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Triple phase technique multi detector computed tomography in various diseases

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Abstract
Title: Triple phase technique multi detector row computed tomography in various diseases.
Background: The various diseases that afflict the liver, diseases caused by viruses, such as hepatitis- A, hepatitis -B, and hepatitis- C diseases caused by drugs, poisons, or too much alcohol example include fatty liver disease and cirrhosis, liver cancer. Inherited diseases such as hemochromatosis and Wilson disease. CT Triple phase exam is one of the most common techniques for all patients to find out various diseases.
Objectives: This study is aimed to see the triple phase multi detector computed tomography in various diseases. The study will helps the radiographer regarding the patient preparation and protocols are optimized for patient care and well standard. The aim is to see the haemangioma, Metastasis, tumour, carcinoma, hepatic vein & portal vein.
Methods: A retrospective cross- sectional study was conducted receiving 76 patient report and request that had CT triple phase scans period of 6 months from October 2019 to March 2020. The information was recorded on a self – designed data capture sheet. Data was analyzed using Microsoft excel 2007 and descriptors statistics.
Result: A total of 76 CT triple phase examination was reviewed consisting of males and females. Their age range is form 50-60 years. the table show the age distribution of patients. The most common and affected age groups in males are 81 and in female47 respectively and out of 76 patients examination reviewed department to patients for examination of CT liver.
Conclusion: Triple phase techniques MDCT in various diseases illustrates general principle that are given each user, however has specific needs preferences, and categories of patient pathology, and may be constrained by available hardware and software. Each imaging protocol should be right mix up speed, resolution and fix the time, given contrast, but because of specific user specific variables. It is a different to recommend a standard set of protocols and preparation of patients. A solution of that work effectively at our college will be establishment of a regular protocols meeting and discuss composed of radiology staff, including CT technologist and CT physicists modified a new protocol is review, discuss and implemented.

Keywords: MDCT, triple phase, liver, CECT

Introduction

The various diseases that afflict the liver, diseases caused by viruses, such as hepatitis- A, hepatitis -B, and hepatitis- C diseases caused by drugs, poisons, or too much alcohol example include fatty liver disease and cirrhosis, liver cancer [1]. Inherited diseases, such as hemochromatosis and Wilson disease. Our liver is an important organ that performs hundreds of task related to metabolism, energy storage, and detoxification of waste. It helps you digest food convert it to energy, and store the energy until you need it.it also helps filter toxic substances out of your bloodstream. CT offers the advantage of characterization and provides important preoperative information. Although current literature search shows that MRI has a comparable rate in detection and classification of focal liver mass. However rapid availability and short scanning time has made CT ideal imaging technique [2]. Multidetector row helical CT scanners have the ability to scan through the entire liver in 120 seconds or less and this allows acquisition of both an early and late arterial set of hepatic images.

General symptoms of liver are

- yellow skin and eyes known as icterus
- Dark urine
- Pale, bloody or black stool
- Nausea
- Vomiting
- Decreased loss of appetite
- Ongoing Fatigue.
- Itchy skin
- Easy bruising

Technique

- Our routine abdominal CT protocol consists of an axial plain survey of liver.
- Spiral CT scan of the abdomen & pelvis after given oral & intravenous administration of contrast agent.
- The early arterial phase of scanning began 15-20 sec immediately after the start of bolus technique
- Late arterial phase 35-40 sec or 20 sec after bolus tracking enhancement of hyper vascular lesions stomach, bowel, pancreas parenchyma & spleen
- Hepatic phase 70-80 sec after bolus-tracking enhancement of hepatic parenchyma detection of hypo vascular liver lesions: cysts, abscess, most metastases
- Delayed phase 6 minutes after bolus -tracking enhancement of liver cholangiocarcinoma fibrotic metastases.

- Pitch usually (1.0-1.6) sufficient to cover the entire liver within the breath -hold period [3].
- Images were reconstruction at 3 mm intervals through the lesions with use of standard soft-tissue (window width 400 Hu level,40 Hu) and liver (window width,150 Hu level 50-80hu) display settings.

The advances in helical computed tomography with great anatomic coverage, more rapid scanning times have revolutionized hepatic imaging. The entire liver can evaluated in a single breath holding without respiratory

Abdomen multi-phase

Combination of 3 phase study including liver, pancreas, and kidney for CT scanner ingenuity family 128 slices Philips healthcare a range of 40 cm including liver, pancreas and kidney in arterial phase will be covered in 10 cm

Intravenous contrast media

Firstly, the administration of intravenous (IV) contrast media allows for effective evaluation of the arteries and veins. The administered contrast medium is transferred to the cardiac though a vein in arm or leg and is then pumped around through arteries and veins. Additionally, enhancements (blood supply, perfusion) of the abdominal organs can be evaluated. At fixed time intervals after administration the contrast agent, mixing with the blood, will arrive at various sites in the body, which can then be scanned scan phases include the arterial, portal, venous, nephrogenic and excretion phases [4].

CT without contrast

This scan is made without the administration of IV contrast agent. a primary indication for abdominal scans without contrast media is the detection of liver problem, condition of internal structure organ of the body like spleen, pancreas, aorta, stomach.

Arterial phase

This scan is made about 20-30 seconds after the administration of IV contrast agent. The contrast agent is still in the arteries and some internal organ structure is starting to absorb the agent. This scan phase is particularly suited for evaluating arteries and detecting hyper vascular abnormalities, e.g. Hyper vascular metastases in the liver (this will be discussed in more detail in the liver masses section) [5].

Portal venous phase

In the portal venous phase hypo vascular tumors are detected, when the normal liver parenchyma enhances maximally. These hypo vascular tumors will be visible as hypo dense lesions in a comparatively hyper dense liver. This scan takes 60 -90 sec [6].

Equilibrium phase

in the equilibrium phase at about 10 minutes after giving contrast injection, tumors become visible, that either lose their contrast slower than normal liver, or washout their contrast faster than normal liver parenchyma. These masses will become either relatively hyper dense or hypo dense to the normal liver.

Delayed phase

6–10 minutes p. i or 6 -10 minutes after bolus tracking. sometimes called “wash out phase” or equilibrium phase “there is wash out of contrast in all abdominal structures except for fibrotic tissue because fibrotic tissue has a poor late wash out and will become relatively dense compared to normal tissue. This is comparable to late enhancement of infarcted scar tissue in cardiac MRI.

- Detection of a lesion depends on difference in attenuation between liver and lesion.
- Left arterial phase showing hyper vascular FNH
- Middle:-portal venous phase showing hypo-vascular metastasis
- Right:-equilibrium phase showing cholangiocarcinoma[7]

Different types of liver diseases

- Fibrolamellar carcinoma
- Hepatocellular adenoma (hepatic adenoma)
- Cavernous liver hemangioma
- Metastasis
- Cirrhosis
- Abscess
- Fatty liver

Fibrolamellar Carcinoma

Fibrolamellar carcinoma is a rare form of cancer that affects the liver. Unlike most cancers of the liver, it occurs with greater frequency in adolescents and young adults who are otherwise healthy. There are often no symptoms or signs of the disorder for a long time. Systems that can develop include abdominal pain, unintended weight loss and a general feeling of poor health. (Malaise) treatment is usually through surgical removal (resection) of the tumor. When surgery is not possible or unsuccessful, then other therapies may be considered. Recurrence following successful surgical removal of tumor can occur meaning that sometimes the tumor can come back after it was removed the exact underlying causes of this disorder is unknown

Causes of fibrolamellar carcinoma

HCC is often associated with chronic inflammation of the liver; either by alcohol abuse or infection by hepatitis b and c on the other hand, fibrolamellar often occurs in the absence of alcohol or hepatitis infection with hardly any sign of an inflammatory reaction in the liver [8].

Hepatic Adenoma

Hepatic adenoma is an uncommon, benign liver tumor. Benign means that it was not cancerous.it also known as hepatocellular adenoma or liver cell adenoma. Hepatic adenoma is extremely rare; it most often linked to the use of birth control pills.

Cavernous hemangiomas are the most common benign liver tumors, and the liver is the internal organ most affected by hemangioma [1, 2]. Many patients are asymptomatic, but in others, asymptomatic may vary from abdominal discomfort to life-threatening complications [1]. women are often affected by hepatic hemangioma [3] and some studies have found that women exposed to exogenous estrogens, progesterone, contraceptives, or hormone replacement therapy show a significant increase in the size of their tumors.

Metastasis

Metastasis means that cancer spreads to a different body part from where it started. when this happens, doctors say the cancer has " metastasized" our doctors may also call it " metastatic cancer," advanced cancer," or stage 4 cancer." for example a cancer that is large but has not spread to another body part can also be called advanced cancer or locally advanced cancer or locally advanced cancer. Ask it doctor to tell where the cancer has spread

Causes of Metastasis

Bone metastasis occurs when cancer cells break away from the original tumor spread to the bones, where they begin to multiply. Doctors are not sure what causes some cancers to spread and it is not clear why some cancer travel to the bones rather than to other common sites for metastasis, such as the liver [9].

Cirrhosis

Cirrhosis is a late stage of scarring (fibrosis) of the liver caused by many forms of liver diseases and conditions, such as hepatitis and chronic alcoholism. Each time your liver is injured-weather by diseases, excessive alcohol consumption or another diseases – it tries to repair itself, in the process, scar tissue forms, making it difficult for the liver to function advanced cirrhosis is life – threatening.

Causes of cirrhosis

A wide range of diseases and conditions can damage the liver and lead to cirrhosis

- Chronic alcohol abuse
- Chronic viral hepatitis
- Fat accumulating in the liver
- Iron buildup in the body
- Cystic fibrosis
- Copper accumulated in the liver
- Liver diseases caused by your immune system
- Destruction of bile – ducts

Abscess

A liver is mass filled with pus inside the liver. Common causes are abdominal conditions causes are abdominal conditions such as appendicitis or diverticulitis due to haematogenous spread through the portal vein. it can also develop as a complications of a liver injury

Causes of liver Abscess

There are many possible causes of liver abscess including

- Abdominal infection such as appendicitis, diverticulitis, or a perforated bowel.
- Infection in the blood
- Infection of the bile draining tubes.[10]

Fatty liver and causes

Fatty liver is also known as hepatic steatosis. it happens when fat builds up in the liver. Having small amounts of fat in your liver is normal but too much can become a health problem our liver is the second organ in our body. It can help processing of nutrients from food and drinks and filters harmful substances from your blood. Too much fat in your liver can causes liver inflammation, which can damage your liver and create scarring in severe cases, these scarring can lead to liver failure.

Causes of fatty liver

Fatty liver develops when your body produces too much fat or does not metabolize fat efficiently enough. The excess fat is stored in liver cells, where it accumulates and causes fatty liver diseases. For example drinking too much alcohol can cause alcoholic fatty liver disease.

Table 1

fig 1	anatomy of the liver right lobe and different anatomical structure
fig 2	different liver diseases they are liver abscess, metastases, cirrhosis, alcoholic
Fig 3	(a) Unenhanced phase, (b) arterial phase (c) portal phase (d) delayed phase.

Anatomical Description

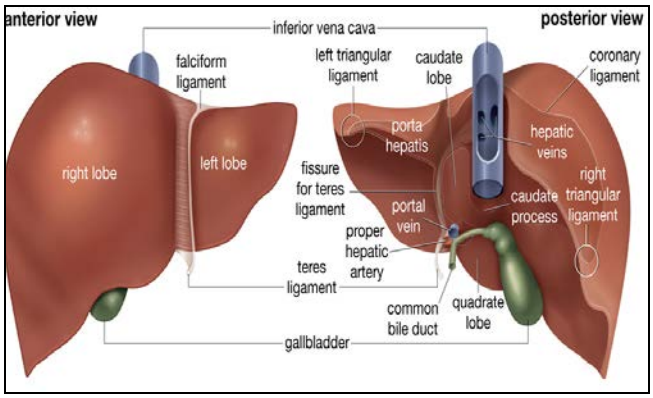

Fig 1

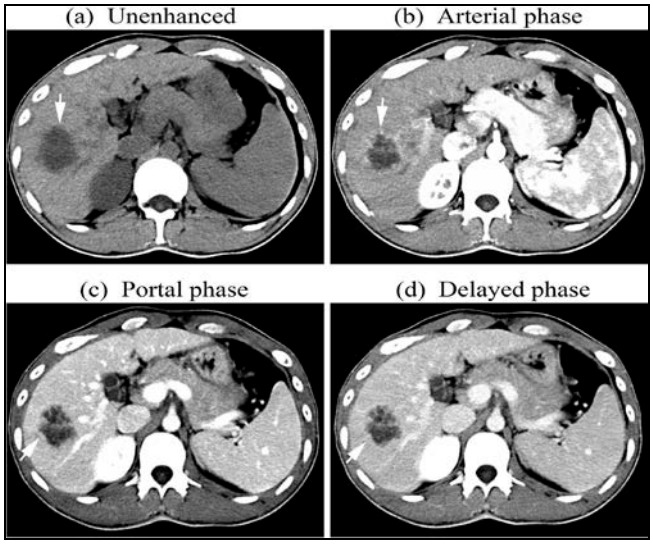

Fig 2: Shown above in the (a) unenhanced phase, (b) arterial phase (c) portal phase (d) delayed phase.

Advantage of CT Scan

- A major advantage of CT is its ability to image bone,
- Soft tissue and blood vessels all at the same time.
- High sensitivity for hemorrhage in the acute phase.
- Rapid acquisition of images CT angiogram can be performed quickly in the same setting to exclude a large artery occlusion or intracranial aneurysm.
- Quick and painless
- Costs less than MRI.
- Good visualization of bony structure and calcified lesions.

- Shows up acute bleed.

Disadvantage of CT Scan

- No target specific imaging.
- Poor soft tissue contrast.
- Involves exposure to ionizing radiation.
- Beam hardening artefact.
- Injection of contrast medium can cause kidney problems or result in allergic or injection site reactions in some people.

AIM and Objective of Study

Aim: This study is aimed to see the triple phase multi detector computed tomography in various diseases.

Objectives of Study

- The aim is to see the haemangioma, Metastasis, tumour, carcinoma, hepatic vein & portal vein.
- The purpose of our study will be to optimize scan delays using bolus-tracking techniques for triple-phase CT of the liver.
- Using the bolus-tracking method, scan delays need to be optimized for portal venous and hepatic venous phases.
- A scan delay of 8 s, after trigger threshold (100 HU) is reached in the lower thoracic aorta, is optimal for the early arterial phase imaging. This phase is most helpful for assessment of hepatic arterial tree (CT angiography).
- The liver parenchyma showed a maximum enhancement at 48 s scan delay.
- This phase is optimal for assessment of hypo vascularized lesions like metastases from primary in the lung or colon

Methods: CT Scanning IN 3 Abdomen Phase Various Diseases

Ct examinations conducted on 1 of 3 scanners in Philips 128 slices CT machine

Table 2

Phase: -	First cycle	Second cycle
Late arterial phase: -	3 ml /s injection rate	5 ml /s injection rate
	EARLY arterial phase	late arterial phase
	(10s post bolus triggering)	(20s post bolus triggering)
Portal venous phase: - (1.7 ml/kg isovue370, max 150 ml)	Fixed IV contrast dose	weight based IV contrast dose
	(100 ml isovue 370)	
	75s total decay	
Delayed phase: -	3 min delay	3 min delay

Fig 3: In the image shown above is liver hepatic abscess.

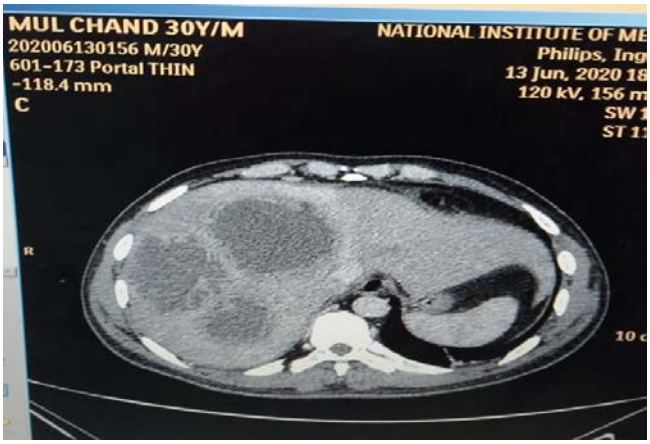

Fig 4: In the image shown above in liver metastatic in the portal thin image

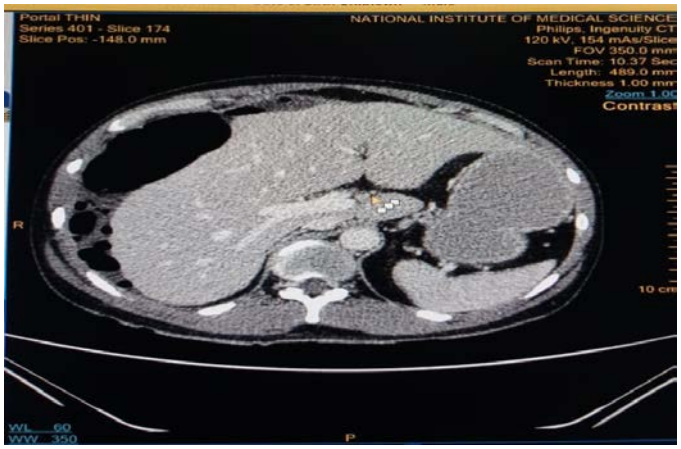

Fig 5: The image shown above the portal vein enhancement

Data Analysis and Presentation

Results

The sample studied consisted of 76 in male and female. Regarding age, 64.5% were 20–29 years old, 20.0% were 30-39 years old, 11.8% were 40-49 years old. The sample studied consisted of 72 women of the age range of 19-45 were referred for pelvis study to the department of Radio-diagnosis with a clinical suspicion of HCC, Metastatic diseases, Obstruction of hepatic and portal vein during the study period. Seventy – six (76) patients were in 3phases (triple phase) In CT study, majority of the patients that fall within the age group with the highest patients i.e. 25-30 years. Regarding the types of study, normal cases are 28% and abnormal cases are 72%.

In CT study the majority of the patients that fall within the age group with highest patient i.e 19-24 years. The total number of normal cases are 76 which is 76% and the total number of abnormal cases are 91 which is 91%

Observation and Results

Table 3: Age wise Distribution of Total Triple Phase Patients

Age Group	No. of Cases	% of Cases
0-10	2	1.9%
10-20	6	5.7%
20-30	16	15.2%
30-40	20	19.0%
40-50	22	20.9%
50-60	16	15.2%
60-70	13	12.3%
70-80	8	7.6%
80-90	2	1.9%
Total	105	

Table 4: Distribution of CT Cases Abnormal and Normal

Study	No. of Patients	Percentage
NORMAL	9	9%
ABNORMAL	91	91%
Total	100	

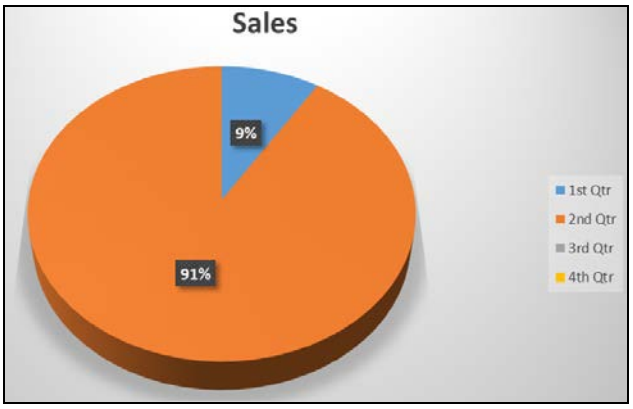

Fig 6

Table 5: Sex distribution of patients in male and female

Gender	No of cases	% of cases
Male	81	63.2%
Female	47	36.7%
Total	128	

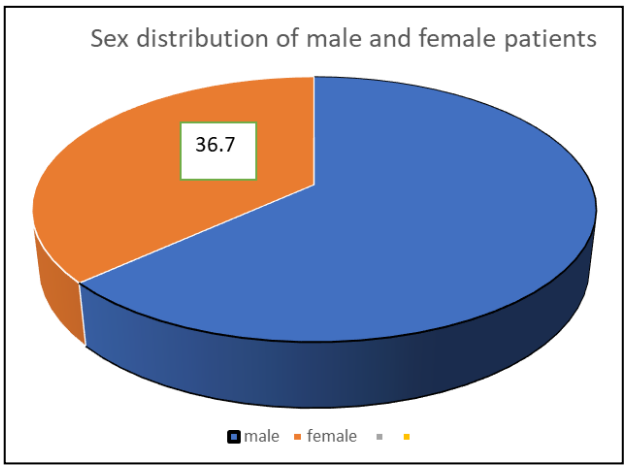

Fig 7

Discussion

The study was carried at radiology department of NIMS hospital, Shobha Nagar, Jaipur, and Rajasthan from October 2019 to March 2020. The study includes "triple phase techniques MDCT in various diseases**"**.

This study consists of 76 patient's male & female which are scanned in different imaging modalities. In triple phase study, majority of the patients that fall within the age group with the highest patients i.e. 25-30 years. Regarding the types of study, normal cases are 9% and abnormal cases are 91%. The common abnormality that I observed in my study is metastatic (75%). Number of failure study is only one.

In CT study the majority of the patients that fall within the age group with highest patient i.e. 19-24 years. The total number of normal cases are 9.91% and the total number of abnormal cases are 91 i.e. 61%. The common cause of various diseases that is observed in my study period includes metastatic, HCC, abscess, cirrhosis, and cortical cyst.

Metastatic =76%

Hepatocellular carcinoma = 20%

Cirrhosis =10%

Abscess =12%

Conclusion

Triple phase CT with great accuracy is highly helpful in confident diagnosis of hepatic masses, has an indispensable role in management of both benign and malignant hepatic lesions and also helped in reaching primary malignancy diagnosis in cases of multiple liver metastases from unknown primary.

It evaluates the hepatic tumor in the three different phases which in better understanding of the vascular property of the tumor which helps in diagnosis as well as management protocol.

Summary

Liver is prone to various diseases including benign and malignant because of its major function of digestion, detoxification and rich blood supply by hepatic artery and portal vein. Objectives of the study were to study the characteristic features of various hepatic lesions using triple phase CT as diagnostic modality, differentiating benign hepatic lesions from malignant and correlating findings of triple phase CT with clinical, histopathology or post-operative findings of calculation of its efficacy.

Scope of Study

This study will be carried out for a period of six months from October 2019 to March 2020, and will be conducted at the Department of Radio-diagnosis NIMS Hospital, Jaipur.

References

1. Zafar W, Zulfiqar Z, Din N, Murad S, Iqbal B. Biphasic & triphasic computed tomography (CT) scan in focal tumoral liver lesions. RadMed Imaging. 2018; 3:1012.
2. Kamlesh Gupta, Neelam Gauba, Garima Gupta. 'Role of computed tomography in evaluation of parenchymal focal lesions of liver''.journal of evolution of medical and dental sciences. 2015; 4(36):6257-6268. DOI: 10.14260 /jemds/2015/910.
3. Lee KH, O'Malley ME, Haider MA, Hanbidge A. Triple-phase MDCT of hepatocellular carcinoma. AJR Am J Roentgenol. 2004; 182(3):643-9.

4. Hussain SM, Semelka RC. Hepatic imaging: comparison of modalities. Radiol Clin North Am. 2005; 43(5):929-47.
5. Hollett MD, Jeffrey RB, Nino-Murcia M *et al*. Dual-phase helical CT of the liver: value of arterial phase scans in the detection of small (< or = 1.5 cm) malignant hepatic neoplasms. Am J Roentgenol. 1995; 164(4):879-84.
6. Miller FH, Butler RS, Hoff FL, *et al*. Using triphasic helical CT to detect focal hepatic lesions in patients with neoplasms. Am J Roentgenol. 1998; 171(3):643-9.
7. Boll DT, Merkle EM. Liver: normal anatomy. Imaging techniques and diffuse diseases. In: Haaga CT. edr. MRI of whole body. 5th edn. Mosby, 2009, 166.
8. Dodd GD. An American's guide to Couinaud's numbering system. Am J Roentgenol. 1993; 161(3):574 5.
9. Sengodan BS, Aiyappan SK, Karpagam B. role of triple phase mdct in the characterisation of liver lesions. J. Evolution Med. Dent. Sci. 2017; 6(24):2003-2008. DOI: 10.14260/Jemds/2017/438
10. Shani J, Jacob V, Retna kumari VL *et al*. Predictive value of ultrasonography & computed tomography in cirrhotic patients of all aetiologies to evaluate focal lesions in liver& outcome. J. Evolution Med. Dent. Sci. 2019; 8(28):22742278. DOI:10.14260/jemds/2019/498.
11. Kish L. Survey Sampling. New York: Wiley, 1965.
12. Preethi Ganesan, Abubacker Sulaiman F, Soorya Prakash EA. Parthasarathy, Rajamani Anand, Ramya Kalaiarasan. Role of CT and MRI in Spinal Trauma. International Journal of Contemporary Medicine Surgery and Radiology. 2018; 3(2):B11-B14.