figure (4.3) Show frequency of patients filled the Questionnaire.

Table (4.4) Show frequency of who is filled the Questionnaire of patients :

Valid	Frequency	Percent
Patient	10	27.8
NO Answer	9	25
Another body	17	47.2
Total	**36**	**100.0**

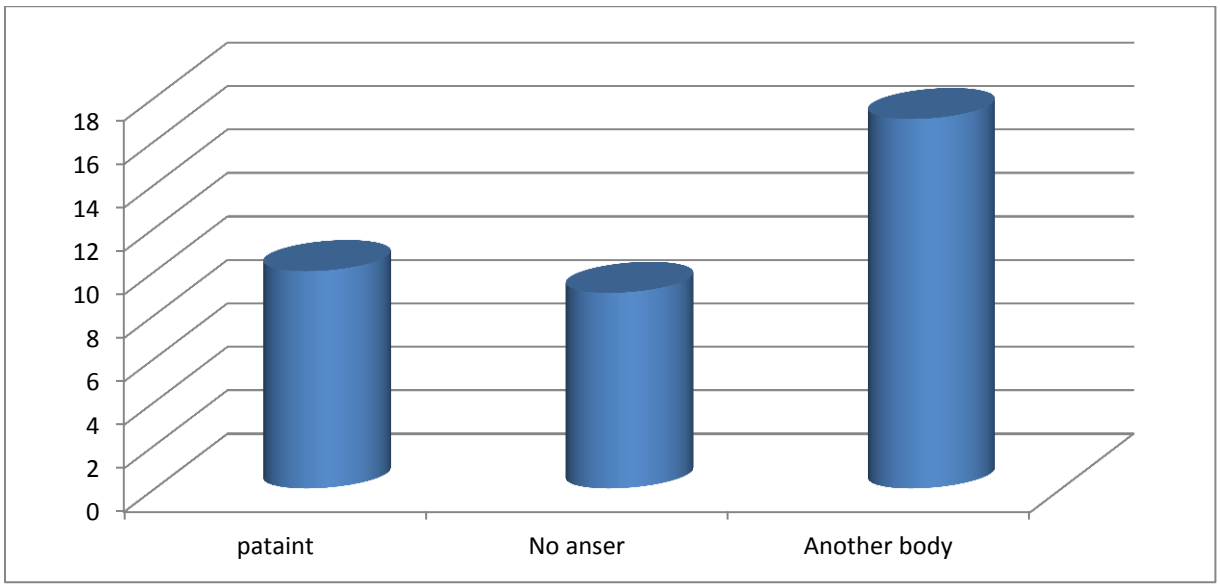
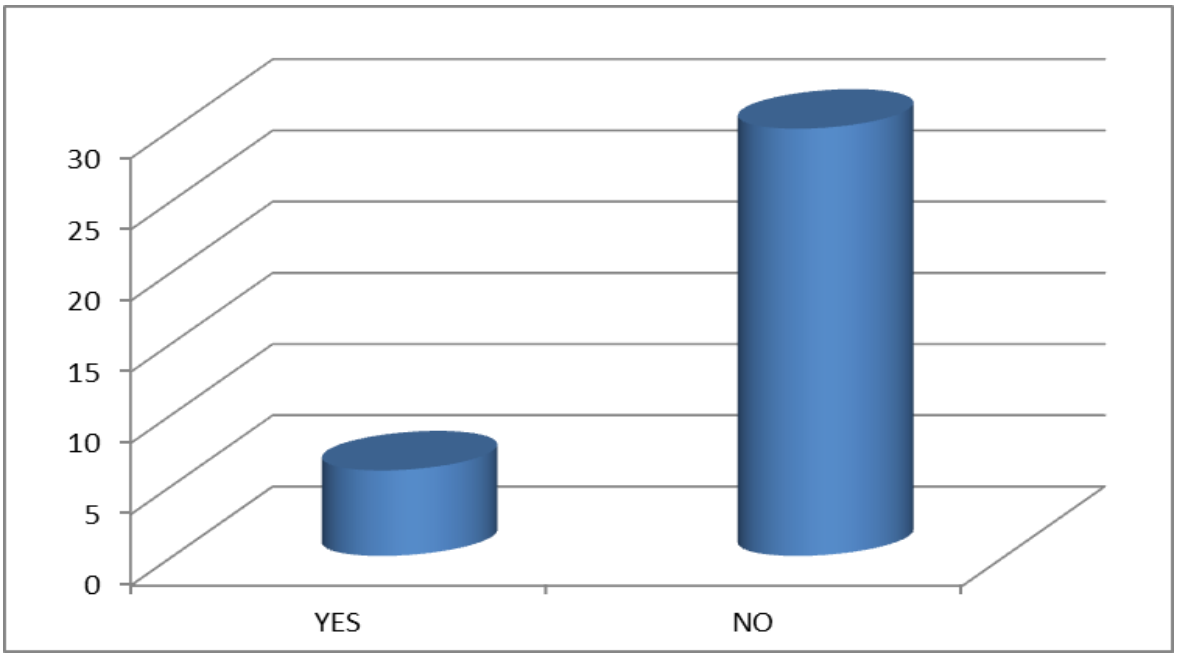


Figure (4.4) Show frequency of who is filled the Questionnaire of patients

Table (4.5) Show frequency of patientsiftechnologist explained to him about MRI hazard before treatment :

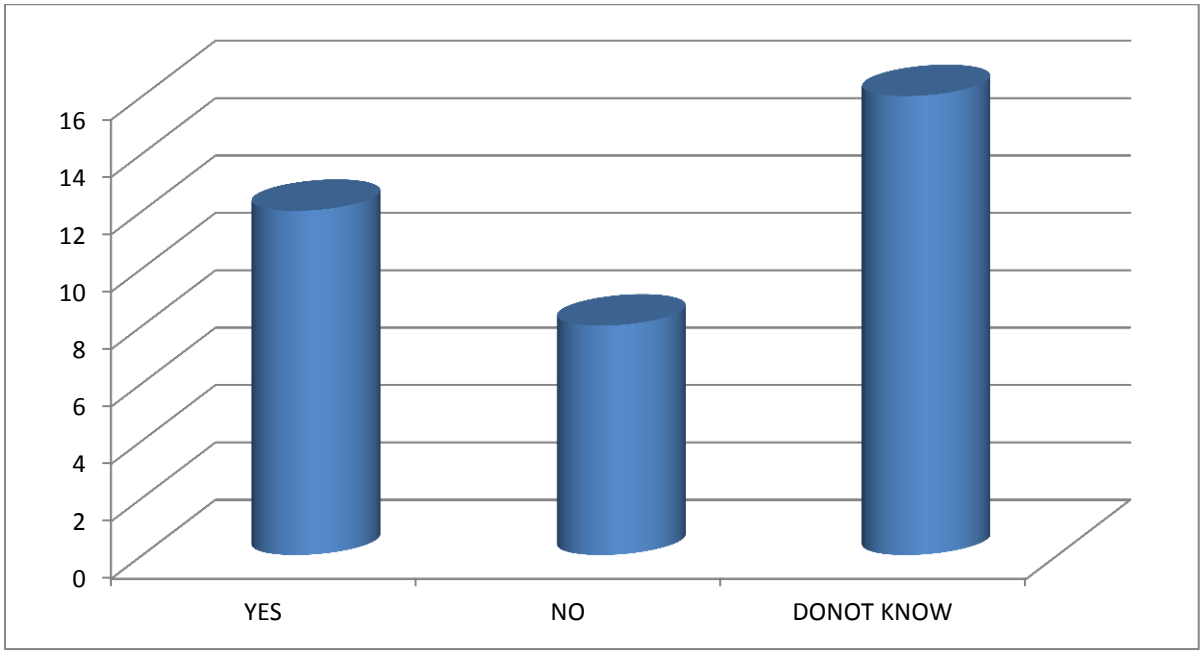
Valid	Frequency	%
YES	6	25.0
NO	30	75.0
Total	36	100.0



Figures (4.5) Show frequency of patients if technologist explained to him about MRI hazard before treatment

Table (4.6) Show frequencyof patients knowledge about MRI magnetic hazard :

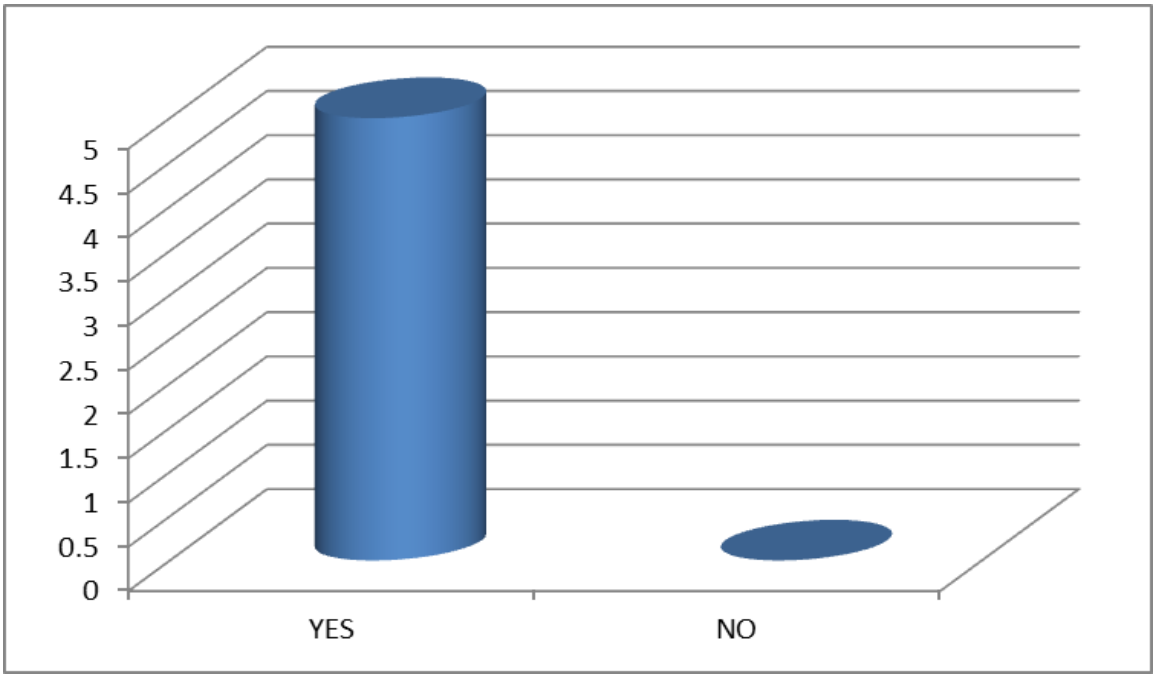
Valid	Frequency	%
Yes	12	33.3
No	8	22.2
I do not know	16	44.4
Total	**36**	**100.0**



Figures (4.6). Show frequency of patients knowledge about MRI magnetic hazard

Table (4.7) showfrequency of house workers if informed or told by device's risks before start working and did they commit it :

Valid	Frequency	%
Yes	5	100.0
No	0	0
Total	5	100.0



Figures(4.7) show frequency of house workers if informed or told by device's risks before start working and did they commit it

.

Table (4.8) show frequency of house workers known about cleaning up device:

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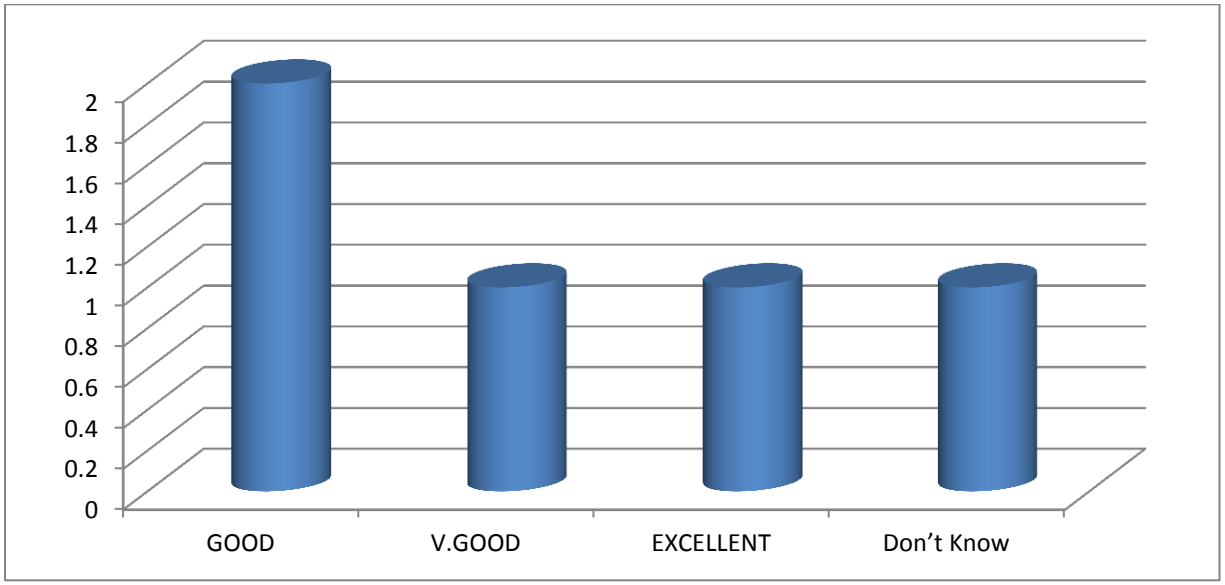
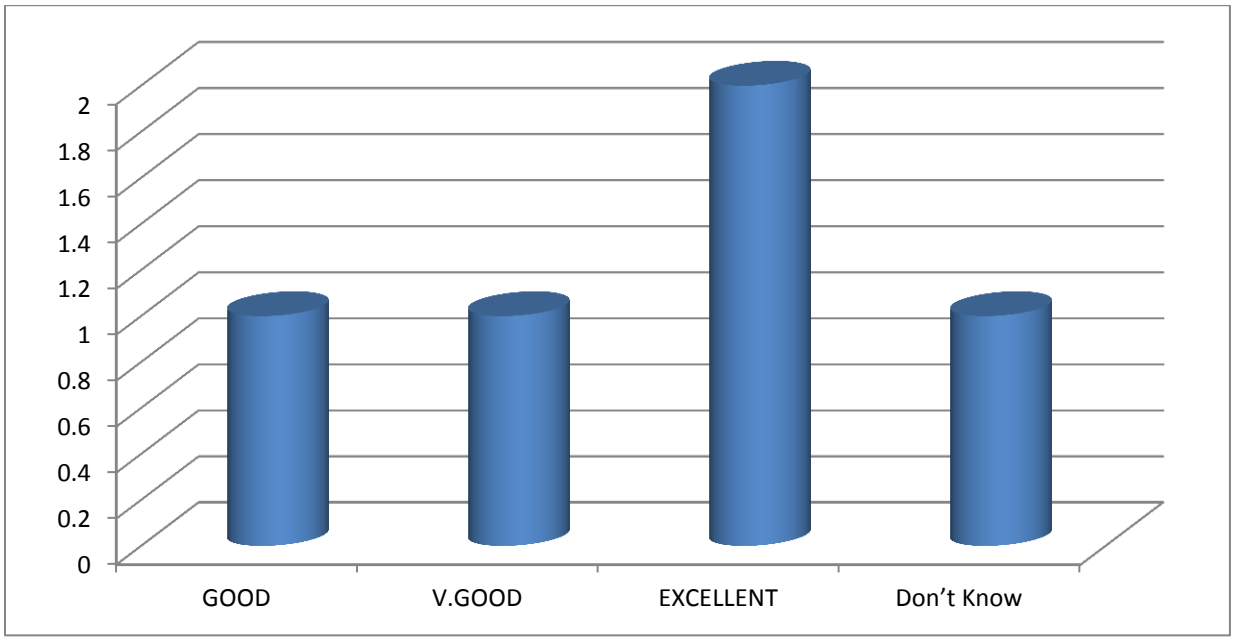
Valid	Frequency	%
Good	2	40.0
v.good	1	20.0
Excellent	1	20.0
I don't know	1	20.0
Total	5	100.0



Figure(4.8) show frequency of house workers known about cleaning up device.

Table (4.9) show frequency of house workers known about procedures when interring room :

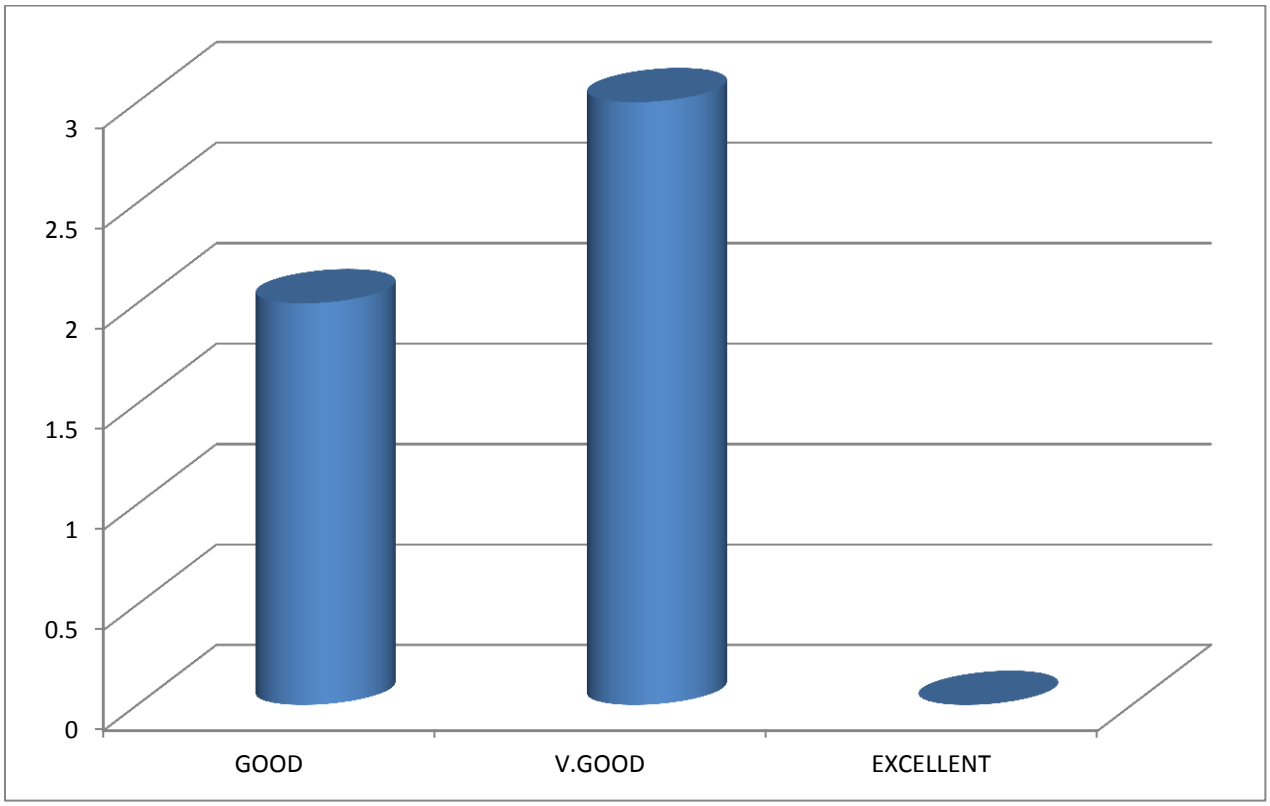
Valid	Frequency	%
Good	1	20.0
v.good	1	20.0
Excellent	2	40.0
I don't know	1	20.0
Total	5	100.0



Figure(4.9) show frequency of house workers known about procedures when interring room

Table (4.10) show frequency of house workersskill's:

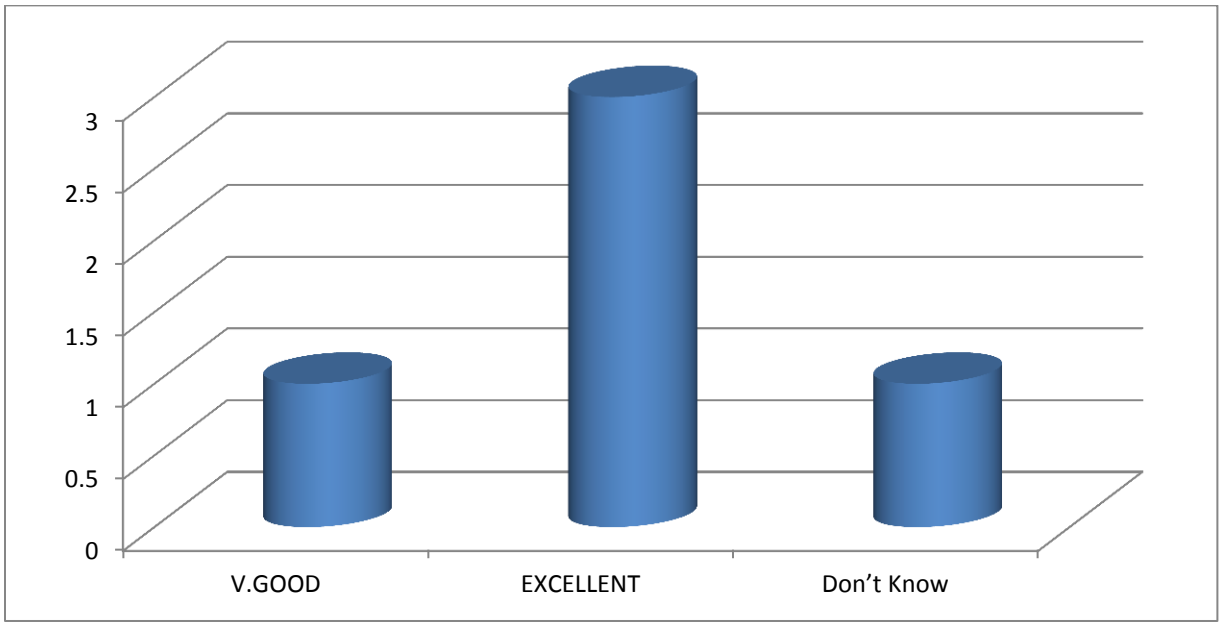
Valid	Frequency	%
Good	2	40
v.good	3	60
Excellent	0	0
Total	5	100.0



Figures (4.10) show frequency of house workers skill's

Table (4.11)Show frequency of house workers known about marks of MRI risk and it's mean:

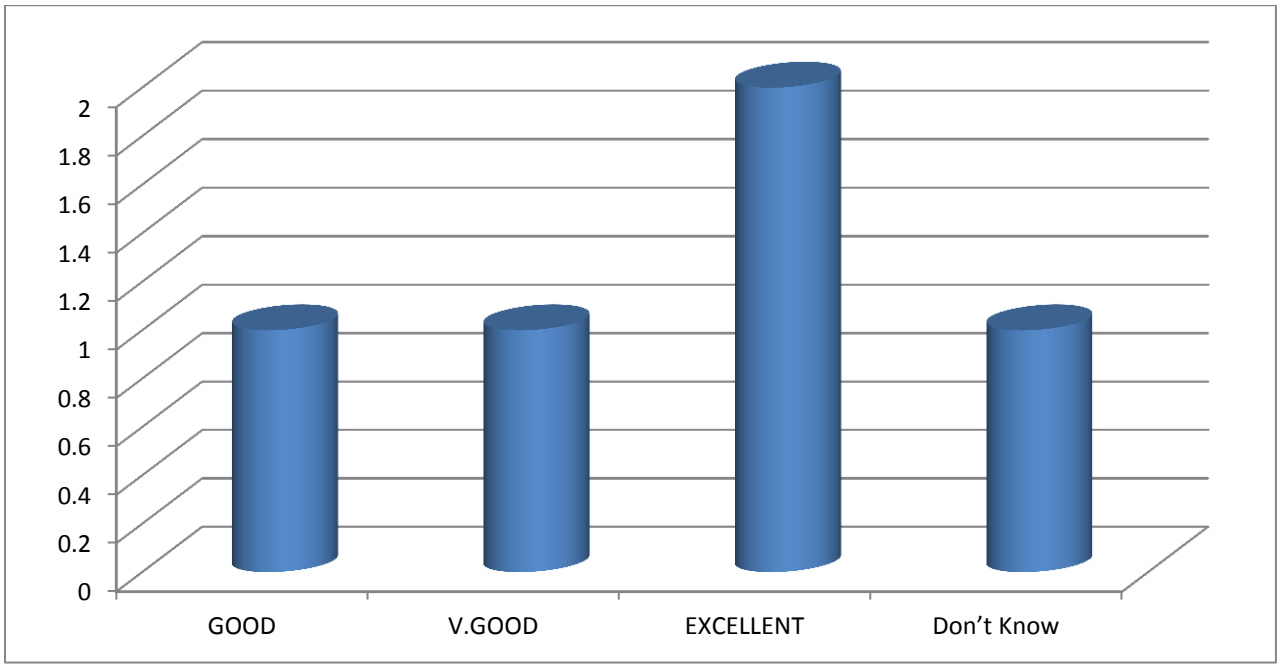
Valid	Frequency	%
v.good	1	20.0
Excellent	3	60.0
I don't know	1	20.0
Total	5	100.0



Figures (4.11) Show frequency of house workers known about marks of MRI risk and it's mean

Table (4.12)Show frequency of house workers applied with accident during working :

Valid	Frequency	%
Good	1	20.0
v.good	1	20.0
Excellent	2	40.0
I don't know	1	20.0
Total	5	100.0

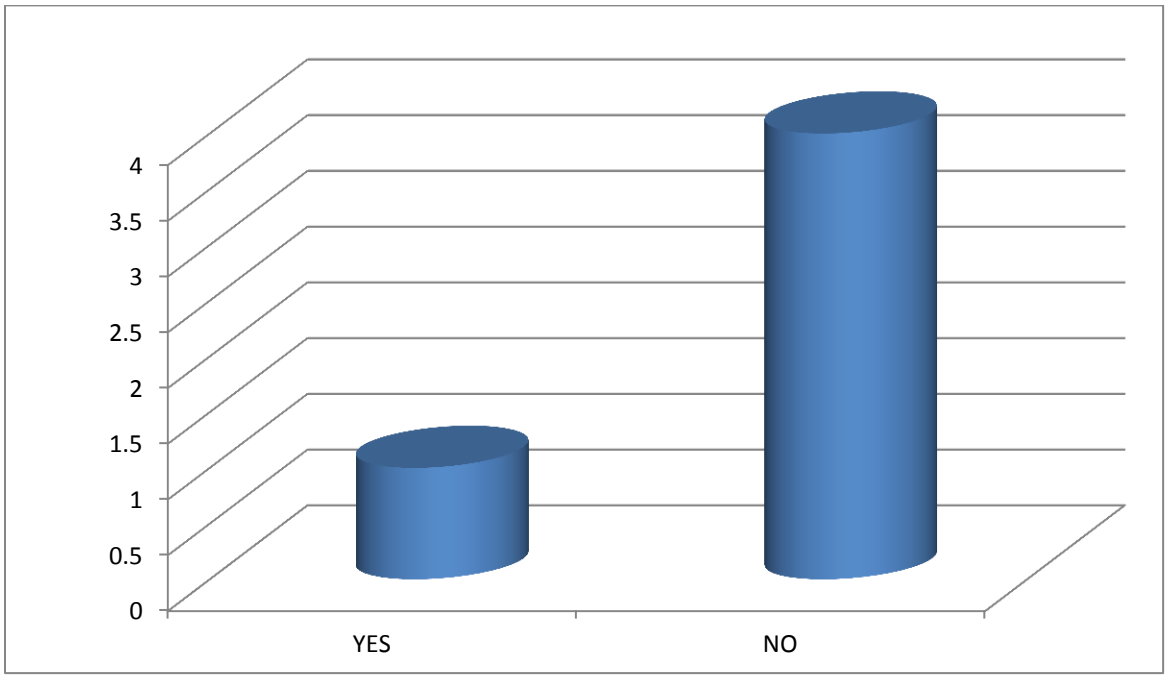


Figures (4.12) Show frequency of house workers applied with accident during working

Table (4.13)Show frequency of house workers known about lethal gas:

Valid	Frequency	%
Yes	1	20.0
NO	4	80.0
Total	5	100.0

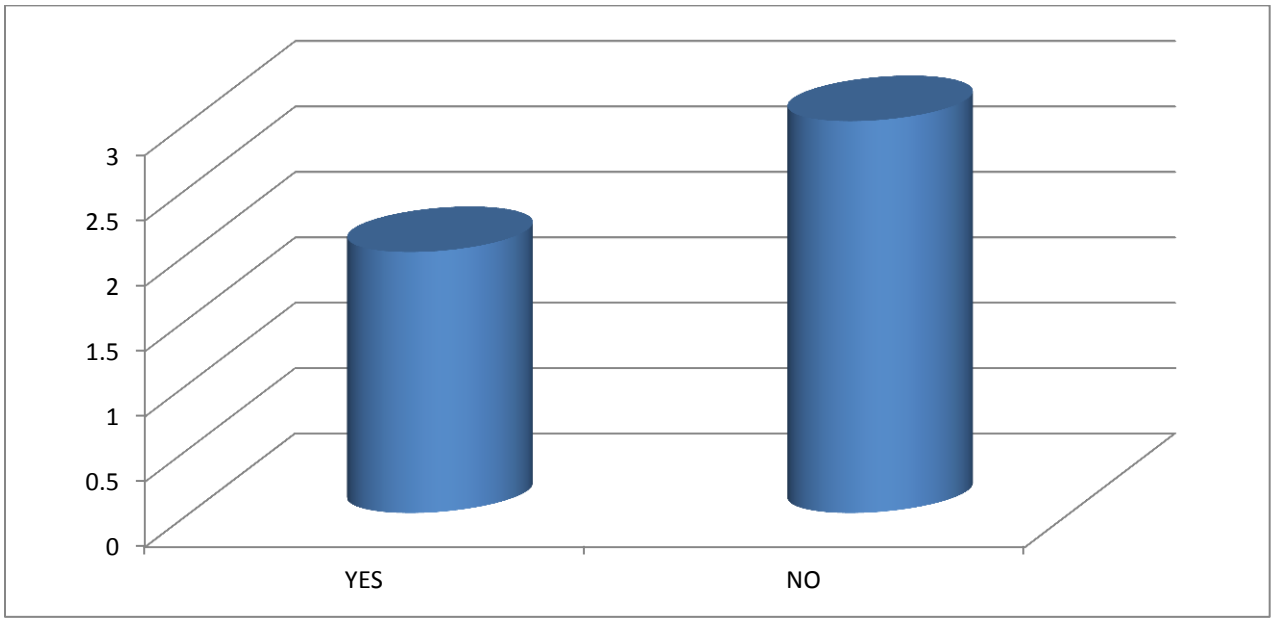
.



Figure(4.13) Show frequency of house workers known about lethal gas

Table (4.14)Show frequency of house workers known about the leakage of gas :

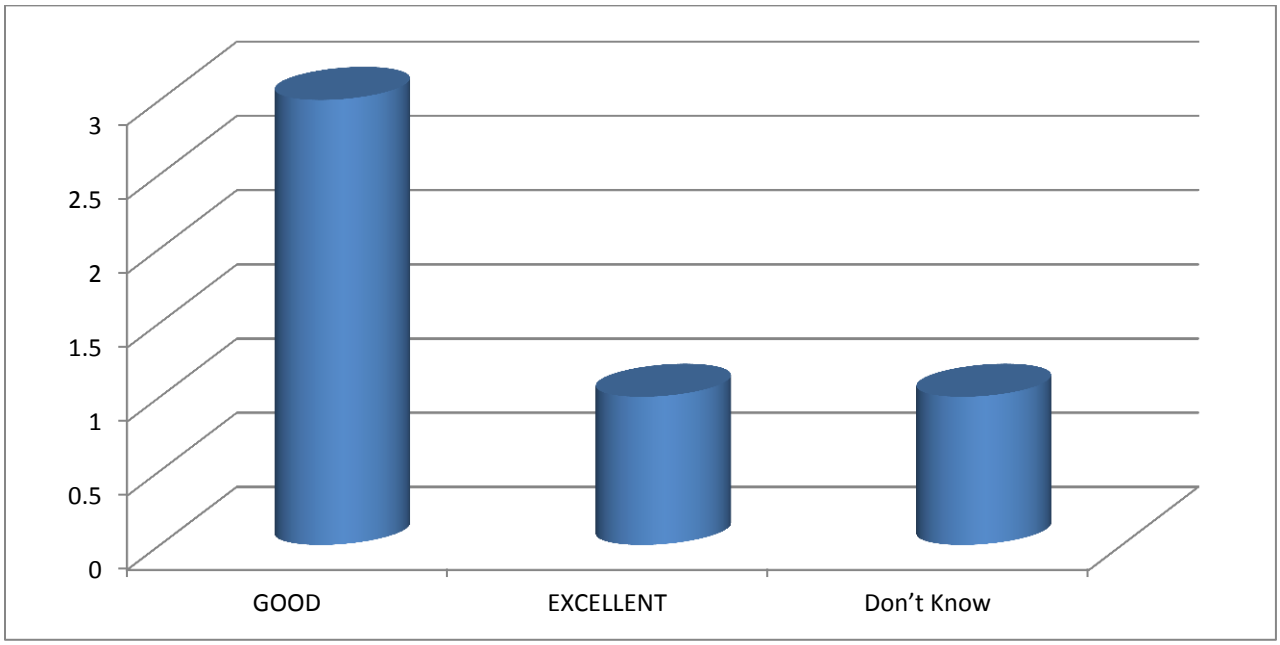
Valid	frequency	%
Yes	2	40.0
NO	3	60.0
Total	5	100.0



Figure(4.14) Show frequency of house workers known about the leakage of gas

Table (4.15)Show frequency of house workers known aboutthe kill by MRI attractive properties :

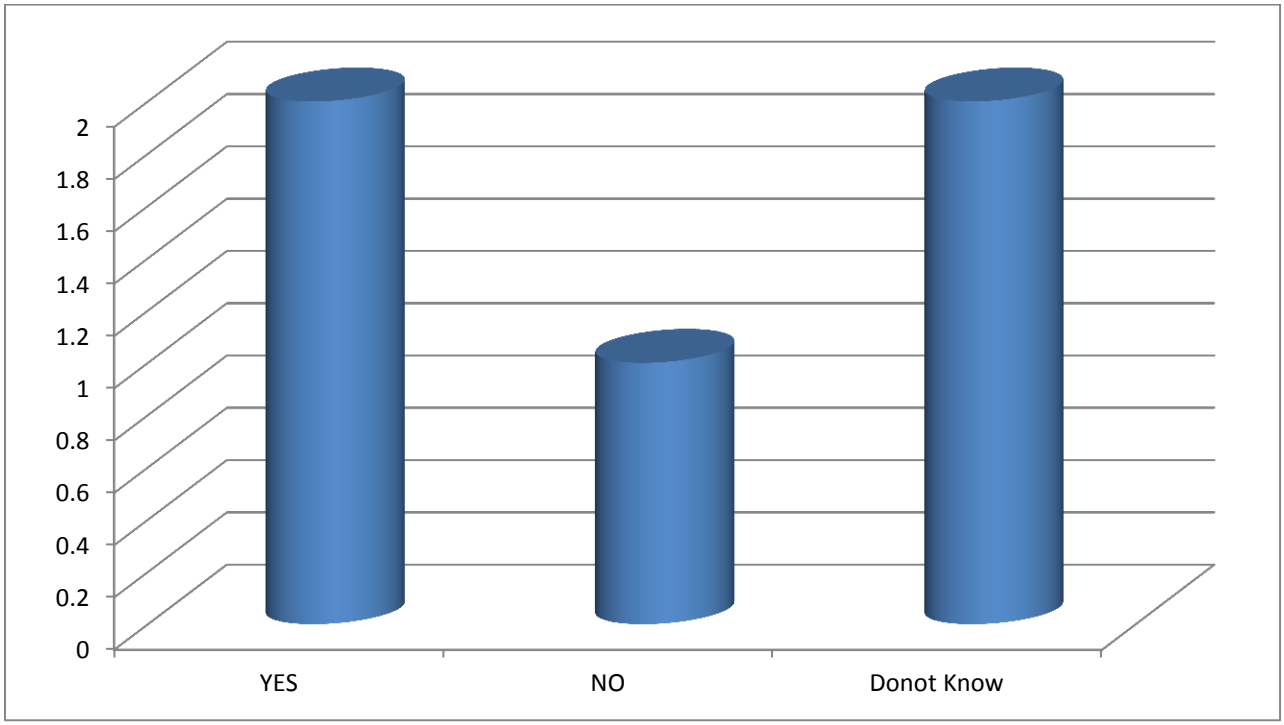
Valid	Frequency	%
Good	3	60.0
Excellent	1	20.0
I don't know	1	20.0
Total	5	100.0



Figure(4.15)Show frequency of house workers known about the kill by MRI attractive properties

Table (4.16)Show frequency of house workers known ifattractive property still on when the device is closed:

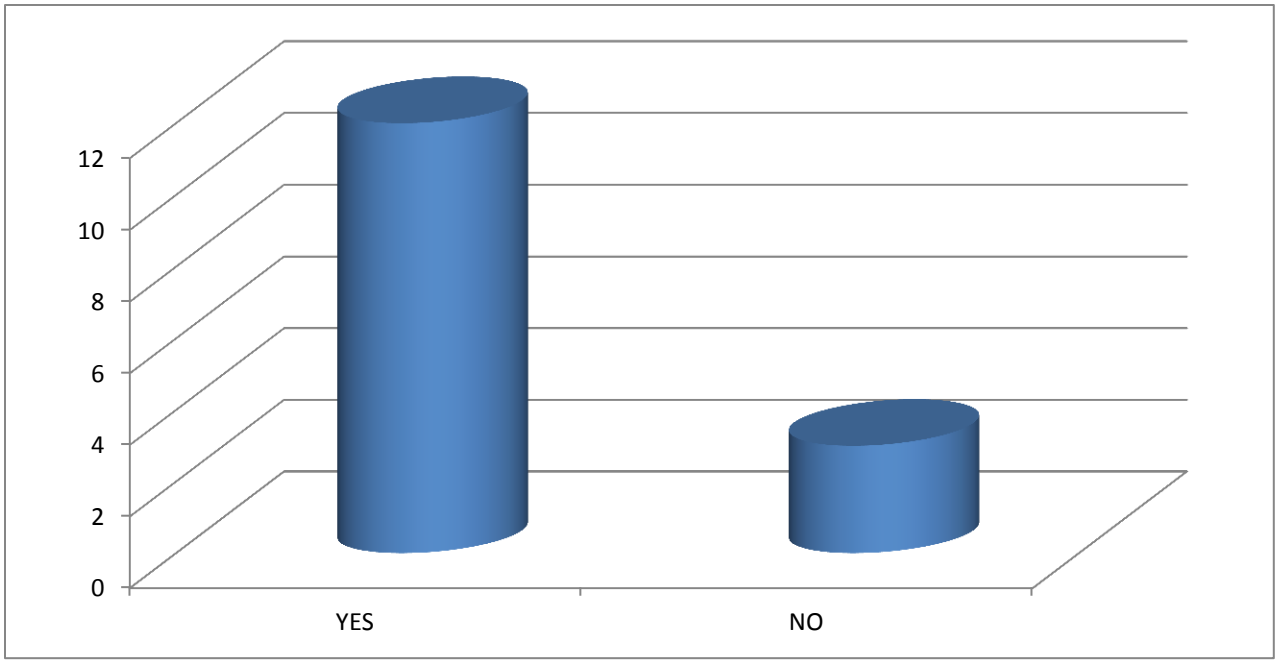
Valid	Frequency	%
Yes	1	20.0
NO	3	60.0
I don't know	1	20.0
Total	5	100.0



Figures (4.16) Show frequency of house workers known if attractive property still on when the device is closed

Table (4.17)Show frequency of technologists told the patient about the risk of device :

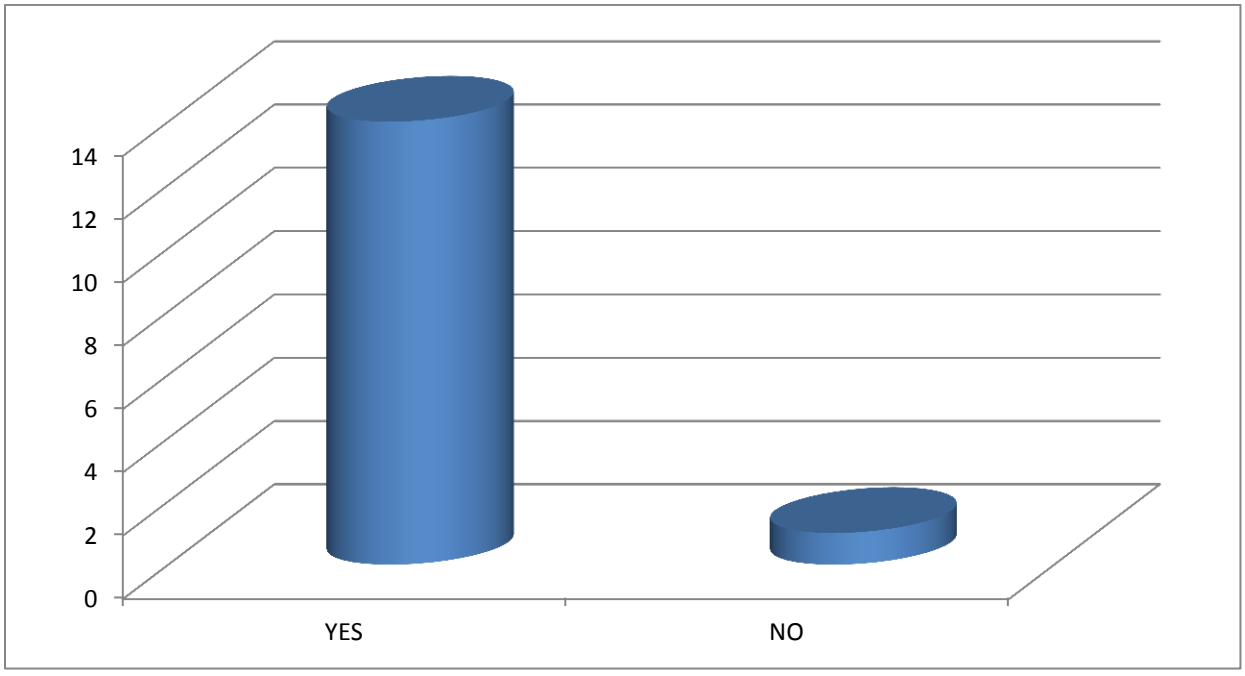
Valid	frequency	%
Yes	12	80
No	3	20
Total	15	100.0



Figure(4.17) Showfrequency of technologists if told the patient about the risk of device

Table (4.18)Show frequency of technologists known if the patients filled forma by himself:

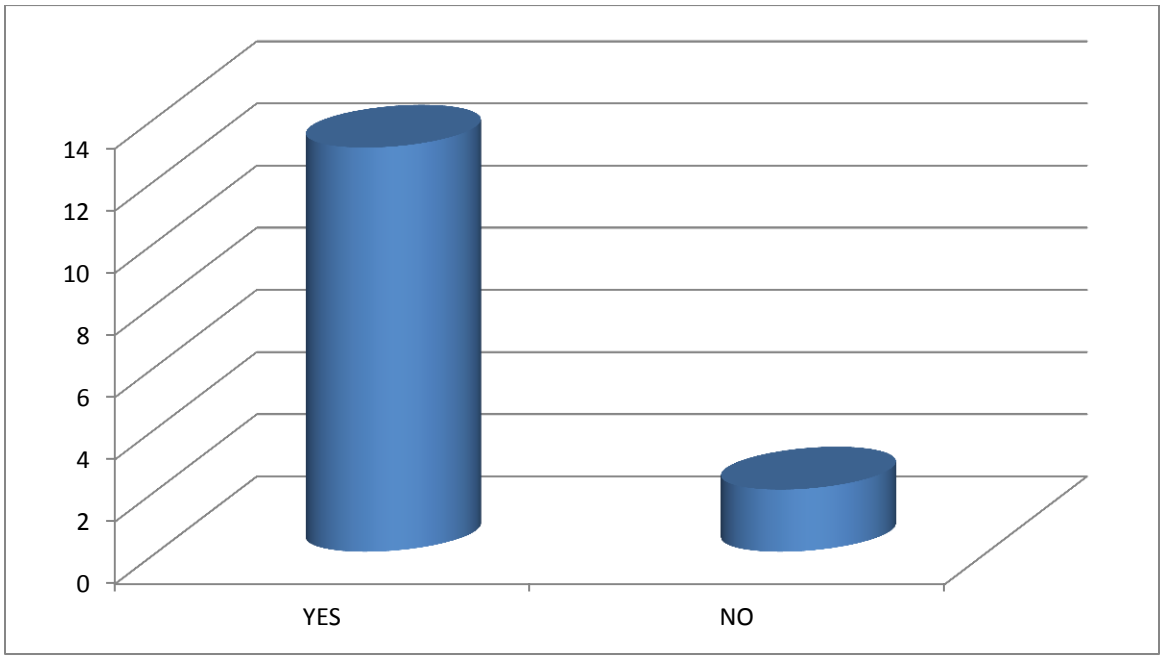
Valid	Frequency	%
Yes	14	93.3
No	1	6.7
Total	15	100.0



Figure(4.18) Show frequency of technologists known if the patients filled forma by himself

Table (4.19)Show frequency of technologistscheck forma after filled:

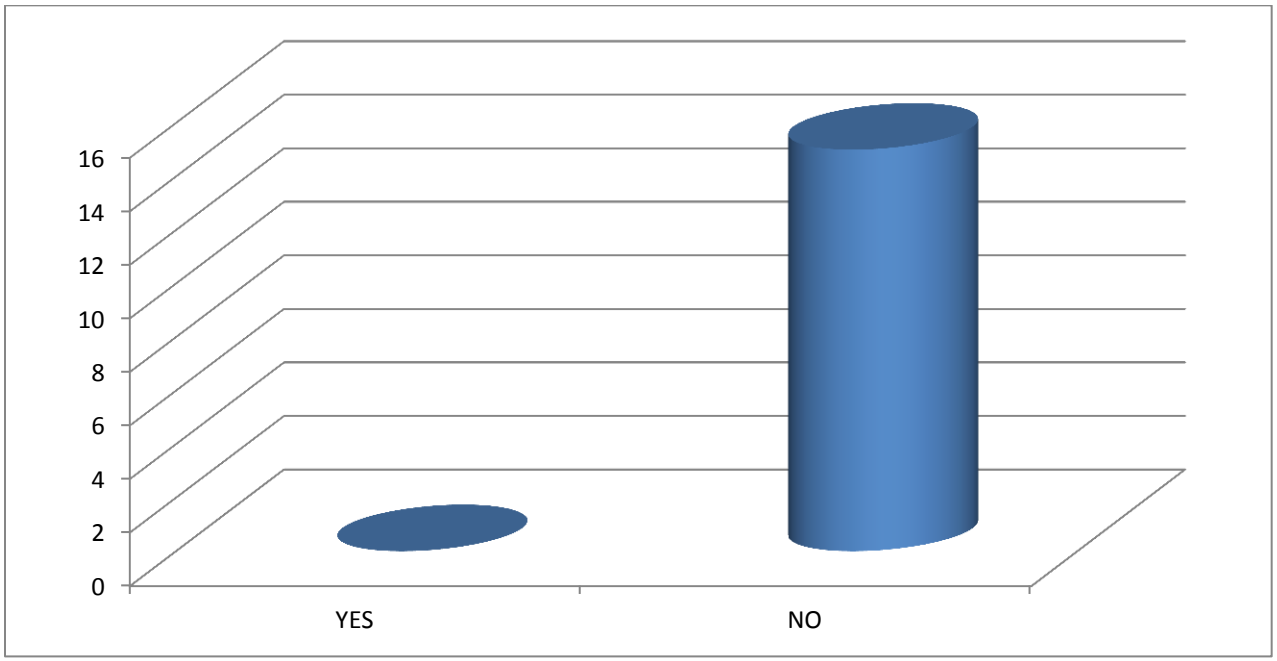
Valid	Frequency	%
Yes	13	86.7
No	2	13.3
Total	15	100.0



Figure(4.19) Show frequency of technologists check forma after filled

Table (4.20)Show frequency of technologists check patient things by manual magnet:

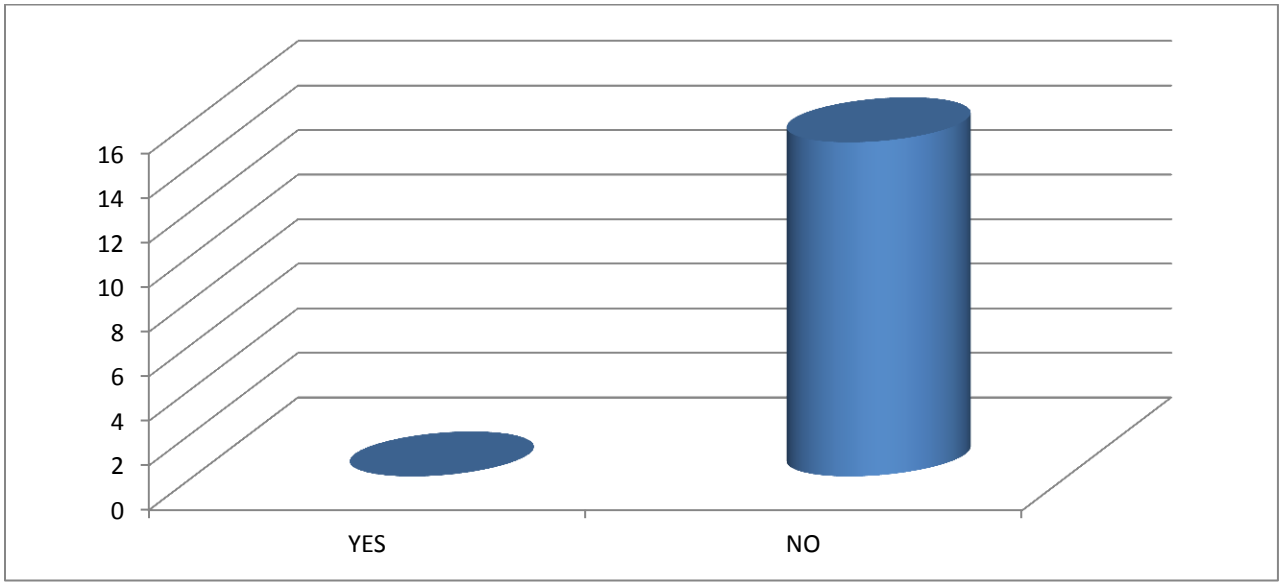
Valid	Frequency	%
No	15	100
Yes	0	0
Total	15	100



Figure(4.20) Show frequency of technologists check patient things by manual magnet

Table (4.21)Show frequency of technologists check patient by scanning :

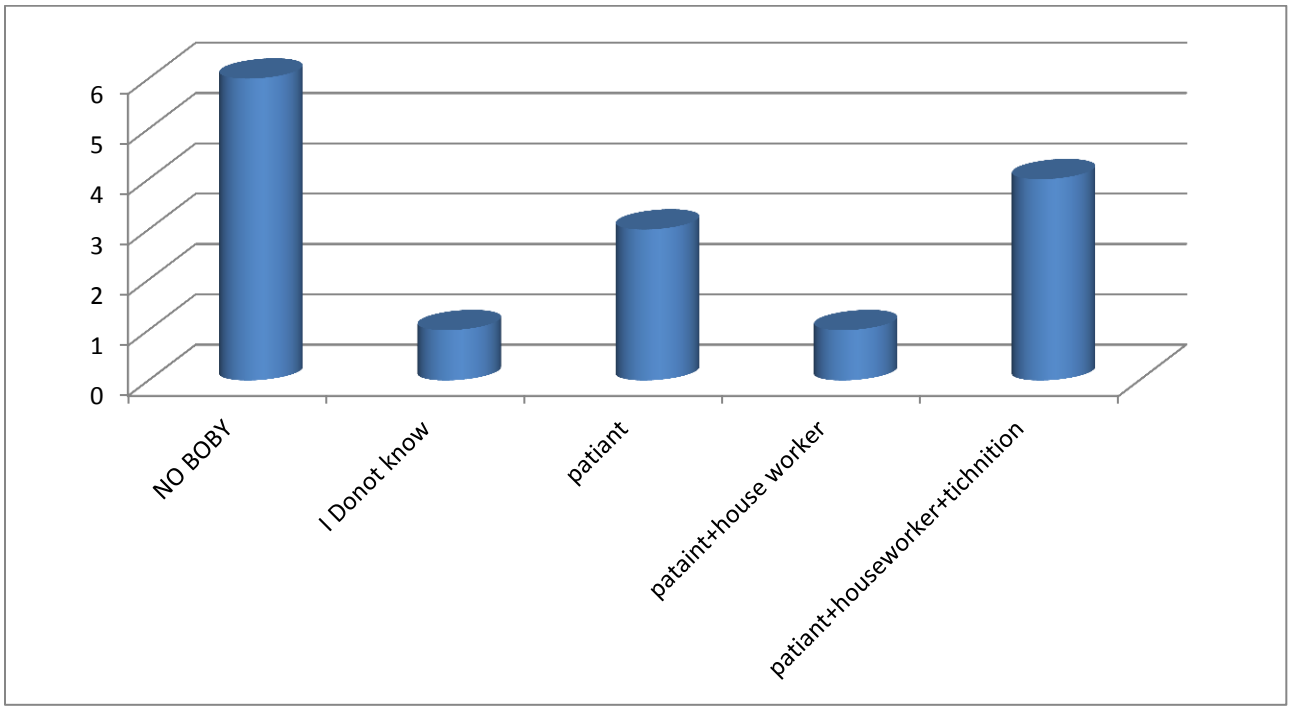
Valid	Frequency	%
Yes	0	0
NO	15	100
Total	15	100



Figures (4.21) Show frequency of technologists check patient by scanning

Table (4.22)Show frequency of technologists Apennine forwhom is responsible about an accident :

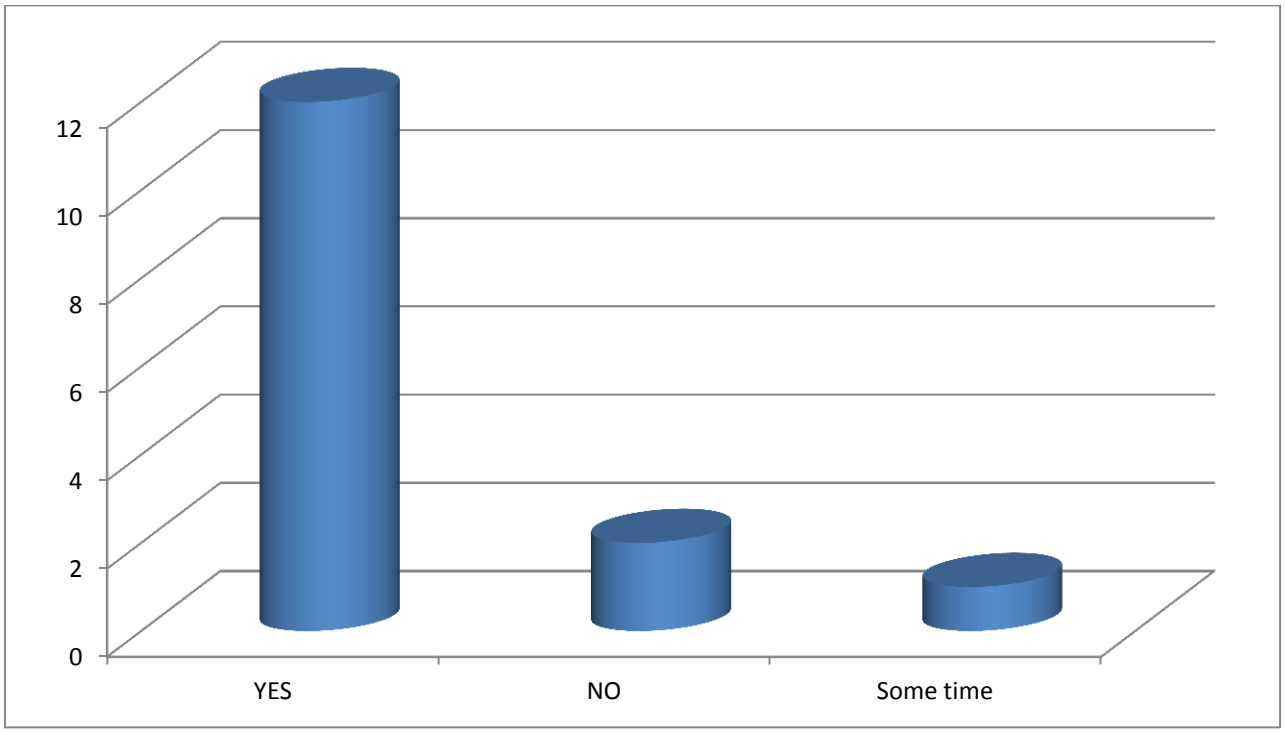
Valid	Frequency	%
no body	6	40.0
I dont know	1	6.7
Patient	3	20.0
Patient +House worker	1	6.7
Patient +House worker+ Technologist	4	26.7
Total	**15**	**100.0**



Figure(4.22)Show frequency of technologists Apennine for whom is responsible about an accident

Table (4.23)Show frequency of technologistsclosed ears of patient during treatment:

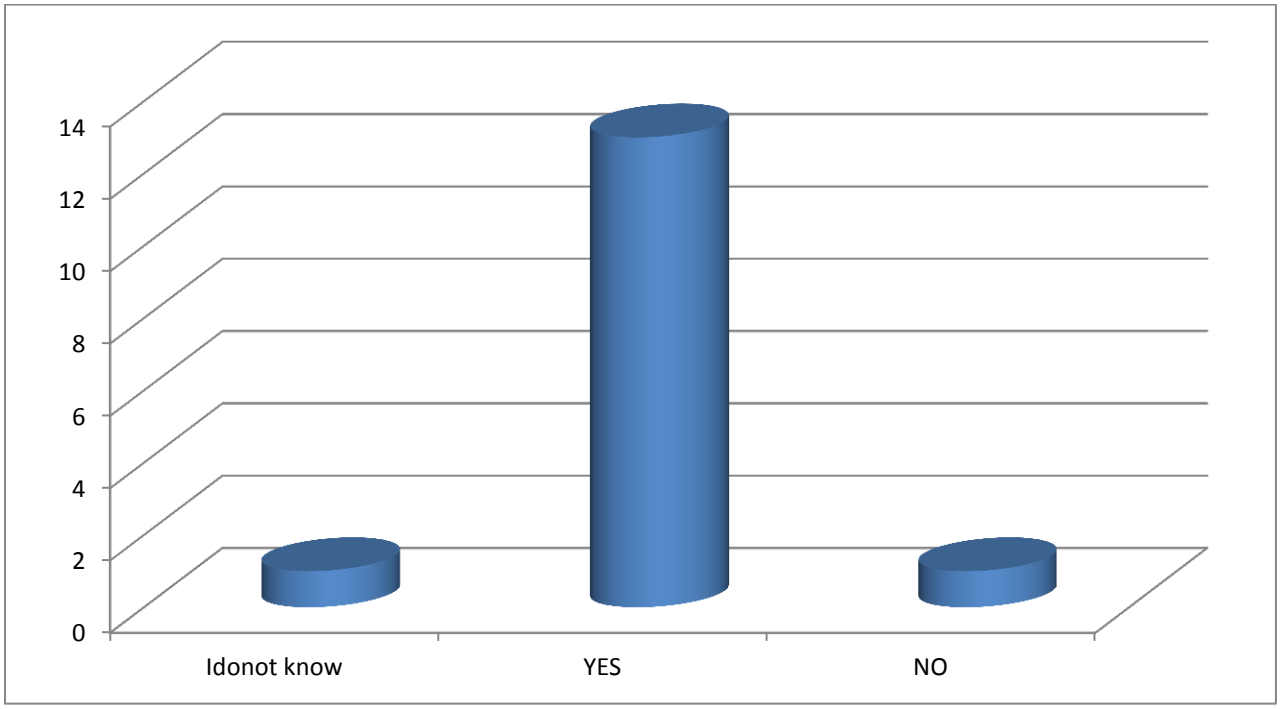
Valid	Frequency	%
Yes	12	80
No	2	13
Some time	1	6.7
Toyal	15	100.0



Figure(4.23) Show frequency of technologists closed ears of patient during treatment:

Table (4.24)Show frequency of technologists if the leakage gas happen to him and applicant produce in center:

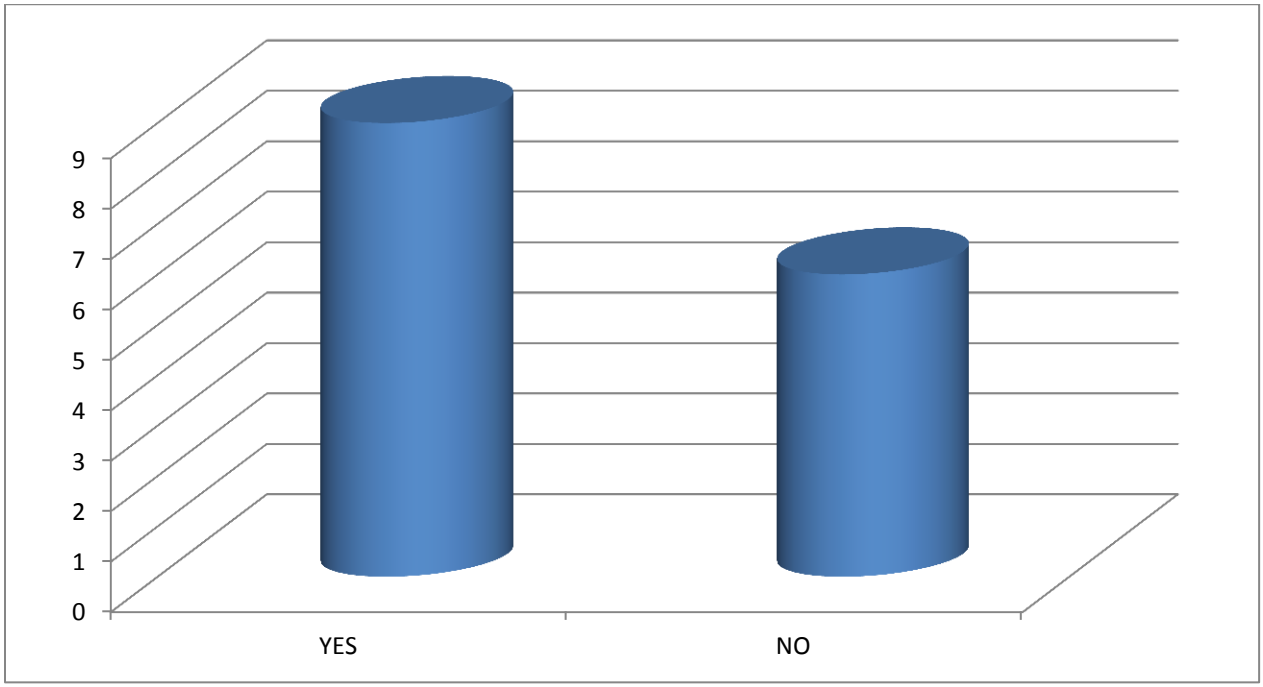
Valid	frequency	%
Yes	13	86.6
NO	1	6.7
I don't know	1	6.7
Total	15	100.0



Figure(4.24)Show frequency of technologists if the leakage gas happen to him and applicant produce in center

Table (4.25)Show frequencyof coach's patient if it's available in centers :

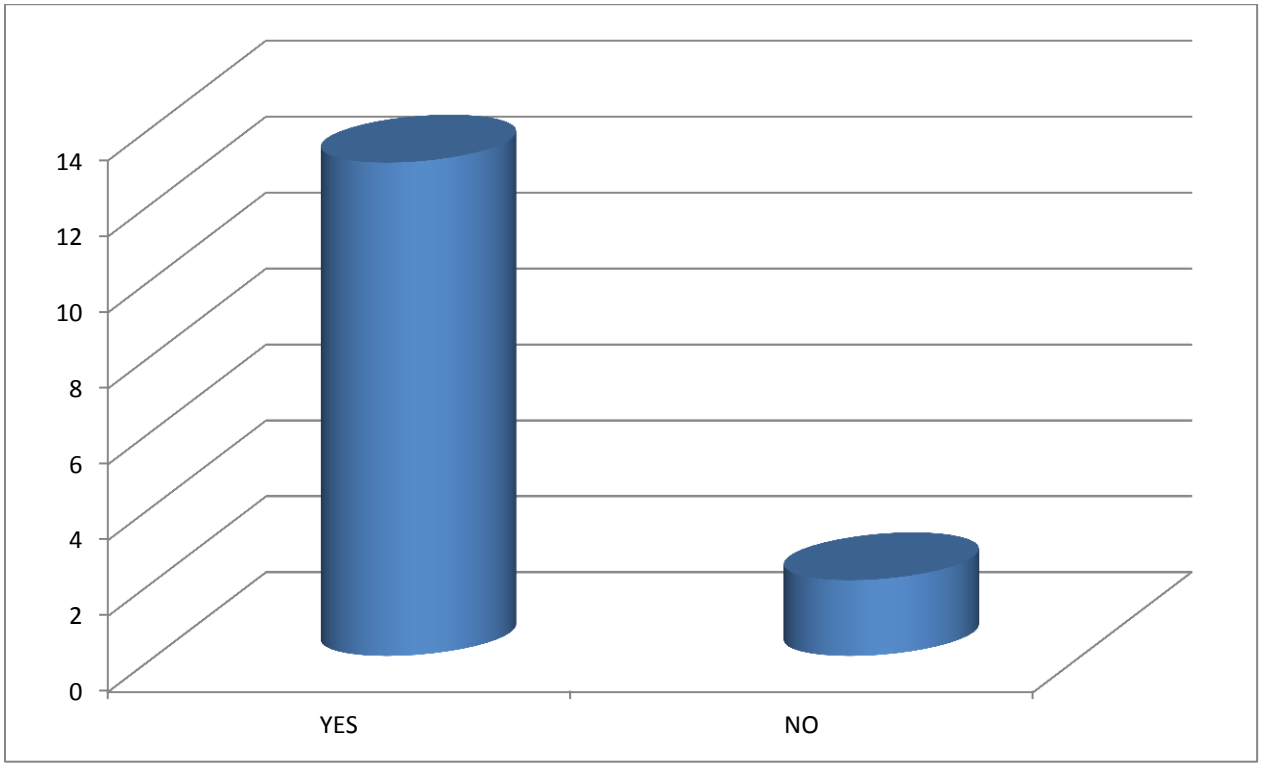
Valid	frequency	%
Yes	9	60
No	6	40
Total	15	100.0



Figure(4.25) Show frequency of coach's patient if it's available in centers

Table (4.26)Show frequency of technologistscheckup sitepatient:

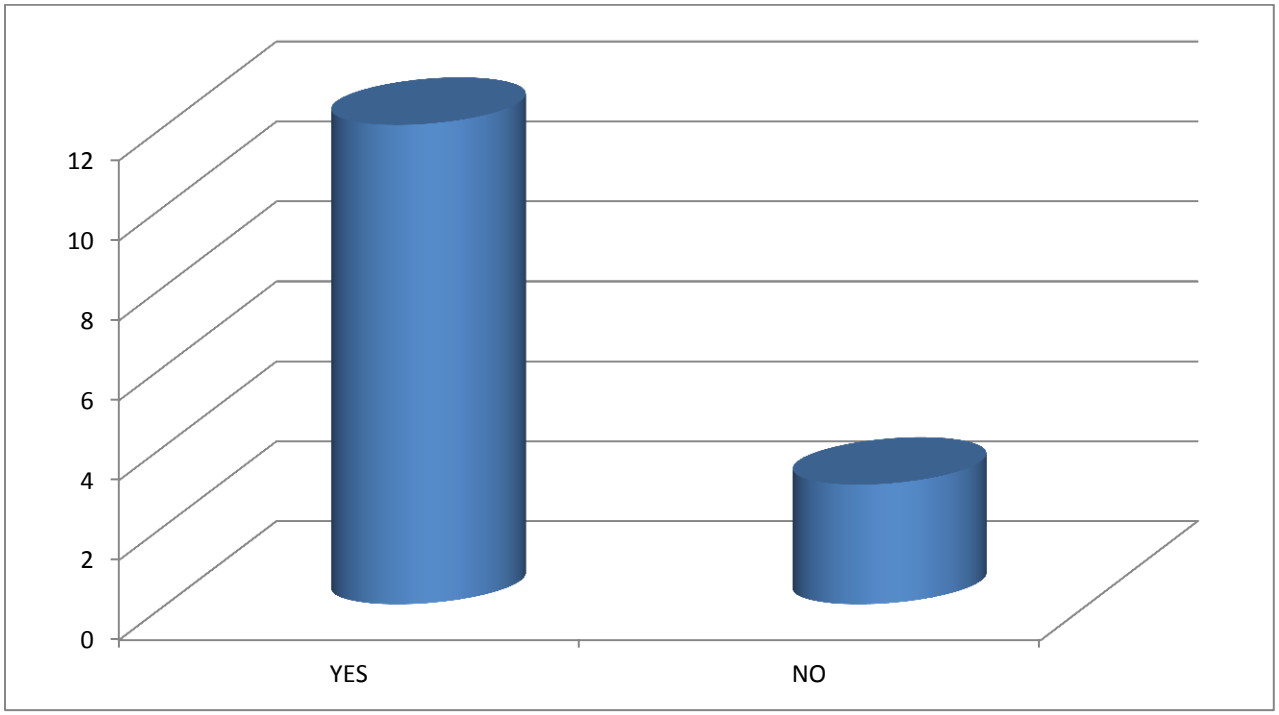
Valid	Frequency	%
Yes	13	86.7
No	2	13.3
Total	15	100.0



Figure(4.26) Show frequency of technologists checkup site patient

Table (4.27)Show frequency of technologists checkup patient before treatment:

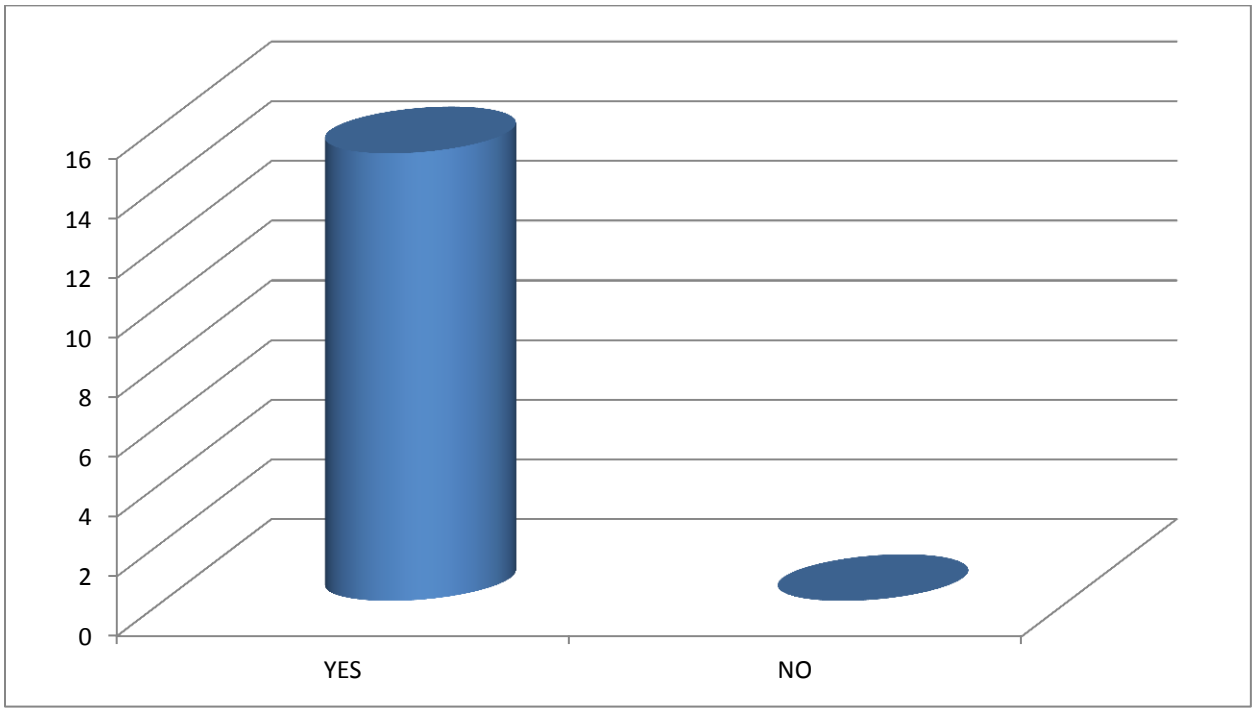
Valid	Frequency	%
Yes	12	80
No	3	20
Total	15	100.0



Figure(4.27) Show frequency of technologists checkup patient before treatment:

Table (4.28)Show frequency of technologists madeawarded for new employees :

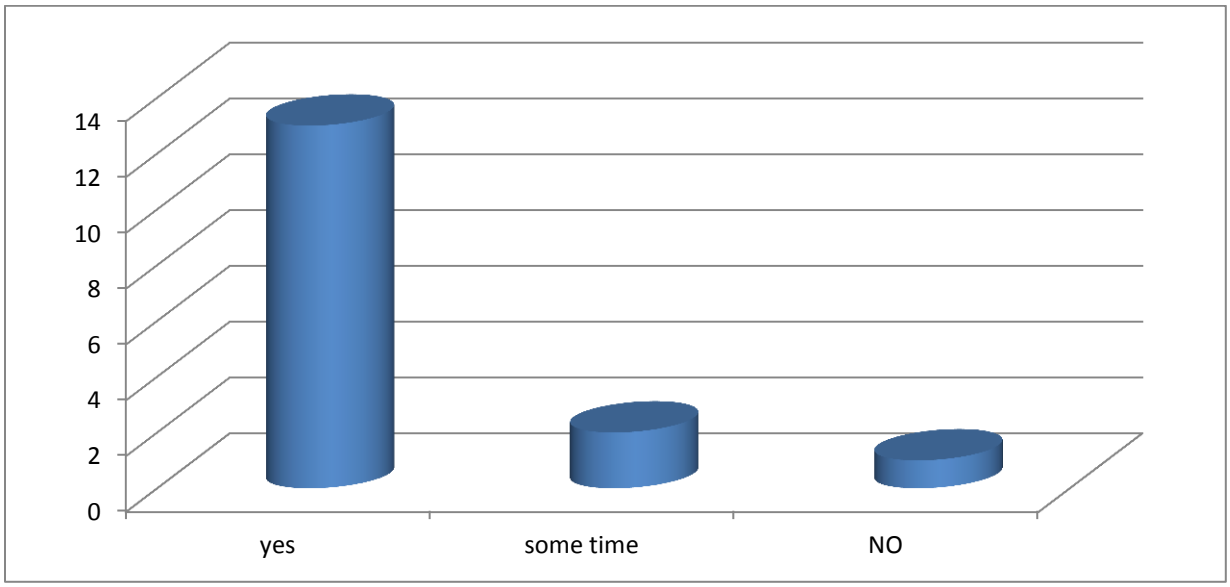
Valid	Frequency	%
Yes	15	100
No	0	0
Total	15	100



Figure(4.28) Show frequency of technologists made awarded for new employees

Table (4.29)Show frequency of technologists talking to patient during treatment:

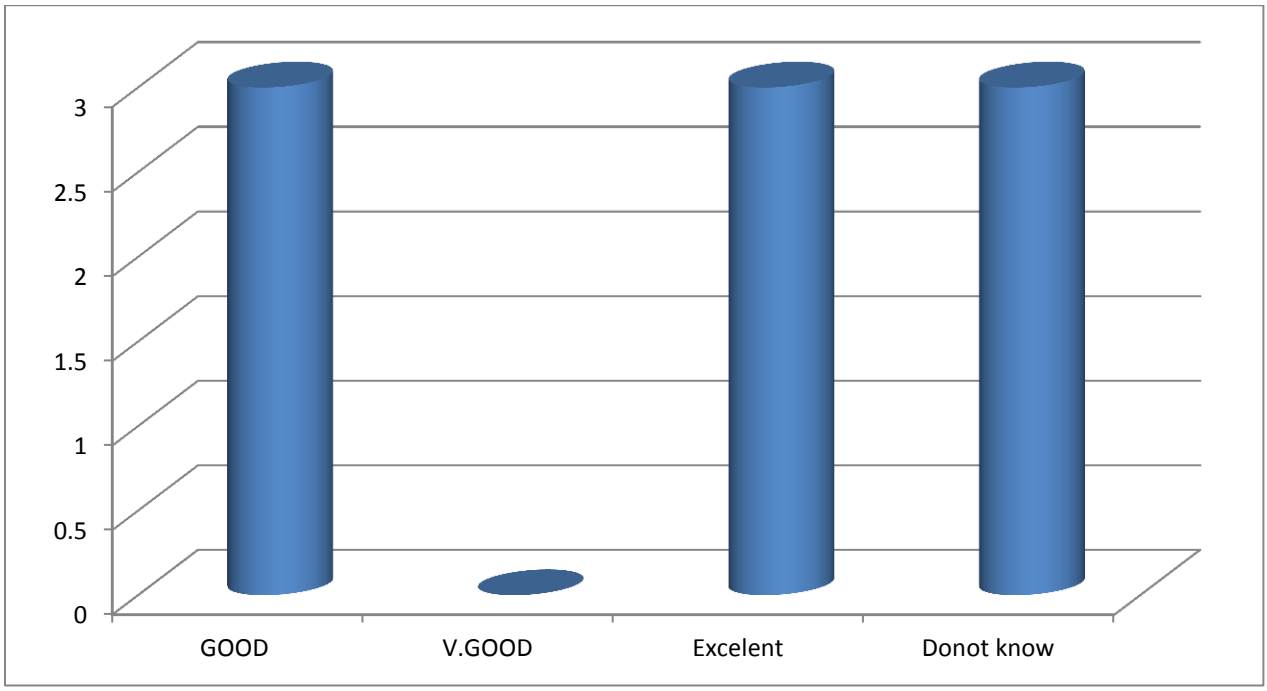
Valid	frequency	%
Yes	13	86.7
No	1	6.7
Some time	2	13.3
Total	15	100



Figure(4.29) Show frequency of technologists talking to patient during treatment

Table (4.30)Show frequency of manager known about MRI devise :

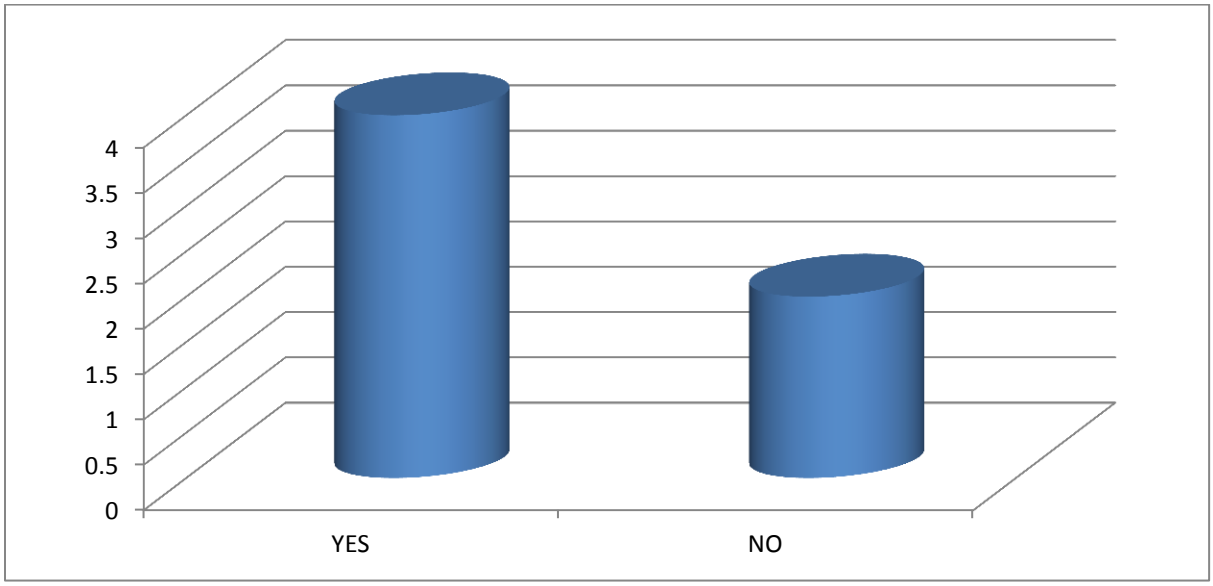
Valid	Frequency	%
Good	1	16.7
v.good	1	16.7
Excellent	1	16.7
Dont know	3	50.0
Total	**6**	**100.0**



Figure(4.30)Show frequency of manager known about MRI devise

Table (4.31)Show frequency of managerKnown safety procedure when entering and existing the room:

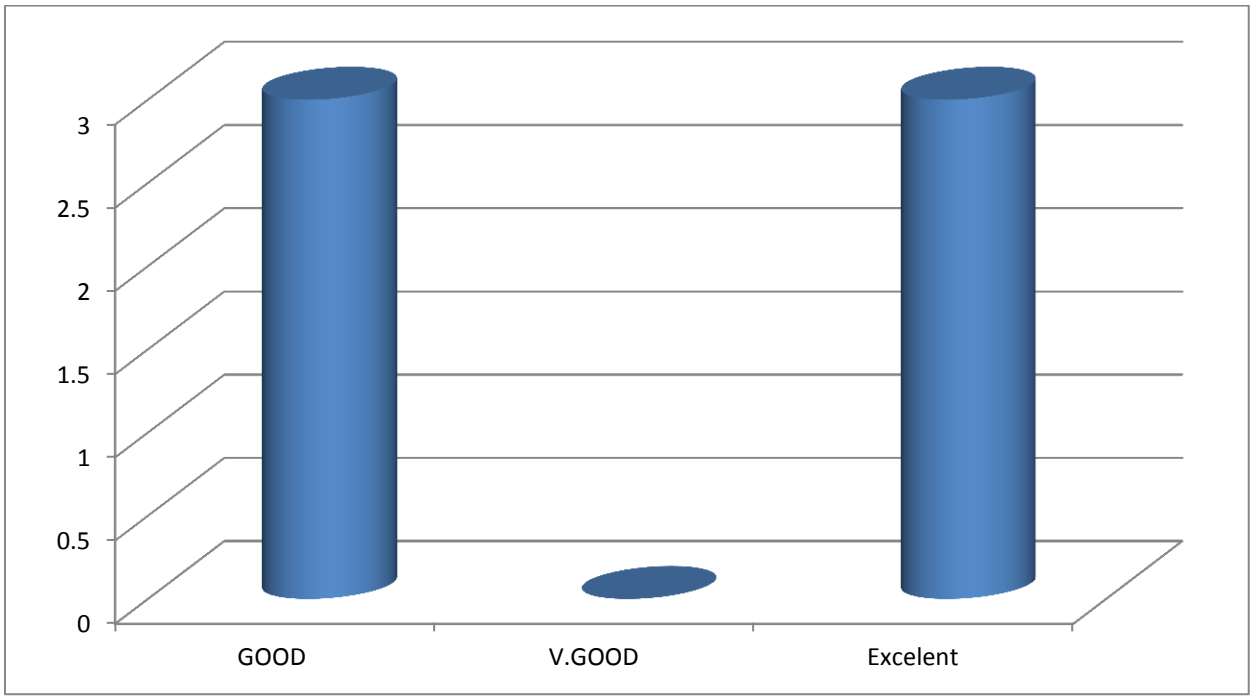
Valid	Frequency	%
Yes	4	66.7
NO	2	33.3
Total	6	100.0



Figure(4.31)Show frequency of manager Known safety procedure when entering and existing the room

Table (4.32) Show frequency of manager procedures applied when entering the room:

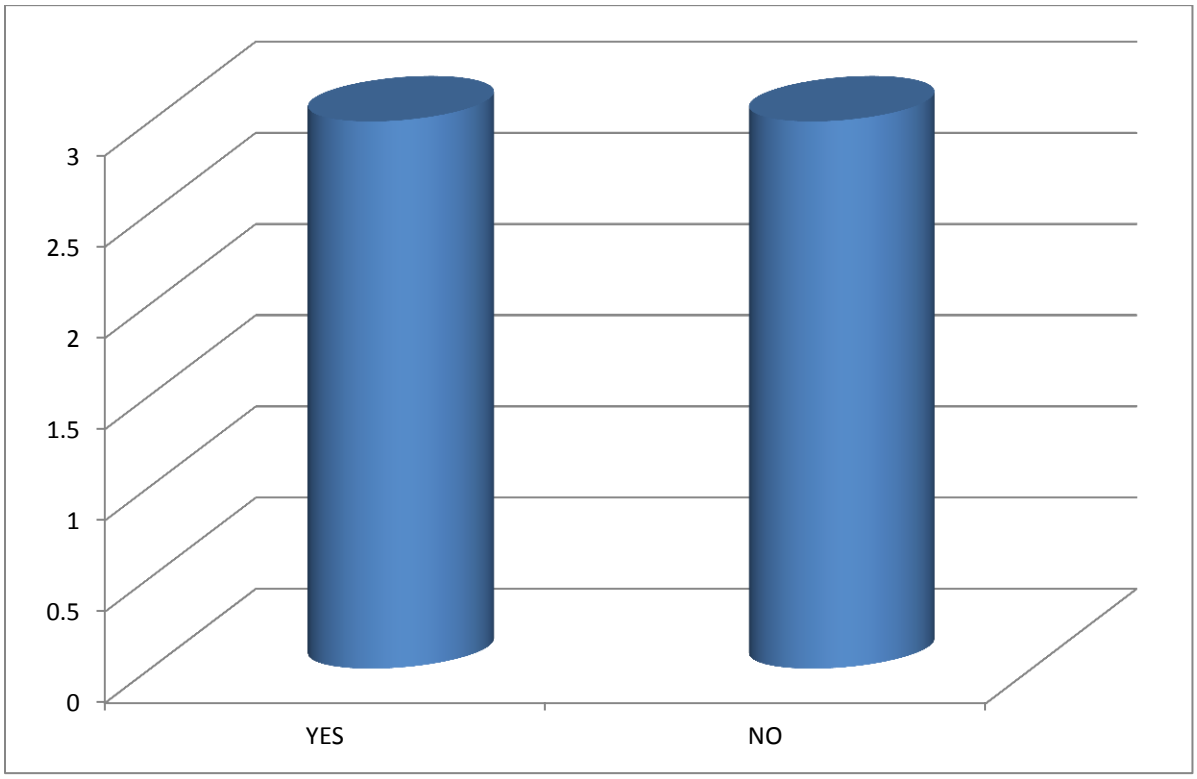
Valid	Frequency	%
Good	3	50
V.GOOD	0	0
Excellent	3	50
Total	6	100



Figure(4.32)Show frequency of manager procedures applied when entering the room.

Table (4.33)Show frequency of managers happened to them an accident during work :

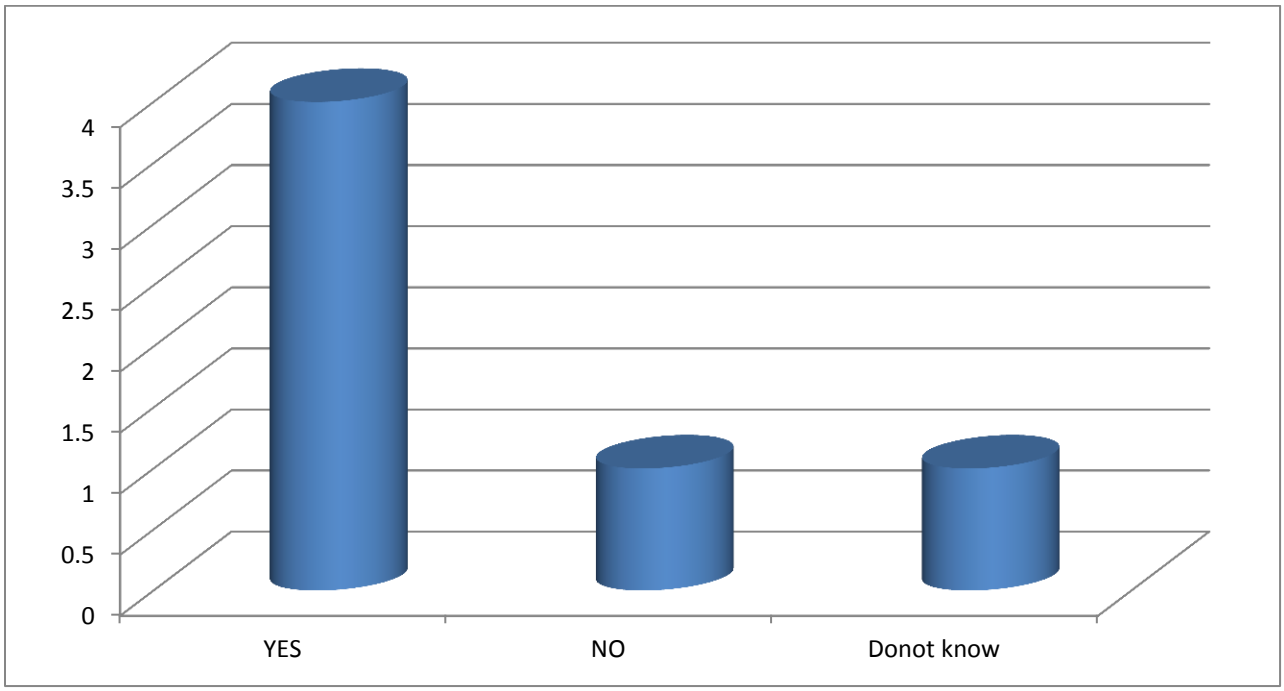
Valid	Frequency	%
yes	3	50
NO	3	50
Total	6	0.0



Figure(4.33)Show frequency of managers happenedto them an accident during work

Table (4.34)Show frequency of managers if madereports checking:

Valid	Frequency	%
Yes	4	66.7
No	1	16.7
Do not know	1	16.7
Total	6	100



Figure(4.34) Show frequency of managers if made reports checking.

Table (4.35)Show frequency of managers ifcalled from constitutional authorizing an accident cause patient disability:

Valid	Frequency	%
Yes	0	0
No	6	100
Total	6	100

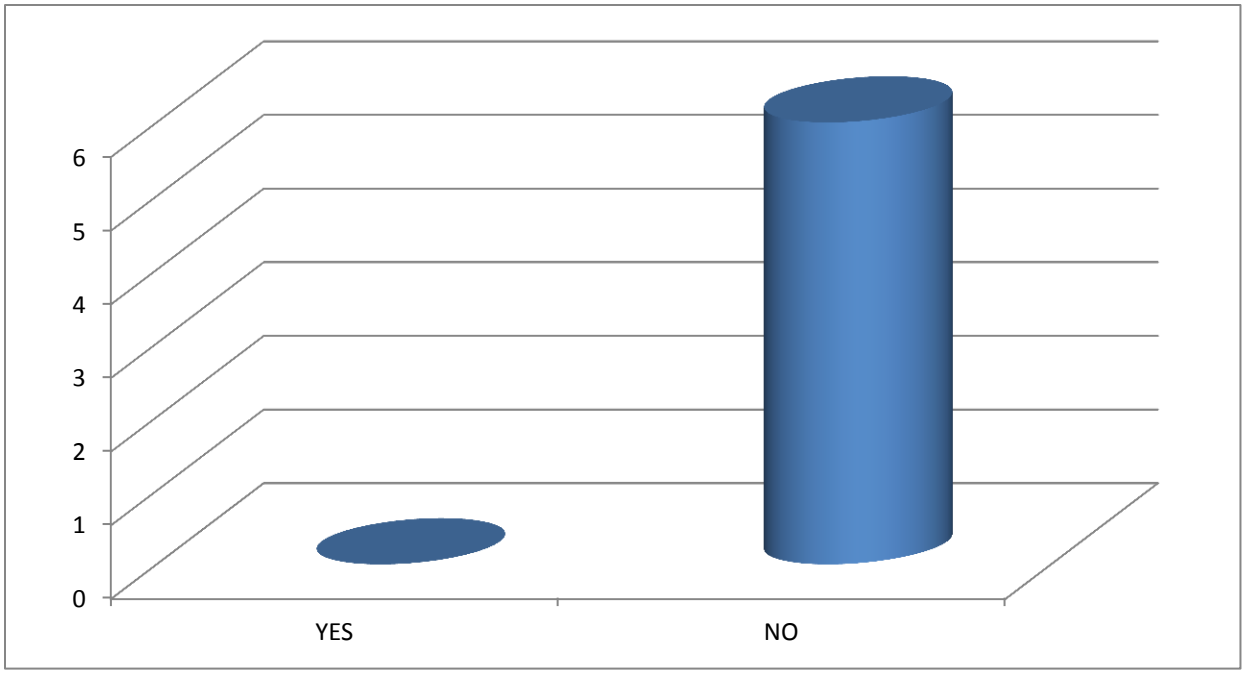


Figure (4.35) Show frequency of managers if called from constitutional authorizing an accident cause patient disability

CHAPTER FIVE

CHAPTER FIVE

Discussion,conclusion, recommendation

5.1 Discussion:

The study shows that the MRI is used in all age groups and both genders expressed in table and figures (4.1), (4.2).

9 patients (25%) didn't file the form so that there is some centers whom didn't care about the patient safety, expressed in table and figures (4.3).

30patients (75 %) the technologists didn't explain and make sure that the patient understand and fill the forma componentsby himself expressed in table and figures (4.4) , (4.5) .

24 persons (66.6%) didn't know any things about the MRI service expressed in table and figures (4.6).

If we take the difference in the power and design between the services in different centers we found that the all workers use the safety application expressed in tables and figures (4.7),(4.8),(4.9),(4.10),(4.11),(4.12), (4.15).

But most of them didn't know about the severity of lethal gas , 4 workers (80%) didn't know any things about it expressed in table and figures (4.13) , and 3 workers (60%) didn't know how to deal with leakage gas expressed in table and figure (4.14) and 4 workers (80%) didn't know about the attractive property after the device is powered off.

12 technologists (80%) apply the safety preparations on the patient by telling them about the device risks expressed in table and figure (4.17) , 14 of the technologists (93.3%) make sure that the patient filed the forma by himself expressed in table and figure (4.18) and 13 technologists (86.7%) review the forme after filling expressed in table and figure (4.19) but all of them 15 (100%) didn't examine patient things by manual magnet and they didn't investigate them by scanning expressed in table and figure (4.20) and (4.21) respectively .

4 of technologists (26.7%) think that all people are responsible abouy the accidents ,3 (20%) put it on the patient , 1 of them (6.7%) put it on the patient,1 of them (6.7%)doesn't know and house worker and 1 (6.7%) think no body responsible expressed in table and figure (4.22).

12 technologists (80%) close the patient eras expressed in table and figure (4.23) and 13 (86.7%) know how to deal with the gas leakage and using safety applications table and figure(4.24) and 9 of them (60%) see that there is deficiency in patient's coach in the centers expressed in table and figure (4.25) also 13 of them (86.7%) looks after the site of patient expressed in table and figure (4.26) and 12 technologists (80%) make checkup to patient prior treatment and all of them (100%) made awarded for new employees expressed in table and figure (4.27)and (4.28) respectively) and all 13 technologists(86.7%) took to the patient during imaging expressed in table and figure (4.29) .

3 managers (50%)didn't know any things about MRI device expressed in table and figure (4.30) and 4 of them (66.7%) known the safety procedure and all of them (100%) follow the safety procedures when interring the room expressed in tables and figures (4.31) and (4.32).

3 of managers (50%) had an accident during working expressed table and figure (4.33) ,4 of them(66.7%) investigate expressed in table and figure (4.34) and all of them (100%) didn’t called from constitution authorizing accident expressed in table and figure (4.35).

5.2 conclusions:

Magnetic resonance imaging is the safest imaging modality in a comparison with others, many centers in Khartoum state applied machines with (0.5T), so the effect of magnetic is very week.

All people on contact with magnetic rooms (House workers and technologist) know the kind of the force and how to deal with it except the patient whom needs a lot of awarded.

The accidents happened in Khartoum state centers of magnetic resonance imaging may see nothing in a comparison with other modalities of imaging , the accidents are rarely occur and they almost always related to carless .

All the magnetic resonance imaging in Khartoum centers are ideal go with the international safety parameter's, but the defect occur when the technologist interlude tow patient at the same time , one of them in the machine room and the other one in the changing room , they want to make treatment section go quickly because the patient's number listed on the treatment sheet is too large .

IN summary:

- In ALneelen center the accident happen when a house worker interring the room device with iron pail to clean up the device after patient was vomit on it .
- In Asia center the accident happen when patient lay on the couch while she was wearing under wear with the metal fastener .
- In Advanced Khartoum Diagnostic center the accident happen in Ied holydays when the electricity cut off from the center then the Quanch happen.

5.3 Recommendations:

Each center should had a form must be filled by the patient after full explanation about the machine and its risks for both patient and his co patient.

Patient must follow all recommendation and he should fill the form by himself and if he can't read by the co patient or technologist after full explanation to the form contact to the patient.

The technologist must explain all the risks of the machine very kindly with looking for the psychological state of the patient.

Give the House workers more knowledge about the machine specially the hilum gas and how to deal with any gas leakage.

The managers must be from the medical field to correct the problems immediately.

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6. Shellock And Kanal , Marrtinos Imaging Center At Govern Institute MRI Safety . com 2006.
7. Westbrook C , Kaut C , MRI In Practice , (1993) .
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9. http://www.blackwell publishing. Com (January 2002) .

بسم الله الرحمن الرحيم

التقني:-

1\ هل تقوم بإخطار المريض شفوياً عن اخطار الجهاز ؟

.....
.....

2\ هل يقوم المريض بملأ الاستمارة يدوياً ؟

.....
.....

3\ هل يتم التاكد من الاستمارة من قبل التقني بعد ملأها ؟

.....
.....

4\ هل تستخدم المغنطيس اليدوي لفحص الاغراض ؟

.....
.....

5\ هل يتم التاكد من المريض قبل دخوله الغرفة بواسطة ماسح كاشف ؟

.....
.....

6\ ماهي الاخطار الاكثر حدوثاً أثناء عملك ؟ وماهي ؟ومن المخطئ ؟

.....
.....
.....
.....

7\ هل تقومون بإغلاق أذني المريض أثناء العلاج؟

.....

.....

8\ ماهي الإجراءات المتبعة في حالة تسريب الغاز من الجهاز ؟وهل هو مطبق ؟

.....

.....

.....

.....

9\ هل طاولة المريض متوفرة في المركز؟

.....

.....

10\ هل يتم التأكد من عدم ملامسة أعضاء المريض للجهاز ؟

.....

.....

11\ هل تتم معاينة المريض من قبل التقني قبل الفحص؟

.....

.....

12\ هل يتم تنوير الموظفين الجدد بكيفية التعامل مع الجهاز ؟

.....

.....

13\ لماذا تم إختيارك في العمل ؟

.....

.....

14\ هل تقومون بالتحدث مع المريض أثناء الفحص؟

.....

.....

ب\ العاملين:-

1\ هل تم إخطارك او تنويرك بأخطار الجهاز قبل بدأك بالعمل ؟وهل التزمت بها ؟

.....

.....

2\ ماذا تعرف عن الجهاز؟كيفية النظافه؟

.....

.....

3\ما هي الاجراءات التي تقوم بها اذا استدعيت داخل الغرفه؟

.....

.....

4\ لماذا تم اختيارك لهذا العمل؟

.....

.....

5\ ماذا تعرف عن العلامات الموضوعه و ماذا تعني؟

.....

.....

6\ هل حدث لك اي حادث أثناء العمل؟و كيف تصرفت ؟

.....

.....

7\ هل تعلم انه هنالك غاز قاتل داخل الجهاز ؟

.....

.....

8\ ماذا تفعل اذا حدث تسريب للغاز ؟

.....

.....

.....

9\ هل تظن ان الجهاز يمكن ان يقتل بواسطة خاصية الجذب ؟

.....

.....

10\ عندما يكون الجهاز مغلق هل تظن ان خاصية قايمة ؟

.....

.....

الإداريين :-

1\ ماذا تعرف عن أخطار جهاز الرنين المغنطيسي ؟

.....
.....
.....

2\ هل تتبع إجراء السلامة في دخولك وخروجك للغرفة ؟

.....
.....

3\ ماهي الإجراءات في الدخول ؟

.....
.....

4\ هل توجد تقارير لاي حادث أثناء العمل؟وماهي وكيف عولجت ؟

.....
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.....
.....

5\ هل يتم التحقق من التقارير؟

.....
.....

6\ هل تم إستدعئك من جهة عدلية بخصوص حادث تسبب في إعاقة مريض ؟

.....
.....

-:المريض

العمر.....

الجنس.....

3\ هل تم ملئ الإستبيان المعد للفحص بالطريقة الصحيحة؟

.....

4\ من قبل من تم ملئ الإستبيان ؟

.....

5\ هل تم شرح الفحص لك من قبل التقني ؟

.....

6\ اذا أغلق الجهاز هل يتوقف المغنطيس؟

.....

Managers:

1. What do you know about the MRI devices ?
   ……
   ……
   ……
   ……

2. Are you follow safety procedure when entering and existing the room ?
   ……
   ……
   ……

3. What the procedures in the entering ?
   ……
   ……
   ……
   ……

4. Have any reportage for any accident during the work ?and which and how processed ?
   ……
   ……
   ……
   ……
   ……
   ……
   ……

5. Are you reports checking ?

   ……

   ……

   ……

6. Have you been called from constitutional authorizing an accident cause patient disability ?

   ……

   ……

   ……

Patient :

1. Age ……
2. Sex…….

3. Is questionnaire dedicated to check up prouder property?
   ……
   ……

4. Questionnaire have been filled by whom ?
   ……
   ……

5. Did it explained before by technician ?
   ……
   ……

6. If device turned off .does magnet stop working ?
   ……
   ……

House worker:

1. Are you informed or told by device's risks before you start ?and did you commit it ?

   ……
   ……

2. What did you know about device ?how cleaning up ?

   ……
   ……
   ……..

3. What is procedures you supposed to do if called inside room ?

   ……
   ……
   ……

4. Why have you been choose for this job ?

   ……
   ……
   ……..

5. What do you know about marks ?and what does it mean ?

   ……
   ……
   ……..

6. Is there any accident happened to you during the job ?and what do you do ?

……
……
……

7. Have you know that lethal gas inside the device ?

……
……

8. What do you do if occurthe gas is leakage ?

……
……
……

9. Do you think the device could the kill by attractive properties ?

……
……..

10. When the device is closed .do you think that the attractive property still on ?

……
……

MRI technologist:

1. Do you told the patient about the risk of device ?

   ……
   ……..

2. Do the patient fill the forma by him self ?

   ……
   ……

3. Are thetechnician check it ?

   ……
   ……

4. Are you used the manual magnet to check the patient things ?

   ……
   ……..

5. Are you scanning the patient before inter the room ?

   ……
   ……..

6. What is the most coming accident that happen during work ?how is responsible from it ?

   ……
   ……
   ……
   ……..

7. Are you close the ears of patient during the treatment ?

   ……

   ……..

8. What the procedures are following in leakage gas case from the device ?is it applied ?

   ……

   ……

   ……

   …….

9. Is the coach’s patient available in the center?

   ……

   …….

10. Can you make sure that the device will not touch the patient’sorgans?

    ……

    ……

11. Is it inspected the patient before check by technician?

    ……

    ……

12. Are the new employees awarded of how to deal with device?

……

……

13. Are you talking to the patient during the treatment ?

……

……

The Excel sheet of the patient answer

ID	AGE	SEX	Q3	Q4	Q5	Q6
1	75	2	3	6	4	3
2	24	2	3	7	4	4
3	30	2	5	5	4	4
4	16	2	3	6	4	8
5	46	2	3	6	4	4
6	45	2	3	6	4	3
7	57	2	3	6	4	8
8	50	2	3	7	4	8
9	29	2	5	5	4	4
10	34	2	3	7	4	3
11	50	2	3	6	4	4
12	18	2	3	6	4	8
13	65	2	5	5	4	8
14	39	2	3	6	4	3
15	22	2	3	7	4	8
16	15	1	3	6	4	8
17	53	1	5	5	4	3
18	20	1	3	6	4	4
19	55	1	3	7	4	8
20	11	1	3	6	4	3
21	48	1	3	7	4	8
22	18	1	3	6	4	3
23	36	1	5	5	3	4
24	65	1	3	7	3	3
25	67	1	3	6	4	8
26	75	1	3	6	3	8
27	53	1	3	7	4	3
28	30	1	5	5	4	4
29	65	1	3	6	3	8
30	45	1	3	6	4	8
31	54	1	5	5	4	8
32	42	1	5	5	4	3
33	65	1	3	6	4	3
34	36	1	5	7	4	8
35	30	1	3	7	3	8
36	50	1	3	5	3	3

The excel sheet of the house workers answers

ID	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
1	3	9	9	9	10	10	4	4	9	8
2	3	9	8	10	11	9	4	3	9	3
3	3	10	11	9	8	8	4	4	8	8
4	3	11	11	10	11	11	3	4	9	4
5	3	8	10	10	11	11	4	4	11	3

The Excel sheet of the technologists answers

ID	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13
1	3	3	3	4	4	16	3	8	3	3	3	3	3
2	4	3	3	4	4	16	3	3	3	3	3	3	3
3	3	3	3	4	4	16	3	3	3	3	4	3	3
4	3	3	3	3	4	8	4	4	4	3	3	3	3
5	3	3	3	4	4	13	12	3	3	3	3	3	3
6	4	3	3	4	4	13	3	3	3	4	3	3	12
7	4	3	3	4	4	14	3	3	4	3	3	3	3
8	3	3	4	4	4	15	3	3	4	4	3	3	3
9	3	4	4	4	4	15	3	3	4	3	3	3	12
10	3	3	3	4	4	16	3	3	4	3	3	3	3
11	3	3	3	4	4	15	3	3	3	3	3	3	4
12	3	3	3	4	4	15	3	3	3	3	3	3	3
13	3	3	3	4	4	13	3	3	3	3	4	3	3
14	3	3	3	4	4	16	3	3	3	3	3	3	3
15	3	3	3	4	4	16	4	3	4	3	4	3	3

The Excel sheet of the managers answers

ID	Q1	Q2	Q3	Q4	Q5	Q6
1	10	3	11	4	3	4
2	8	4	11	4	8	4
3	11	3	11	4	4	4
4	8	4	9	3	3	4
5	9	3	9	3	3	4
6	8	3	9	3	3	4

Codes Of Tables

answer	code
Male	1
Female	2
Yes	3
No	4
No answer	5
Another Body	6
I Am	7
Don’t Know	8
Good	9
V.Good	10
Excellent	11
Sometime	12
Patient	13
Patient +House worker	14
Patient + House worker +Technologists	15
Nobody	16