Ultrasound guided percutaneous injection of alcohol as scolicidal agent for treatment of liver Hydatid cysts – Our experience in a tertiary level hospital

A dissertation submitted in partial fulfilment of MD Radiodiagnosis (Branch VIII) examination of the Tamil Nadu Dr. M.G.R Medical University, Chennai to be held in April 2014.

CERTIFICATE

This is to certify that the dissertation entitled "Ultrasound guided percutaneous injection of alcohol as scolicidal for treatment of liver Hydatid cysts – Our experience in a tertiary level hospital" is the bonafide original work of

Dr. John Samuel V. submitted in partial fulfilment of the requirement for

MD Radiodiagnosis (Branch VIII) Degree Examination of the

Tamil Nadu Dr. M.G.R Medical University, Chennai to be held in April 2014.

GUIDE:

Dr. Shyamkumar N K,

Professor,

Department of Radiology,

Christian Medical College,

Vellore 632004

CERTIFICATE

This is to certify that the dissertation entitled "Ultrasound guided percutaneous injection of alcohol as scolicidal for treatment of liver Hydatid cysts – Our experience in a tertiary level hospital" is the bonafide original work of Dr. John Samuel V. submitted in partial fulfilment of the requirement for MD Radiodiagnosis (Branch VIII) Degree Examination of the Tamil Nadu Dr. M.G.R Medical University, Chennai to be held in April 2014.

Head of the Department

Dr. Shyamkumar N K,

Professor,

Department of Radiology,

Christian Medical College,

Vellore 632004

ACKNOWLEDGEMENTS

This study could be carried out only due to the untiring efforts and hard work of many individuals. I wish to place in record my sincere appreciation and immense gratitude to them.

To my guide, Dr. Shyamkumar for his continued support and guidance in performing this study.

Dr. Vinu Moses, who as my co-guide helped me all through and made this study possible.

Dr. Sitaram, Dr. Philip Joseph, Dr. Dhiraj Sonbare and the entire Department of Hepatobiliary Surgery for their immense help throughout the study.

Dr. Thambu David and his team for the helpful workshop on thesis.

I would also like to thank the Radiographers, Nursing staff and the Parasitology lab staff for being so accommodating and rendering help as required.

I thank the Christian Medical College, Vellore and all my teachers, for making this study and this course a reality.

I am grateful most importantly to all the patients without whom this study would not have been possible.

My family, friends and colleagues for their love, constant support and encouragement.

Above all I thank God for His abundant grace.

CONTENTS

INTRODUCTION

Hydatid disease or Echinococcal disease of the liver is a zoonosis type of disease. The causative organism is a parasite, larval cestode Echinococcus granulosus. It is endemic in many countries where sheep rearing is a common occupation including Africa, Asia, parts of Europe, parts of the Americas and also in New Zealand and Australia. Dogs remain to be the definitive hosts for the cestode organism and sheep being the main intermediate host. Other animals like goats, yak and camel also can be infected. Incidental transmission happens to human beings. When infection occurs in human beings, the liver being the first filter to the disease, remains to be the commonest organ affected and the cystic lesions are mostly seen in the liver. The other organs can also be involved and the lung is the second most common organ to be involved in the disease. Other viscera can also be involved by the disease.(1)

The treatment of Hydatid disease of the liver has changed course over the years. The usual management of the Hydatid disease of the liver involves open surgical treatment. The techniques could involve various different methods from conservative to radical surgical operations. The method of percutaneous aspiration was thought to be at a higher risk for a long time thinking was this would cause leakage of the contents and may lead to anaphylactic reactions or even cause peritoneal spill leading to seeding in the peritoneal cavity. Hence it was not favoured by clinicians for a long while.

The invention of effective anti-Echinococcal medical therapy with Albendazole / Mebendazole has changed the thought and has helped establishing the percutaneous therapy more favourable as it can be used in adjunction with the drugs for better treatment. Adequate therapy with these drugs prior to and continued after the procedure can give excellent results. Using the percutaneous aspiration injection and reaspiration [PAIR] technique has been extensively studied and used and there are many studies revealing its advantages over the surgical treatment. The percutaneous aspiration injection and reaspiration technique is much less invasive, less morbid procedure compared to the surgical method. There is no need for general anaesthesia which in itself has its own risks. The procedure can be performed under local anaesthesia with mild sedation prior to the procedure. The procedure time is much lesser and also the hospital stay is reduced significantly as compared to the open surgical technique. More than these advantages, the cost of the procedure is significantly lesser as well. The procedure could only be performed by professionals specially trained in image guided procedures [either ultrasound or computed tomography guided]. Non availability of equipment and expertise may act as some limiting factors to execute the performance of this procedure. Although the percutaneous aspiration injection and reaspiration technique has been advocated by various centres, it is still not widely accepted.

This study was done here to establish this therapeutic method as a standard treatment protocol for liver Hydatid disease and also to know the difficulties that one could encounter during the procedure and the immediate post procedure complications that can happen and how to manage them in a tertiary care hospital. This study will also try to study the efficacy of absolute alcohol as an effective alternative scolicidal agent against the traditional hypertonic saline [typically 20 % hypertonic saline] that has been used as the scolicidal agent by many who have studied the percutaneous aspiration injection and reaspiration technique. Most

Hydatid cysts in the liver can be accessed under ultrasound guidance however some might need computed tomography guidance in case there is any difficulty in accessing the cyst by ultrasound guidance.

AIM

To assess the efficiency of the percutaneous sclerotherapy as an effective method of non – surgical management of liver Hydatid cysts using sterile absolute alcohol as the injected scolicidal agent.

OBJECTIVES

1. To describe the patient selection, indications, contraindications and technical aspects and the procedure of percutaneous sclerotherapy in the non - surgical management of liver Hydatid disease with details of equipments and devices used in this study.

2. To describe the intraprocedural and post procedural complications of the percutaneous aspiration injection and reaspiration procedure that one could expect with a brief account of how those were handled during the course of this study.

3. To identify the clinical and radiological parameters like improvement in the patient's symptoms and imaging appearances that would help in assessing the post procedure response to treatment and document these parameters.

4. To assess the efficacy of absolute alcohol as an effective scolicidal agent.

REVIEW OF LITERATURE

Echinococcus granulosus – a brief account of the disease.

Human echinococcosis, being a zoonosis is transmitted by dogs that live near the sheep and cattle rearing areas. It is caused by a tapeworm. The larval forms are also called the metacestodes of the tapeworm Echinococcus and is seen in the small bowel of carnivorous animals. Accidental ingestion of the eggs of the parasite by humans leads to infection. In humans, this parasite Echinococcus granulosus causes the cystic form of the disease. This is a parasitic disease and is typically observed as the typical slow growing cysts which are most commonly seen in the liver (nearly 50-70% of cases), the second most common organ being the lungs (nearly 20-30% of cases). Other viscera like the spleen, kidneys, central nervous system other organs also do occur less frequently.(2). Countries where cattle and sheep rearing are practiced more are at a higher risk for acquiring echinococcosis.

Scenario in the world:

Echinococcus granulosus has a worldwide distribution and it also spans across all kinds of climate zones including the tropical, temperate and even the regions near the geographic north and south poles. Among the endemic countries, high endemicity has been reported to be in parts of South America, Australia, Eurasia and Africa. Only a few countries have actually been declared as being Echinococcus – free countries.

The following map would give us an idea of the distribution of the parasitic infection.

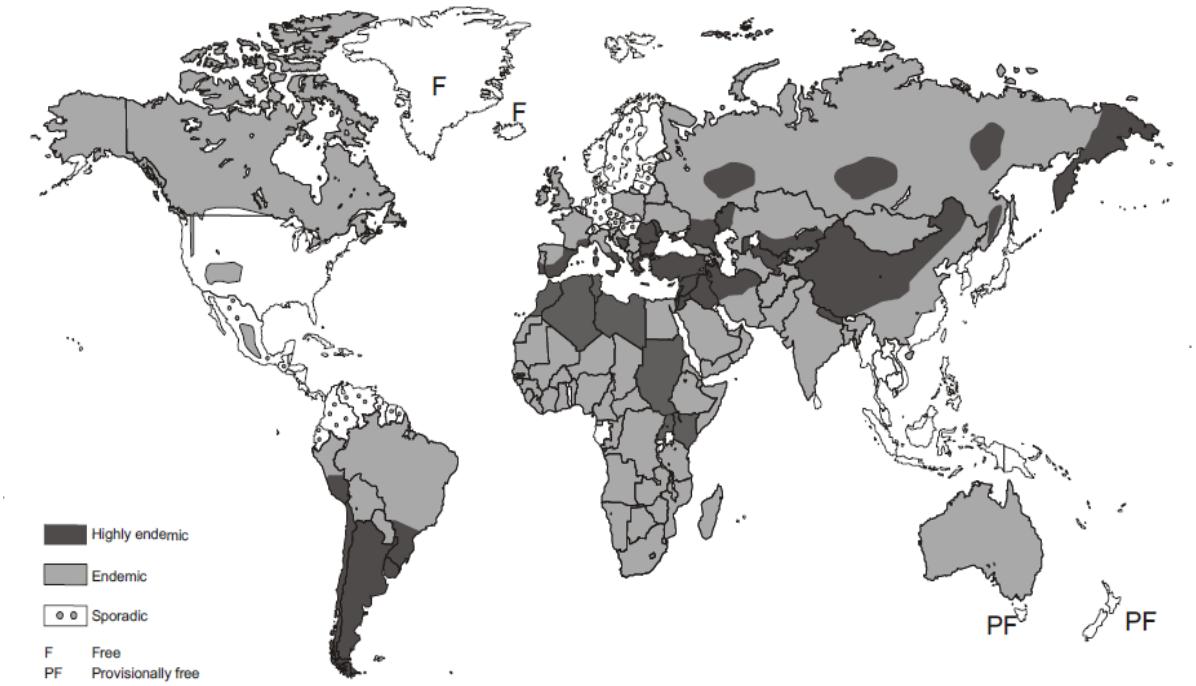


Fig 1: Map showing the endemic areas in the world for Echinococcosis

Scenario in India:

India also has areas where human echinococcosis occurs and Andhra Pradesh and Tamil Nadu are shown to be the highest prevalence states in the country than other states (3).

Actual details about the disease's prevalence in animals is not correctly known however a study done in New Delhi revealed that an approximate of 10% of the slaughtered sheep in New Delhi had been infected by the larval forms of Echinococcus (3). Another similar infection caused by the less common fox tapeworm Echinococcus multilocularis is noticed much at a much lesser prevalence than the Echinococcus granulosus.

Etiopathogenesis and life cycle of the parasite:

As mentioned earlier, the mature tapeworm resides in the proximal small intestine of the pet dogs, which remains to be one of the common definitive hosts to Echinococcus granulosus. There are many other definitive hosts such as pet cats, jackals, wolves etc. A number of animals that are commonly reared are shown to be the intermediate hosts to the infection. These include cattle, sheep and pigs. These animals and humans contain the larval stage of the parasite and become the intermediate hosts. They route of transmission is the faeco-oral route, by accidental ingestion of *Echinococcus* eggs that are deposited in the environment from the excreta of infected animals like dogs. These accidentally ingested parasite eggs hatch within the intestinal mucosa of the intermediate host like humans and emerge into oncospheres that penetrate the intestinal wall and enter into the portal venous system blood, which then are carried directly to the liver which acts as the first stop for the organism. The developing embryos there become encysted and they have been observed to grow at a shown rate of approximately 1 cm/year.

The resultant lesion, the hydatid cyst in the liver typically is characterized by the presence of three layers which consist of the ‘pericyst’ which is nothing but a fibrous layer arising from inflammatory response by the host tissue origin, the middle layer or the ‘ectocyst’ which is secreted by the organism and is a laminated cuticle to permit nutrients to pass through it and finally the inner most layer or the ‘endocyst’ which is the germinal membrane layer where daughter cysts are formed which contain protoscolices that grow and secrete the typical clear cyst fluid. These daughter cysts are formed by a process that starts as invaginations and can later lead to daughter cysts which on imaging can give the cysts within a cyst appearance. The following figure demonstrates the life cycle of Echinococcus granulosus and also how it gets transmitted between the hosts.

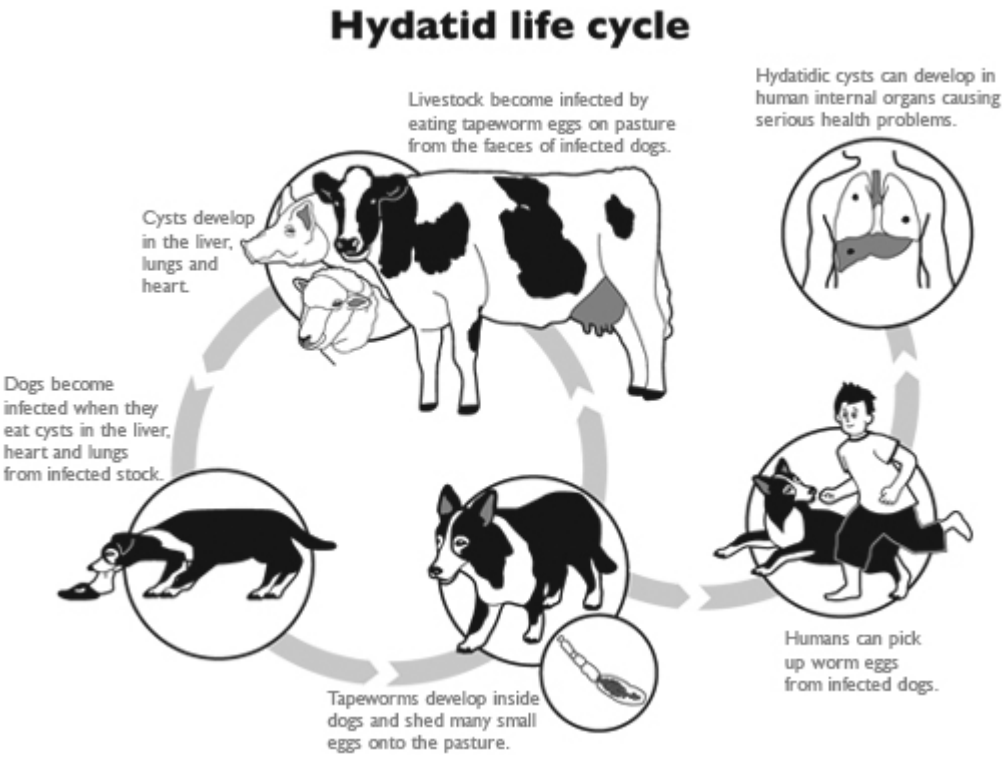


Fig 2: Diagram showing the life cycle of Hydatid organism

When a definitive host like the dog is infected by ingestion of organs containing a living cyst of intermediate host animal. Within the small bowel of the dog, protoscolices evolve into mature tapeworms. Human beings become a dead end accidental host by accidental ingestion of the Echinococcus eggs that are in the environment contaminated by the excreta of the infected definitive hosts.(4)

Diagnosis of the disease:

The diagnosis of Echinococcus infection is made based mainly on the history and clinical examination and also the typical imaging characteristics on the various modalities. Serology and microscopy help confirming the diagnosis made on the other available information.

Clinical symptoms:

Symptoms in patients with liver hydatid cyst can present with symptoms related to mass effect or due to a complication because of the cyst and some may also present with a systemic response to the parasitic antigen and resulting in asthma like illness. Many of the patients may not be symptomatic and the cyst is a slow growing lesion as mentioned earlier. The usual complaint a patient with liver hydatid cyst presents is right upper abdominal pain with varying intensities and durations. In case of any complication occurring in the cyst, then the patient can present with fever in case of an infection occurring in the cyst. Some cysts can rupture and enter the biliary system which in turn can lead to cholangitis and then the patient could present with symptoms relate to that. On examination, corresponding features could be seen which includes raised temperature, tender and markedly enlarged and palpable liver etc. In some cases where the cyst becomes really large in size then it could compress on the structures leading to cholestatic jaundice like picture in case of biliary obstruction or even a Budd Chiari like symptom in case of compression of hepatic veins or even the inferior vena cava. Lab results may reflect the effects and in case of a strong suspicion, serum IgG or IgM levels that are specific for the parasite can be assessed to support the clinical diagnosis.(4). Microscopy demonstrating the hooklets and scolices also give a definite diagnosis in case of diagnostic aspirations carried out in cases of doubtful diagnosis. On microscopy, the adult tapeworm can be of very different sizes. It does not grow like the tinea worms to large sizes. It is usually small and the size can be anywhere from 2 mm to 11 mm long. Usually they are about 3 mm to 4 mm long. Their body is composed of segments, the numbers of which can vary from two to seven, however there are usually three to four of these segments. There are different types of segments, the immature, mature and the gravid segments. Usually in the adult Echinococcal worm, the last segment is the gravid segment and it occupies more than half of the body of the adult

Echinococcal tape worm. The body also has a rostellum and head which is also known as the protoscolex which in turn consist of many hooks which are called the hydatid hooklets which are arranges usually in two rows of largely varying sizes. The first row of the hooks that are arranged in the protoscolices measure approximately between 25 to 49 µm while the other hooklets that are arranges along the second row in the protoscolices usually measure anywhere between 17 and 31 µm. These are the structures seen in the microscopic examination of the cyst fluid that has been aspirated either by percutaneous needle placement during a percutaneous scolicidal injection procedure or even after surgical procedure of cystectomy where the cysts is excised completely and examined for presence of scolices and hooklets of hydatid organism.(5)

Fig 3: Microscopic picture showing hooklets of Echinococcus

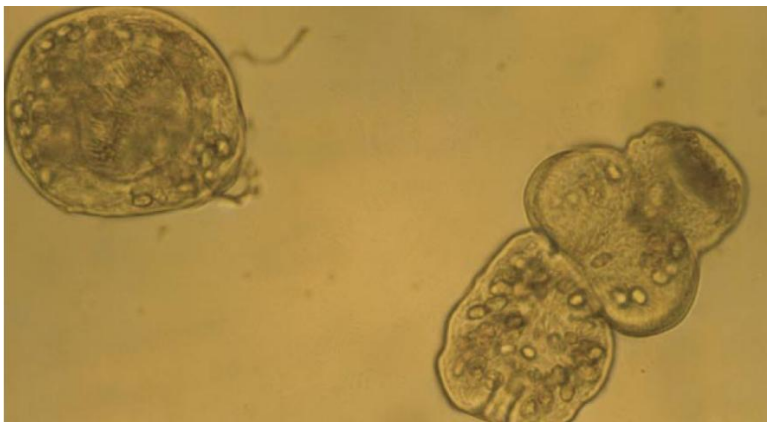


Fig 4: Microscopic picture showing scolex of Echinococcus

The larval form of the Echinococcal organism is the one that causes the usual fluid filled cyst in the target organs, the most common being the liver as the oncospheres get transported from the small intestine to the liver first by the portal blood flow. Other organs like lungs, brain, kidneys and more organs can also get involved in this disease.

Imaging in liver hydatid cyst:

Different radiological imaging modalities can be used to characterize and classify the different imaging appearances of liver hydatid cysts. These include ultrasonography [USG], computed tomography [CT] and magnetic resonance imaging [MRI] which will give us very good anatomical details that will help planning further treatment options in these cases of liver hydatid disease. Ultrasound is probably the first modality of choice as it is rapid, easy to operate, easily available and it is also cheaper than the other modalities, not to mention it does not involve ionizing radiation as well. More than all these, it give a clear picture of the viability status of the cyst. Computed tomography helps in some special conditions like when a complication is suspected like infection or rupture. CT also helps in demonstrating wall calcification better than other modalities which will tell us that the cystic lesion is already inactive and is on its way to healing and no further intervention would be required in that case. Magnetic resonance imaging will help further characterize the cyst in case there is any doubt in the ultrasound or computed tomography imaging. It can better demonstrate the membranes and also may be useful in assessing infection etc. Both computed tomography and magnetic resonance imaging can give us a better idea when whole abdomen and pelvis is imaged, with regards to presence of other extrahepatic cysts like in other viscera or the peritoneal cavity also as these also are known to occur. These imaging modalities also help in assessing the

anatomical relationships with the adjacent structures which will also help in planning the surgical or interventional radiological procedures.

Classification:

Two major methods of classification have been established to characterize the cyst which mainly will give us an idea about the viability of the cyst and aid in planning further management. These two main systems are the Gharbi system which classifies the liver hydatid cysts into five types [Type 1 to 5] and the other is the World Health Organization Informal Working Group on Echinococcosis [WHO - IWGE] which classifies the liver hydatid cysts into six types [CL, CE1 to CE5].

Gharbi classification:(6)

The 5 types are described as follows:

Type 1 – Univesicular hypodense cyst containing “hydatid sand”

Type 2 – Univesicular hypodense cyst with double or undulating membrane

Type 3 – “Mother and daughter” cyst which is highly specific for hydatidosis

Type 4 – Detachment of the germinal layer which produces classical “Water Lilly” sign, echogenic content with solidifications or a pseudotumor aspect

Type 5 – Cyst wall calcification

Type 1, 2 and 3 are viable cysts at postoperative parasitological examinations and type 4 and 5 are nonviable cysts.

WHO – IWGE classification:

The WHO classification(6) as mentioned above classifies the cysts into 6 classes with each of them showing specific imaging features and help in the identification of the stage of the disease to further plan the necessary treatment procedure - be it operative or percutaneous aspiration injection and reaspiration procedure.

The following figure shows the different stages of the cystic disease which is also used in this study. They are sub-classified into active, transitional and inactive cysts based on these appearances and are shown below.

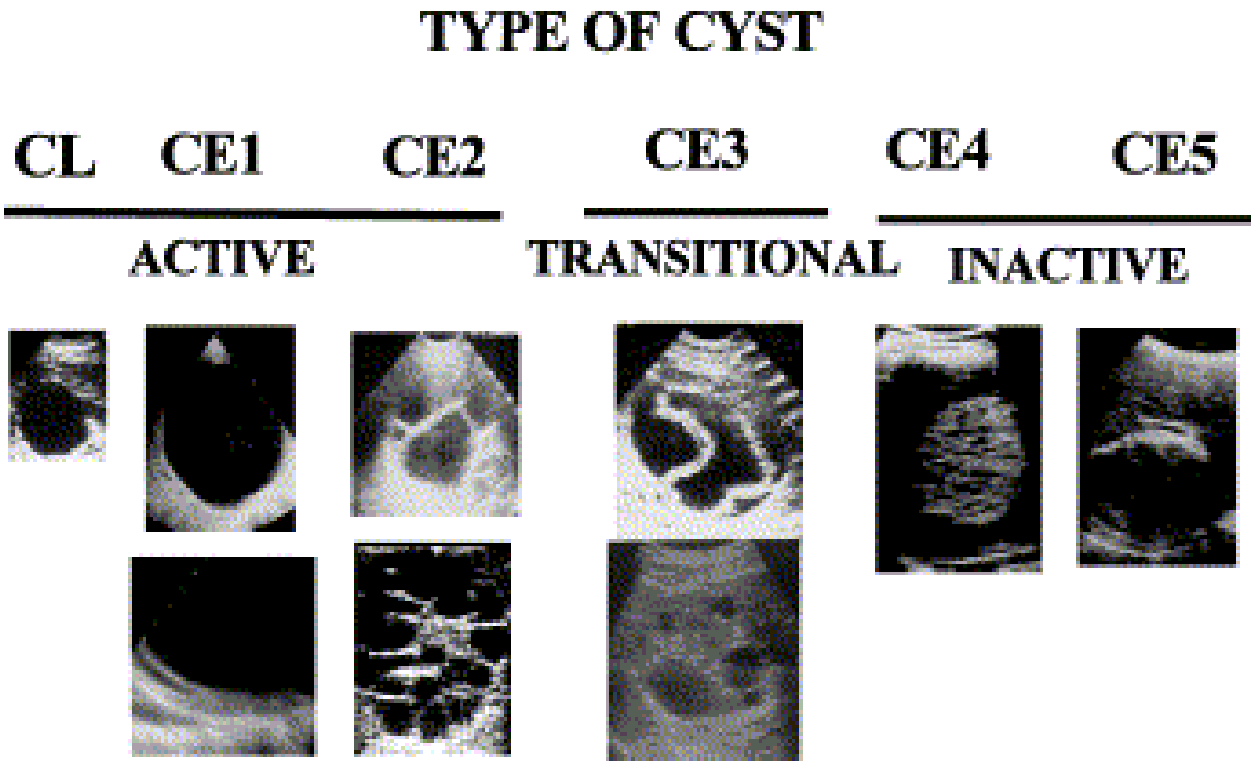


Fig 5: Image showing the different types according to the WHO IWGE classification

Description of each type according to the WHO – IWGE classification:

The 6 types of hydatid cysts in the liver are denoted by the labels CL, CE1, CE2, CE3, CE$ and CE5 with the specific imaging appearances, a brief account of which are as described below.

CL :

- the cyst usually consists of a single locule and the content is without any internal echoes – anechoic
- usually the cyst wall in a hydatid cyst of the liver shows a classical trilaminar wall consisting of two hyperechoic layers separated by a hypoechoic layer in between them and this is not well demonstrated in this category
- shape of the cyst may vary from being round however the cysts may also be oval in shape
- size of this category cysts is generally smaller being less than 5 cm however they can be larger less frequently and hence they can be categorized further into three divisions as being smaller than 5 cm – CLs, if size is between 5 and 10 cm then they are labelled as CLm and further if they measures more than 10 cm they can be labelled as CLl.
- in cases of such a s lesion occurring in the earlier stages of disease development, they are usually not fertile
- imaging by ultrasound may not demonstrate the classical appearances as mentioned earlier and hence the differential diagnosis for cystic lesion in the liver need to be considered and further diagnostic work up needs to be carried out.

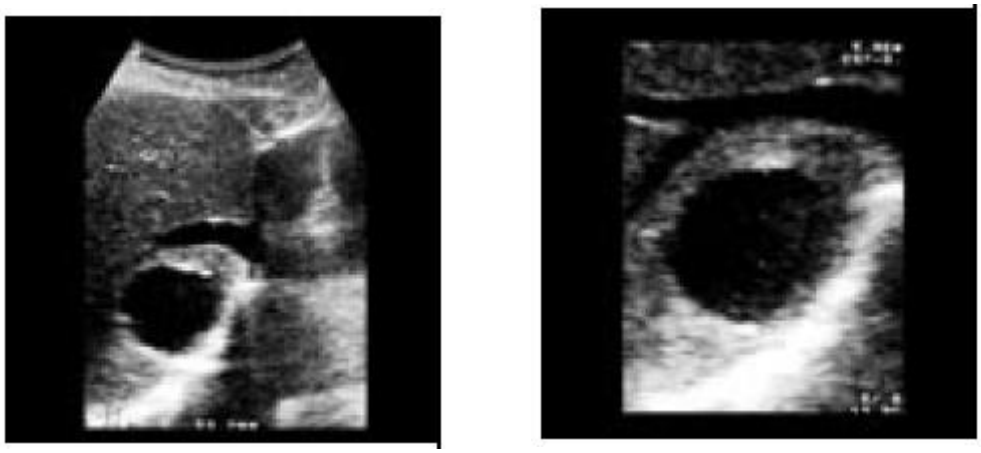


Fig 6 & 7: CL type of hydatid cyst

CE1:

- These can be similar to the CL class cysts in the features of being unilocular and may contain contents that are anechoic
- In some of the cyst of this CE1 class, the 'snow flake sign' could be demonstrated which indicate the presence of echogenic material that shift with change in the patient's position. These are caused by the intrinsically mobile brood capsules seen as fine mobile material
- Here in this category the differentiating feature from the CL class is that the typical trilaminar wall can be clearly seen on ultrasound imaging
- Shape could vary just like the other CL cysts
- size of this category cysts is also usually smaller being less than 5 cm however they can also be larger less frequently and hence they can also be categorized further into three divisions which is similar to the CL sub-classification as being smaller than 5 cm are denoted as CE1s, if size is between 5 and 10 cm then they are labelled CE1m and the cysts that are larger than 10 cm are given the label CE1l.
- These cysts are fertile when considered the status of the disease.

- Like mentioned before, the classical signs that indicate this particular class is the presence of the typical trilaminar wall and also the shifting echoes giving the classical snow flake sign.

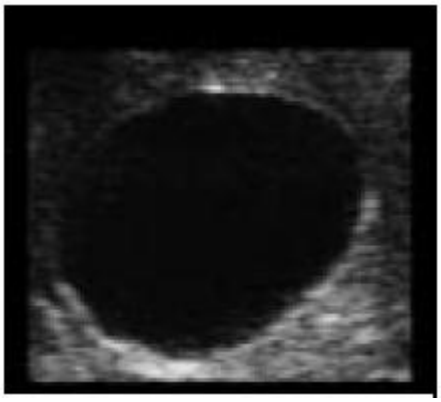



Fig 8 & 9 : CE1 type of hydatid cyst

CE2:

- This category of cysts show different imaging appearances due to presence varying number of daughter cysts
- As a result, these cysts appear to be containing multiple vesicles [multivesicular] / multiple septations [multiseptated] cysts. Sometimes these can also be described as ‘rosette’ pattern and some other cysts due to presence of septations can produce ‘wheel’ pattern of appearance.
- These cyst can be either partially or fully filled by the smaller cysts called the daughter cysts.
- Again, the size wise classification of the cysts are applied to this category as well and the denotation CE2s refers to cysts smaller than 5 cm, the denotation CE2m indicates cysts of sized between 5 and 10 cm and also the CE1l class denoting size greater than 10 cm

- On imaging again the typical trilaminar wall is generally seen
- As far as the status goes, these are active and fertile cysts

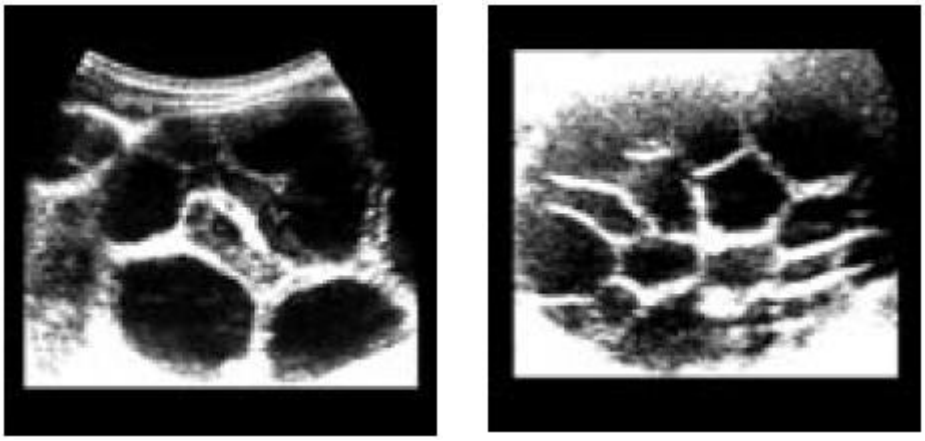


Fig 10 & 11: CE2 type of hydatid cyst

CE3:

- This category as opposed to the CE2 class, are usually composed of a single locule [unilocular] and they may demonstrate the presence of daughter cysts within them.
- These cysts usually indicate that the cyst and the disease are on their way to the start of healing which is seen a detachment of the membrane which collapses and forms folded sheet like appearance and hence the classical description of these cysts, the 'water lily' as the rest of the cyst is mostly anechoic
- the shape of the cyst is generally round
- size varies, and the same classification applies to this as well, the thee sub types being CE3s, CE3m and CE3l referring to the sizes as smaller than 5 cm, between 5 and 10 cm and the later greater than 10 cm
- Disease status of this class of hydatid cyst in transitional however these can still generate daughter cysts or regress further
- Imaging features are usually very characteristic

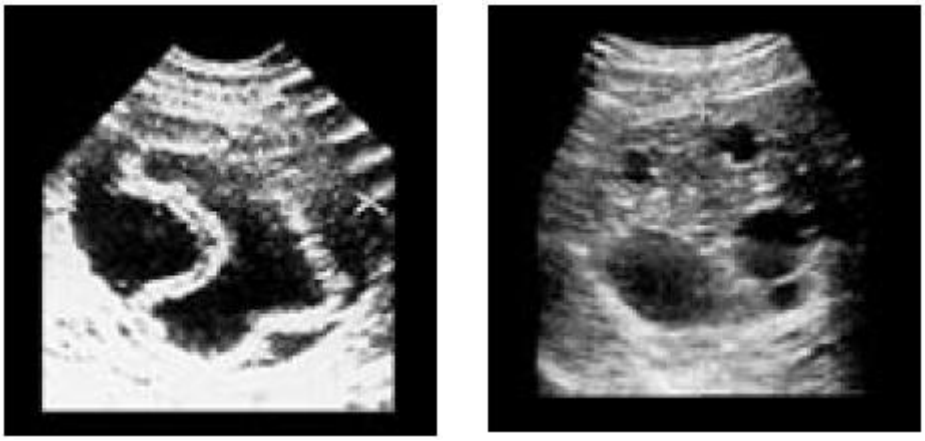


Fig 12 & 13: CE3 type of hydatid cyst

CE4:

- The contents in this class start becoming solid like and they can show varying degrees of echogencity. They could be hypoechoic, hyperechoic and many a times shows mixed heterogeneous echogenicity because of the contents that are degenerating – this may give a typical 'ball of wool' appearance on ultrasound imaging
- In this type of cysts, the daughter cysts are absent
- Although degenerating, these cysts can also vary in size and similar to the other cyst types, these can also be sub-classified in to the three categories, less than 5 cm, between 5 and 10 cm and finally the more than 10 cm groups indicated by CE4s, CE4m and the CE4l respectively.
- As the cysts are already degenerated, they are inactive as far as the status of the disease course goes.
- As the appearance can mimic a pseudotumor appearance, sometimes more diagnostic tests may be required in case of doubt in the diagnosis

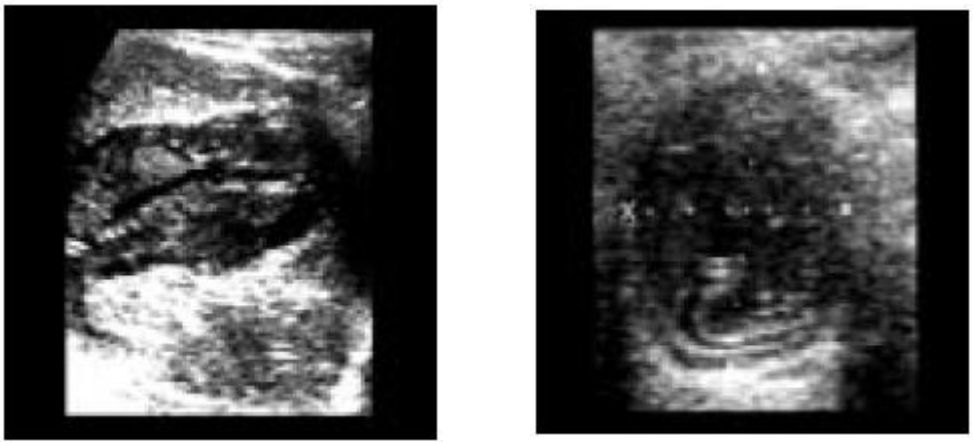


Fig 14 & 15: CE1 type of hydatid cyst

CE5:

- This class represents the most inactive form of the cystic disease
- Imaging wise the striking feature of this class in the presence of a typical very thick wall that is calcified producing a posterior acoustic shadowing.
- The wall could be completely calcified or may show varying degrees of calcification of the circumference of the wall.
- The same size criteria could again be applied here, these can also be sub-classified in to the three categories, less than 5 cm, between 5 and 10 cm and finally the more than 10 cm groups indicated by CE5s, CE5m and the CE5l respectively.
- Imaging features are not definitely diagnostic however indicate a very high probability of this being Echinococcus granulosus cyst and as mentioned above they are inactive.

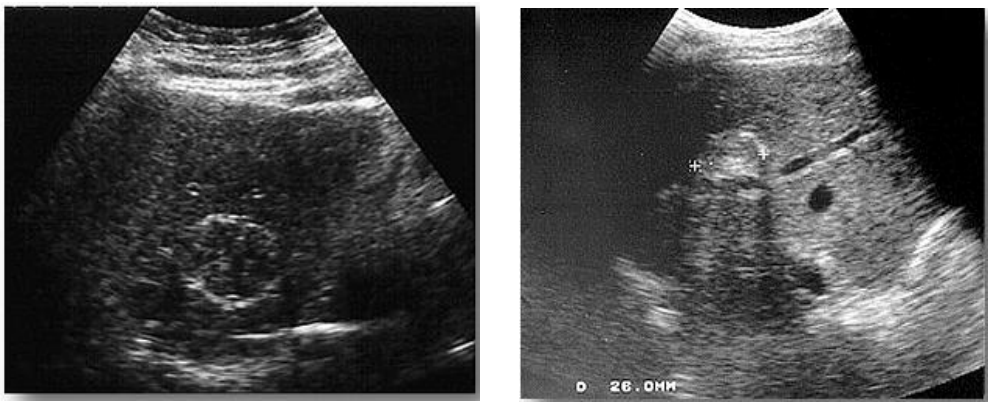


Fig 16 & 17: CE5 type of hydatid cyst

Treatment options:

Echinococcal cysts in the liver have been treated with surgical, medical and percutaneous treatment procedures. Open surgical treatment was the usually done procedure for treatment of liver hydatid cysts. The drug belongs to a group of agents called the benzimidazoles with a broad spectrum of antihelminthic agents and shares a structural relationship with Mebendazole. It is an organic drug with many substructures. The mode of action of Albendazole is that it inhibits tubulin polymerization and results in cytoplasmic loss of microtubules. The resultant alterations in the teguments are degenerative to the tape worm's intestinal cells and hence the worm becomes less active. The changes are also seen in the adenosine triphosphate producing mechanism in the worm leading to energy depletion. This is done by bringing about degenerative changes in the germinal layer as well. Finally, since adenosine triphosphate is the energy source of the helminth, this leads to inactivity and finally the death of the organism. Albendazole is not very highly aqueous soluble and hence its absorption in the gastrointestinal tract is very poor. Hence sometimes ingestion with a fatty meal is advised to enhance bioavailability. Open surgery may be conservative or even radical procedures were performed in cases of large cysts. In the presence of multiple cysts, hydatidosis of the liver where the patient is diagnosed with multiple cysts, even liver transplant has been considered. Later in the treatment course of Echinococcus granulosus, the surgical techniques were taken to an advanced laparoscopic surgical procedures where the cysts were approached through laparoscopes and the membranes removed. However this technique is usually done in cases where the cyst are located very anteriorly within the liver and approach to deeply located cysts is a very tedious and difficult manoeuvre. The laparoscopic procedures proved to be better than the open surgical techniques as they are shown to be of lower

complication rates and also lead to significantly less morbidity and minimized the hospital stay markedly and the patients recovered in a much shorter duration.

Medical therapy is given for parasite control using agents like Albendazole and Mebendazole are common. Albendazole has been recommended highly in the recent studies and have been shown to affect the outcome of either percutaneous therapy or surgery when used as an adjunct therapy. Albendazole is an antihelminthic agent used commonly in the treatment of hydatid disease of the liver. However the effective drug concentration reaching the cyst cavity is very less due to the presence of the thick wall which the drug fails to traverse and hence the effectiveness of medical therapy alone is not very adequate. But treating patients with medical therapeutic agents like the ones mentioned above become very important in case the patient is decided to be operated upon or decided to undergo radiological interventional therapeutic procedure such as the percutaneous aspiration and injection therapy. The manner in which such adjunct medial therapy helps in these interventional procedure is that the complications that arise due to spillage that may occur during manipulation of the cyst may be reduced by these drugs when administered in the periprocedural period(7).

Percutaneous approach and therapy options in liver hydatid cysts have long been studied and attempted by various people and many of them have shown promising results. There are different techniques and different scolicidal agents that were used to perform this approach to treatment of liver hydatid cysts. The various techniques described and done involve the PAIR – percutaneous puncture, aspiration, injection and reaspiration(4,6,8) ; PAI – percutaneous puncture, aspiration and injection (9); PAIRD – percutaneous puncture, aspiration, injection and reaspiration with drainage (10); PD – percutaneous drainage of

Echinococcal cyst in the liver(9) and also PEVAC – percutaneous evacuation of liver hydatid cysts with an assisted suction device.(11).

In the extensively performed percutaneous treatment techniques, many a studies have been done also to see which would be the ideal scolicidal agent. Many researchers and physicians have tried various scolicidal agents. The most common one being the hypertonic saline [in concentrations of 15 to 20%], absolute alcohol [95%], mixture of Albendazole and hypertonic saline, mixtures of Albendazole and Mebendazole and some have even tried povidone iodine solutions. All these various procedures have been shown to have different efficacy rates and complication rates and many have compared different scolicidal agents to come up with the ideal scolicidal agent that could be used.

The commonly studied and established scolicidal agent is the hypertonic saline that is used in concentrations of 15 to 20 %. This hypetonic saline has been shown to be one of the most commonly used in the percutaneous treatment of liver Echinococcal cysts. Various articles have been published on the efficacy of the hypertonic saline. Prominent journals have published articles showing that using 20 % hypertonic saline has been very safe and effective at the same time, some of them showing significant improvement in the disease status as indicated by statistically significant reduction in the size of the cysts, some showing improvement in almost all the cases that have been studies and injected percutaneously with hypertonic saline. In a meta-analysis article published in the oxford journal of clinical infectious diseases, Smego et al have shown effective results and the complications that occurred in using various scolicidal agents. (7).

Twenty percent hypertonic saline has been shown to be a safe and effective scolicidal agent. Dwivedi et al had studied nearly thirty nine cysts and have shown that this can show very good response to injection of hypertonic saline. Almost all of their patients had shown significant effect of the injection and they had also showed a very low complication rate. And even in the patients where the complications had occurred, they were minor complications and did not require any major intervention.(12)

Absolute alcohol as an effective scolicidal agent:

Absolute alcohol [95% ethanol] has also been used as an effective alternative to the traditional hypertonic saline. The availability, cost and also the cumbersome procedure of preparing the 20% hypertonic saline has been a concern in our setting and hence the use of alcohol was considered to be used as the scolicidal agent in the procedures done in our hospital and also the efficacy of this was planned to be studied against the already well proven hypertonic saline. Many studies have been done assessing the efficacy of absolute alcohol as an effective agent in the percutaneous therapy of liver Echinococcal cysts. One of the prominent studies that shows the efficacy of absolute alcohol as a very effective alternative to hypertonic saline is the Giorgio et al article publishing their eleven year experience on injecting absolute alcohol as a scolicidal agent in about a hundred and twenty nine patients. Although the technique used by them was the DPAI technique – Double Percutaneous Puncture, Aspiration and Injection technique, the study is taken as the base for the use of absolute alcohol as a cheaper and effective alternative agent to hypertonic saline. They had also shown that the complications that were significantly lesser and the mean hospital admission duration was also markedly shorter. (13). Ustonsoz et al have also studied the use of alcohol to be an effective scolicidal agent in the use of injection sclerotherapy of liver Echinococcal cysts. (14). Varro

et al have even gone a step ahead and have shown advanced method of balloon occlusion of a cyst that had a communication with the biliary system and they had blocked it and went ahead with the injection of alcohol in to the cyst cavity and also have shown it to be very successful.(15).

The World Health Organization has devised protocols and also have drawn up guidelines to the safe an effective of percutaneous injection sclerotherapy. These have been laid down and are to be followed in the event of performing a percutaneous injection sclerotherapy.

PAIR sequence as described by the WHO – IWGE:

The patient needs to be on prophylaxis with Albendazole / Mebendazole at least 4 hours [in some cases up to a week before procedure] prior to the percutaneous puncture, aspiration, injection and reaspiration procedure and is to be continued for a month after the procedure has been performed. Puncture of the cyst to be done under ultrasound guidance and if required, CT guidance may also be used in cases where the cyst is not optimally seen on ultrasound imaging. About ten to fifteen millilitres of the fluid is to be aspirated after careful placement of the needle inside the cyst cavity. The aspirate is to be sent for examination for scolices and hooklets and also for the presence of bilirubin. If bilirubin is present, the procedure is to be discontinued. If bilirubin is not present in the aspirate fluid, then 95% of ethanol is injected, the injected volume of alcohol being approximately one-third of the aspirated volume. This is left inside the cyst cavity for approximately 5 minutes and then the contents are reaspirated. Then the patient is to be followed up with ultrasound examination every week for a month, every month for a year and then every year for 10 years to look for signs of response to treatment.

In the study done by Giorgio at al, they had punctured nearly 254 cysts and they had followed up the patients for a mean of nearly 2 years. They had punctured cysts that varied considerably in size, ranging from twelve millilitre to two hundred and fifty millilitres. The patients had to be in the hospital for a mean duration of approximately 3 days. In their total follow up period, they had shown that nearly half [47 %] of the cysts had disappeared, and almost nearly the other half [45%] of the cysts had shown a more solid appearance like a pseudotumor appearance on ultrasound imaging. A very small [6%] percentage of the cysts showed very minimal fluid in the cysts cavity. They had also experienced a recurrence rate of approximately 5% and one of their patients died due to a procedure related cause. In the end Giorgio at al concluded that in their extensive study that spanned over eleven years where they had studied a large number of patients, use of absolute alcohol is very safe in the percutaneous injection sclerotherapy of the liver Echinococcal cysts.

MATERIALS AND METHODS

MATERIAL REQUIREMENTS:

* radiologists trained in ultrasound guided liver punctures
* good resolution ultrasound machine with the necessary probes

[Toshiba Xario Ultrasound machine with 3.5 and 7.5 MHz probes used in this study]

* all the necessary needles, guide wires and catheters
* nursing staff with knowledge of the procedure
* good laboratory set up for microscopy and also biochemical analysis

* a specialized Hepatobiliary surgical team to back up in case a necessity arises to take up the patient for an emergency surgery

* anaesthetists being present in the patient goes into anaphylaxis and requires immediate resuscitation

* resuscitation trolley with emergency drugs, ventilating mask and bag etc



Fig 18, 19 & 20: Toshiba Xario USG machine with the 3.5 and 7.5 MHz probes.



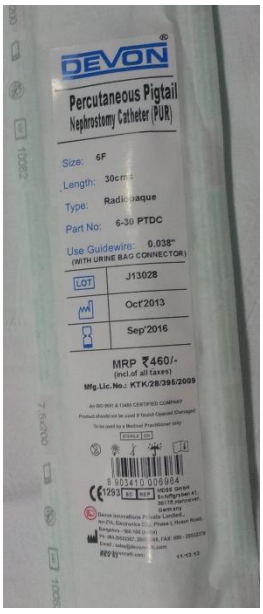


Fig 21, 22 & 23: 18G Chiba needle [Cook Medicals] & 6F pigtal drain catheter [Devon]

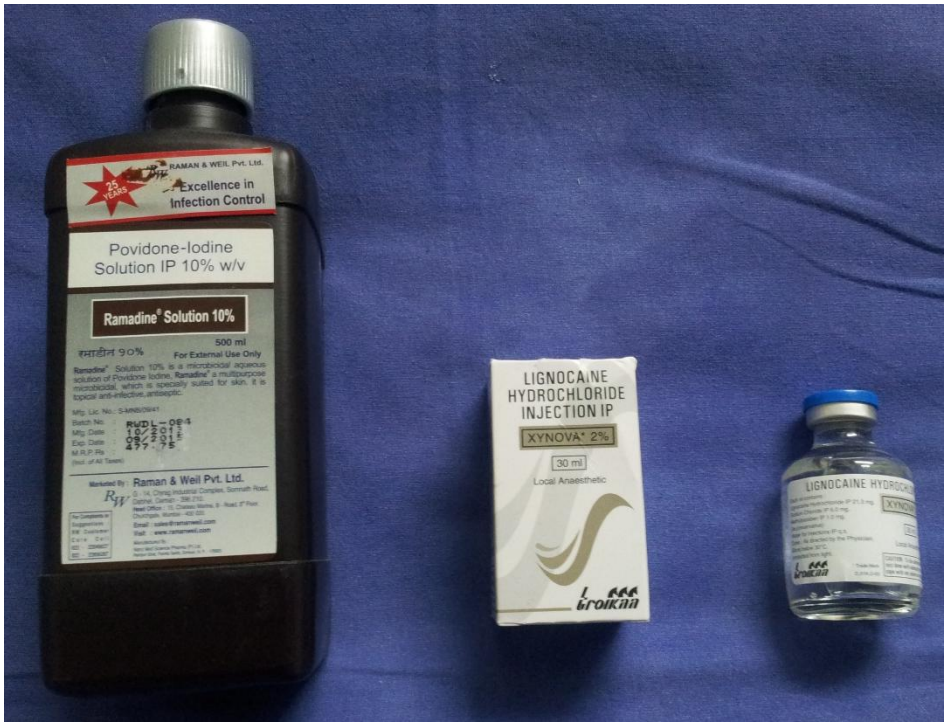


Fig 24: Pictures of 10% Povidone Iodine solution used and 2% Lignocaine used for local anaesthesia.

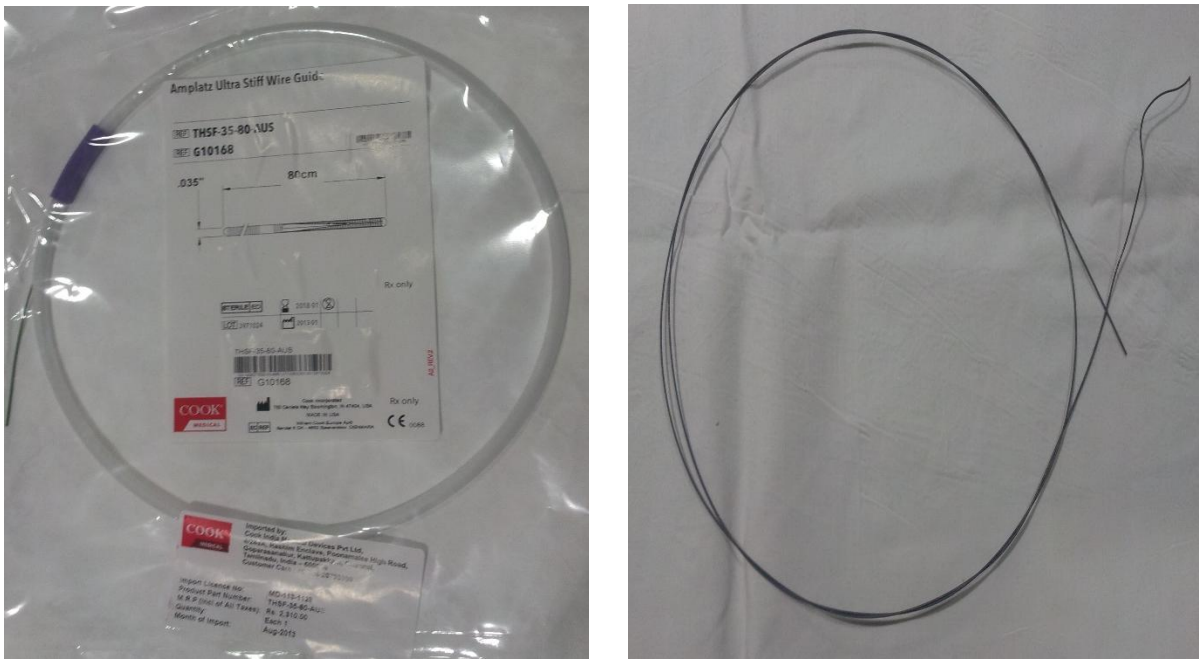


Fig 25: Amplatz stiff guide wire [Cook Medicals] with soft tip used for the procedure.

STUDY DESIGN:

This study was designed to be a prospective interventional study and the duration of the study was 17 months, between June 2012 and November 2013.

PATIENT INCLUSION:

All the patients referred to the Department of Radiology for percutaneous puncture, aspiration, injection and reaspiration procedure for liver hydatid cysts only. This study was limited to liver cysts only.

PROCEDURE PLANNING AND METHODOLOGY:

All the patients were treated with 3 courses of oral Albendazole, each course consisting of 400 mg of Albendazole twice daily for 4 weeks and a gap of 1 week. After this course, they were imaged with ultrasound as well as computed tomography. Some of them also underwent magnetic resonance imaging. The medical therapy was to render serological stability and also in anticipation of any complications that could occur during the procedure and in order to reduce those complications. During this medical therapy course or sometime before the procedure was scheduled, the patient was counselled well about the nature of the disease, the different treatment options, and the advantages and disadvantages of both the open surgical approach and also the percutaneous therapy approach. The patient was explained about the non-necessity of general anaesthesia and hence the avoidance of the risks that are innate to the general anaesthesia itself. The relatively short procedure time, the benefit of much less pain

during and after the procedure and also the cost of the treatment as compared to open surgery were explained to the patient.

The details of the procedure were also informed to the patient and the importance of the various imaging modalities in performing such a procedure were also told. All patients had to undergo one cross sectional imaging modality which was mostly a computed tomogram however in some cases magnetic resonance imaging was also performed. After the imaging was done, these cysts were classified into the various types as described by the WHO IWGE classification.

All patients referred to the Department of Radiology for percutaneous injection sclerotherapy of liver Echinococcal cysts were explained for the need of hospital admission for at least a period of forty eight hours since some patients have already shown to develop fever after a period of twenty four hours following injection sclerotherapy. They were admitted under the wards seen by the specialized Hepatobiliary Surgical unit. After complete evaluation of the patients with ultrasound and computed tomography, they were planned for ultrasound guided puncture in the specially designed ultrasound guided procedure room. Pre procedural laboratory work up included a complete list of blood investigations which are required to plan the procedure and assess the condition in future. These tests included a complete blood count which indicated the total white blood cell count that could indirectly indicate presence of any infection, the platelet count that could indicate the bleeding profile and other bleeding parameters like prothromin time with international normalized ratio [PT with INR], activated partial thromboplastin time [aPTT] and finally the blood borne viral screen [BBVS] which included screening for HIV, Hepatitis B and Hepatitis C viral screens. The recommended values for safe liver procedure with less risk of bleeding has been a topic for discussion and

consensus have been laid down with the following values. The prothrombin time with international normalized ratio is a test of the extrinsic pathway and a normal international normalized ratio is considered to be safe when the values are between 0.9 and 1.1. The activated partial thromboplastin time should be within an interval of 25 and 35 seconds for a safe procedure. A platelet count between 1,50,000 and 4,50,000 is again considered to be safe for the procedure.(16)

PROCEDURE:

All the patients were posted for ultrasound guided puncture of the cysts only during the days when anaesthesiologists were available in the department. Patients were explained in detail about the procedure, the steps involved and the potential complications. After the patient understood the exact procedure and all that has been explained to him / her, the informed consent was signed. The usual consent form used in the Department for ultrasound guided procedure was filled with the details about this procedure and signed either by the patient or the relative accompanying the patient and also by the Radiologist performing the procedure. The patient was adequately sedated with Pethidine and Phenergan injections intramuscuarly prior to shifting from the ward. The patient was shifted on a trolley and made to lie comfortably. Two tubes were asked to be sent with the patient, one for parasitological sample to examine the aspirated fluid for scolices or hooklets and the other for biochemical analysis of the fluid that is aspirated for the presence of significant amount of bilirubin as an indirect evidence of significant communication of the cyst cavity with the biliary system. Again prior to the procedure, all precautions were taken as to minimize the procedure related complications. For example, blood values like platelet count, prothrombin time [PT with INR] and activate partial

thromboplastin time [APTT] were evaluated and made sure that these values were normal to minimize the risk of bleeding during puncture of the liver. Blood borne virus screen [BBVS – HIV, HBsAg and HCV] was also performed before the procedure and in case required to take extra precautions.

The patient is placed in the trolley in a comfortable position and the point of entry is marked after a thorough screening and avoiding major vessels traversing the liver. An area where at least a centimetre of normal liver is intervening the abdominal wall and the cyst cavity is chosen. This will make sure that the needle or the catheter used is anchored well in place and also the chance of spillage is almost nil as the normal liver tissue fits tightly around the needle or the catheter that passes through it.

Materials used:

* Sterile procedure set and gloves
* Betadine solution to paint the area sterile
* Sterile drape sheets
* 2% Lidocaine local anaesthetic
* 18 gauge puncture needle [Chiba needle; COOK medicals] – length could be either 10 cm or 15 cm depending on the depth of the cyst location within the liver
* 0.035 Amplatz guide wire [COOK medicals]
* 6F Pigtail catheter [Devon company – polyurethane radiodense catheter – used in cases of large cysts or thick content seen on aspiration with the needle]
* Sterile syringes and scalpel blade
* Ultrasound machine with sterile probe covers
* Pulse oximeter and oxygen supply.

* Emergency trolley with all required drugs to manage any complication

* Tubes to collect samples

After positioning and identifying the point of entry, the patient is again assured and the area is painted with Betadine solution thrice to ensure sterile surface to minimize the risk of infection. After explaining to the patient, undiluted 2% Lidocaine is injected adequately along the expected trajectory of the needle all the way till the peritoneum. Then the skin and subcutaneous tissue are also well anaesthetized to ensure adequate pain relief to the patient as patient movement during the procedure could lead to difficulty in placement of the needle / catheter and may also lead to complications like spill and anaphylaxis.

After adequate local anaesthesia, firm pressure is applied over the area of injection and about a minute later, a gentle stab is made at the point of entry and gauze pieces applied over the area with gentle pressure. Then the Chiba needle is prepared for the procedure. The needle has an inner stylet and an outer cannula. The stylet is pushed inside the cannula and is locked in place in the groove provided to make sure that they fit well and don't move inadvertently during the puncture. The needle is then kept anchored in the subcutaneous tissue and the ultrasound probe covered in sterile probe cover is also used to direct the needle, is kept in place. Under constant ultrasound visualization, the Chiba needle is gently advanced into the liver parenchyma directing it into the centre of the cyst cavity or the more anechoic and more fluid part. Once the needle is in place, the stylet is withdrawn slowly and soon the cyst fluid will be seen flowing out of the cannula. The colour of the fluid is noted at this point. This varies form very clear water like fluid to yellowish bile stained fluid. A sterile syringe is then attached to the cannula and approximately 10 ml of the cyst fluid was aspirated and a part of the aspirate was sent for microscopy to the parasitology lab to look for scolices and hooklets while the other

part was sent to biochemistry lab for bilirubin level assessment. The serum bilirubin level was already available as it was part of the pre-procedure work up.

Steps in the procedure:

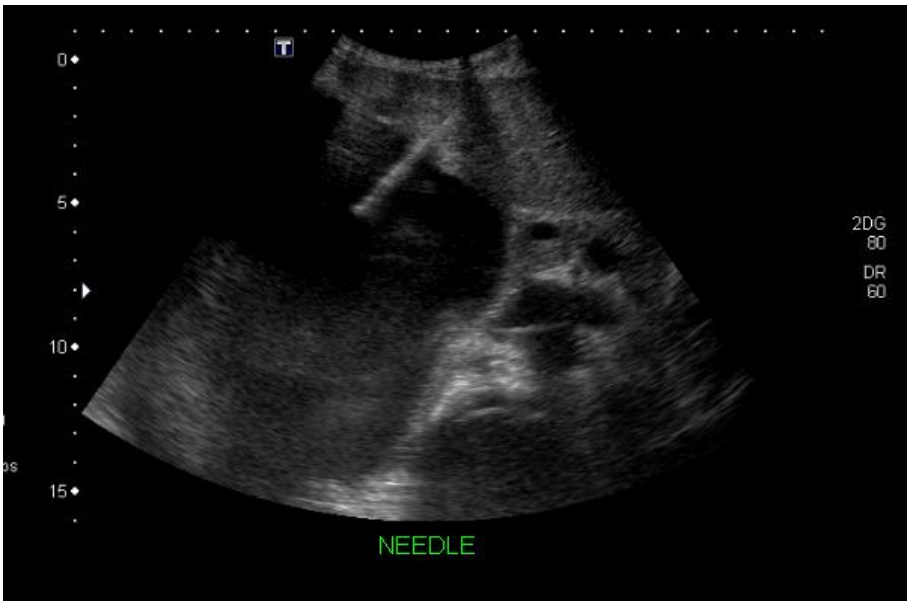


Fig 26: Needle being placed under USG guidance

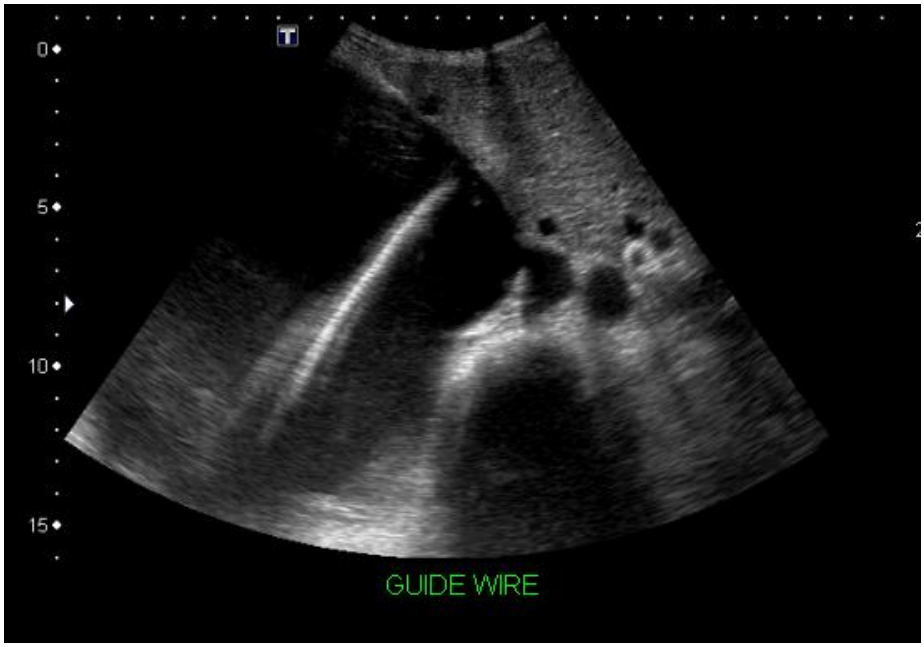


Fig 27: Guide wire being passed into the needle

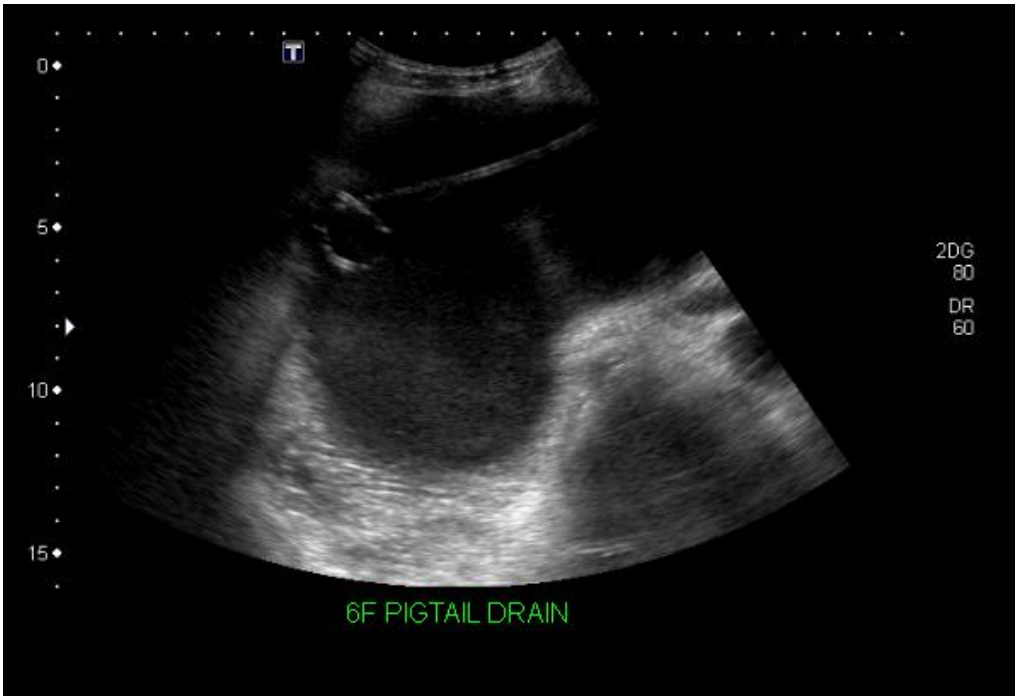


Fig 28: Pigtail catheter has been placed over the guide wire

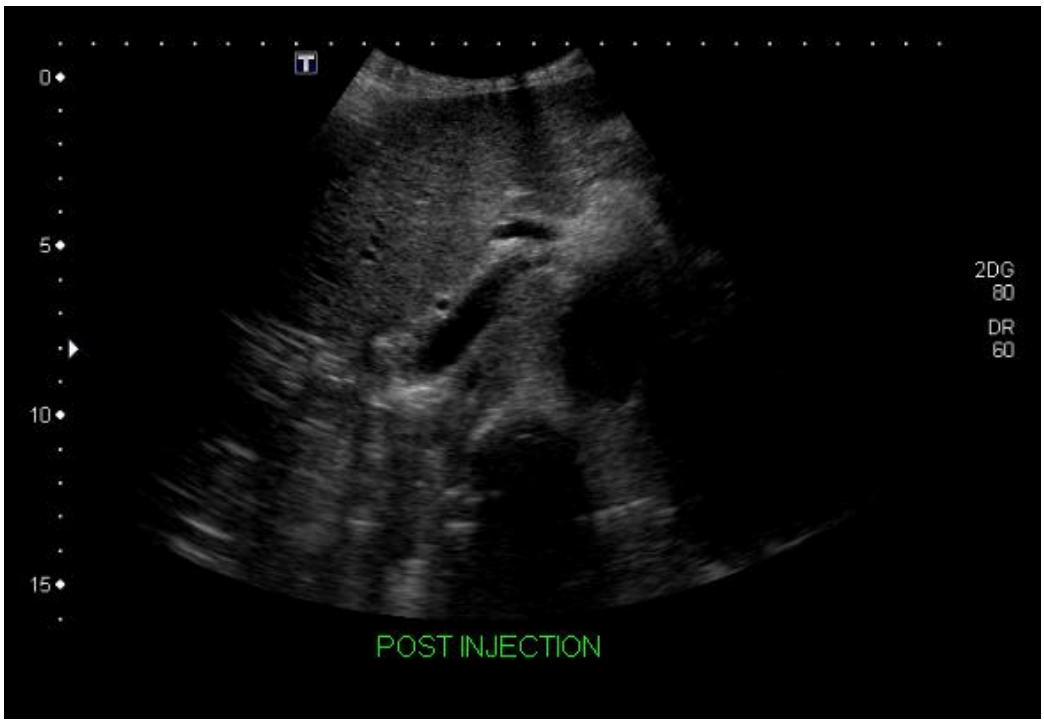


Fig 29: Image after injection of alcohol

Intra-procedure pictures

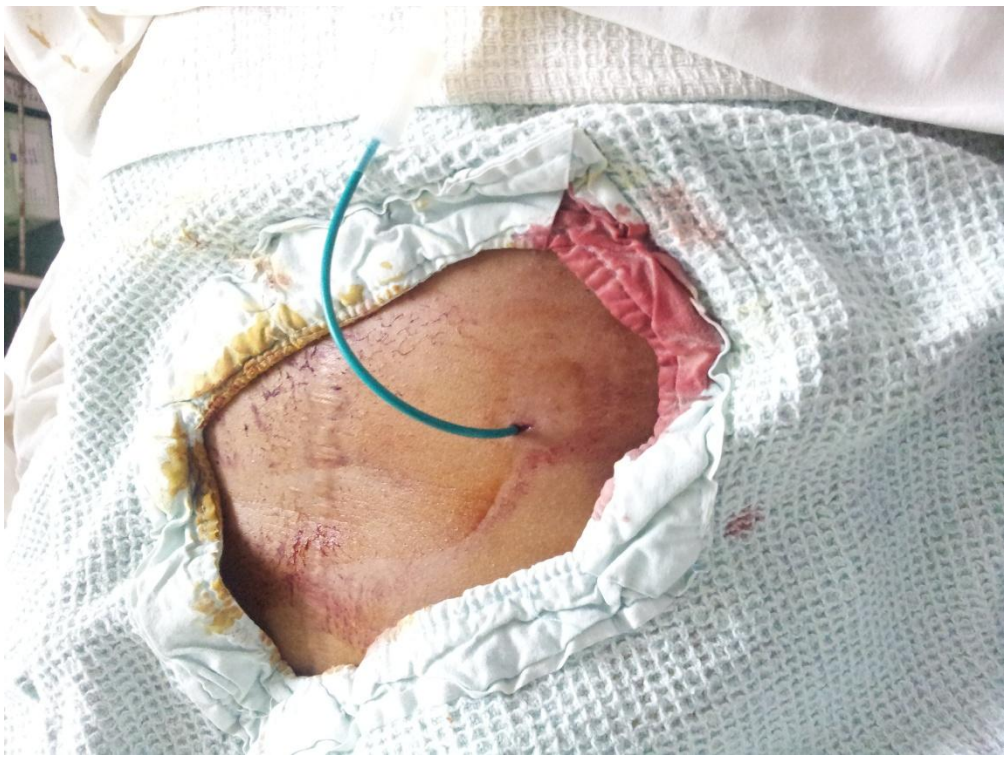


Fig 30: Pigtail catheter in situ

Fig 31: Syringe connected to pigtail drain showing yellowish fluid

To establish biliary communication with the cyst, many different techniques were used in the earlier studies. Some people have used qualitative methods like dipstick methods to evaluate the presence of bilirubin in the cyst fluid. Some have measures the values of bilirubin in the cyst fluid as well. Since some form of communication would happen during the needle entering the cyst cavity, we decided to measure the cyst fluid bilirubin levels to determine whether there was communication between the cyst and the biliary system or not. A cyst fluid bilirubin level that exceeded the serum level by three fold, we would take that as significant communication of the biliary system with the cyst. Soon after the samples were taken, in cases where the cyst content was very thick or if the cyst size was larger, a guide wire was passed through the Chiba needle and once the wire is well in place inside the cyst cavity, the needle was gently withdrawn and then a 6 French polyurethane pigtail catheter is taken inside the cyst cavity over the guide wire and then after conforming the position of the catheter within the cavity, the guide wire is withdrawn. In cases of large cysts, the drain was connected to a bag and the contents were let to drain. Otherwise the contents are aspirated with a sterile syringe attached to the needle.

The aspirate sample that was sent for bilirubin level assessment in our laboratory would take between twenty minutes to forty minutes depending on the density of the fluid sent for examination. In case of very thin aspirate fluid, the results would be given soon while the thicker contents would generally take slightly longer. As mentioned earlier, in case the lab bilirubin levels were more than thrice the serum level, then the procedure is discontinued and the catheter is withdrawn gently. Such patients would undergo surgery during the same admission or at a later date.

The volume of sclerosant injected should also be kept in consideration as this cannot be large enough to keep the cyst under tension which in turn will push the injected sclerosant, in our case sterile absolute alcohol [95% ethanol] into the biliary system which in turn leads to further complications like chemical cholangitis. Many different people have again studied different quantities of sclerosant to be injected however these varied form a quarter to nearly half of the volume of the cyst content aspirated. We decided to inject a quarter to about one third of the volume aspirated to be on the safer side and also to avoid pushing alcohol into the biliary system which could cause problems.

The patients who underwent successful injection of alcohol into the cyst cavity were shifted back to the ward after explaining the possible complications that could occur including pain, fever etc. The patients were monitored in the ward for nearly 48 hours after which they were discharged with the recommended course of Albendazole and other symptomatic treatment measures. They were asked to come for follow up on the third day, soon after discharge and then at the first month, third month, sixth month and then in the first year for follow up ultrasound scans. Although this was the devised protocol, since patients were for far off places, coming repeatedly in short intervals would prove more expensive for them however they were advised to follow this protocol to ensure good follow up record and recording of the treatment response both clinically and also imaging wise. Documentation of all the details of the patient, including the personal contact number, addresses etc. were collected. Imaging documentation of the procedure, sometimes the colour of the fluid was photographed and also the samples sent, volume of fluid aspirated and volume of alcohol injected were all recorded online in the reports along with images archived in the Picture Archival and Communication System of the institution. These information can be retrieved anytime for reference and for further data entry and analysis of the results.

ANALYSIS AND RESULTS

All the data were entered into Microsoft Excel spread sheets and data analysis was performed using the excel sheet functions. The results of the study performed is given under different headings and are presented below.

Patient demographic information:

The study was carried out in the department of Radiology at our institution over a period of approximately seventeen months starting from June 2012 till November 2013. The first procedure was performed on the 13th of June 2012 and the last procedure was performed on the 8th of November 2013. During this period of approximately 17 months, a total of 30 patients were referred to the Department of Radiology for percutaneous injection sclerotherapy of liver Echinococcal cysts and were included in the study. The types of cysts that were denoted as inactive according to the WHO IWGE classification were already screened and excluded from the percutaneous therapy option and they were treated by other methods like laparoscopic or open surgical excision of the cyst. Most of these patients had a single cyst however there were patients with more than one cyst and in those patients where there were more than one cyst, the largest cyst was usually targeted for the percutaneous injection sclerotherapy. In some patients, the other cysts were much smaller and also some showed evidence of disease inactivity as seen as calcified lesions. Hence finally one cyst per patient was only selected for the procedure.

The patients included in the study consisted of varied demographic profiles. They were of different age groups and were hailed from different parts of the country. All patients were

started on Albendazole 4 courses before the procedure. Among the thirty patients referred to the department for percutaneous injection of hydatid cysts in the liver, 7 of them did not undergo the procedure. The reasons for this being, 4 of them did not return after initiation of the medical treatment, 2 patient chose to undergo surgery when given the treatment options and 1 patient was still in the adjunct medical therapy phase and is yet to be planned for the procedure. So 23 patient out of 30 were planned finally for the procedure. Of these 23 patients, all of them had pre-procedure ultrasound imaging, 22 of them had computed tomography and 7 of them had magnetic resonance imaging done. The age range of the patients involved ranged from 21 years to 74 years. The mean age of the patients included in the study was 44.2 years. Out of the 23 patients, 10 [43.5%] were males and 13 [56.5%] were females.

Table 1. Demographic profile of patients taken up for procedure

No	***Age***	***Gender***
1	48	Male
2	27	Female
3	74	Male
4	48	Male
5	31	Female
6	66	Female
7	27	Male
8	65	Female
9	48	Female
10	53	Male
11	57	Male
12	45	Female

13	28	Female
14	53	Male
15	33	Female
16	57	Male
17	21	Female
18	57	Female
19	31	Male
20	21	Female
21	36	Female
22	35	Female
23	60	Male
Total N = 23	Mean age = 44.2 years	Male = 10 [43.5 %] Female = 13 [56.5 %]

All the patients were admitted and were planned for percutaneous injection sclerotherapy. On the day of the procedure, the patients were pre-medicated and shifted to the department of Radiology to a special room where ultrasound guided procedures were performed. All the patients were scheduled for the procedure on the day when anaesthetists were available in the department in case there was a need to resuscitate the patient immediately like in case of anaphylaxis. While for most patients the Toshiba Xario ultrasound machine was used for guidance, for some patients the GE LogiQ ultrasound machine was employed for guidance. In most of the patients, the curvilinear probe of 3.5 MHz was used for guidance to perform the procedure.

A pre - procedure ultrasound screening was done and images of the cyst, the imaging appearances to designate the WHO class of the cysts and the volume of the cyst prior to the percutaneous injection sclerotherapy were all documented. In the total of the thirty patients, the cyst were largely different in their sizes. The smallest cyst measured approximately 34 cc and the largest approximately 3400 cc. The mean volume of the cysts were 319.2 cc. On classification of the cysts, the most common type was that of the CE1 type which is described as a unilocular cyst with a trilaminar wall and mostly containing anechoic fluid. The second most common was that of the CE3 type which is in turn described as cysts with undulating and floating membranes within the cyst or of a cyst containing daughter cysts within the larger cyst. Of the 23 cysts that were planned for percutaneous injection sclerotherapy, 13 were of CE1 type, 7 were of CE3 and one each of CE2, CE4 and CE5 types. After positioning the patient, an area through normal liver was marked and prepared with povidone iodine solution and draped in sterile sheets. Then under local anaesthesia and constant ultrasound visualization, the Chiba needle was introduced till the tip is well within the cyst cavity. There are two types of needle depending on the length, one being 10 cm long and the other 15 cm long. The length of the needle was chosen based on the depth of the cyst cavity within the liver.

After positioning the needle well within the centre of the cavity, approximately 10 cc of the cyst fluid was aspirated and sent in parts to biochemistry lab for assessment of bilirubin levels in the fluid and the other part to the parasitology lab for examination under microscope to look for scolices and / or hooklets suggesting the organism Echinococcus in the cyst fluid. After sending fluid for examination, in cases of large cysts or if the cyst fluid was thick, a 6F pigtail was inserted over a guide wire in exchange for the needle. Among the 23 patients, in 16 of them, a 6F polyurethane pigtail catheter was placed under ultrasound guidance and in one patient, an 8F pigtail was inserted due to non-availability of 6F pigtail catheter. In

the remaining 6 patients, no catheter was used and the aspiration Chiba needle was left in place for the procedure under careful monitoring preventing the patient form moving and leading to injury. Among these patients, 8 of them showed clear aspirate while the others showed yellowish fluid. The volume of the aspirated fluid varied, the least aspirated was 2 cc in one patient as the contents were extremely thick. The largest cyst fluid aspirated was close to 4 litres. The bilirubin level assessment was ready approximately between 20 and 45 minutes. The cyst fluid bilirubin levels also varied in the 23 patients in whom percutaneous alcohol injection therapy was attempted. The cyst fluid bilirubin levels ranged from 'nil' meaning no bilirubin detected to a maximum of 7.2 mg /dL. Out of the 23 patients in whom the procedure was attempted, in about 9 patients, the bilirubin level in the aspirate was more than 3 times the serum bilirubin level. Hence in these 9 patients, the cyst cavity was drained completely and irrigated with normal saline and the catheter was pulled out. The interpretation of this would be that there is significant fistulous communication between the cyst cavities and hence injection of alcohol into these cyst cavities would be a definite contraindication as this could lead to chemical cholangitis. These patients were referred back to the Hepatobiliary surgical unit for further management – either surgery or follow up on medical therapy. In one patient, soon after the placement of the pigtail catheter inside the cyst cavity, the patient experienced severe burning pain throughout the body, vomiting and developed severe hypotension. She was rushed to casualty with the catheter in situ where she was resuscitated promptly and she recovered. Alcohol injection could not be done in this patient also considering her condition. Details of this patient and the events are discussed later under the section describing complications.

All patients underwent the procedure under ultrasound guidance and none of the patients required CT guidance for the same. Among the 23 patients in whom the procedure was

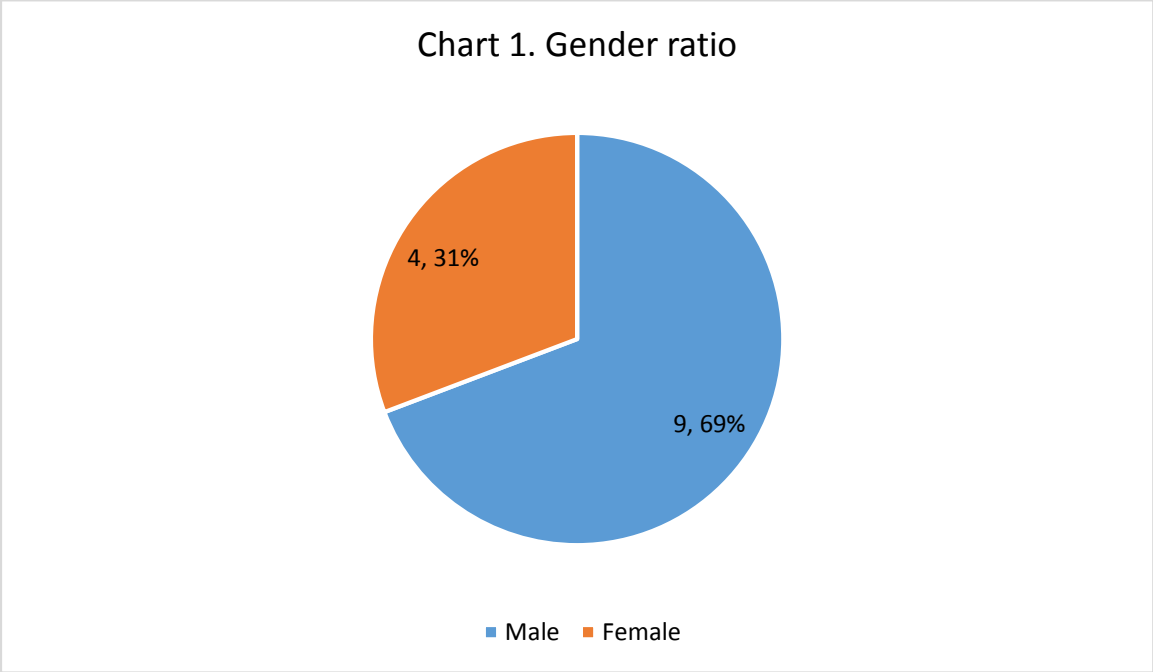
attempted, 13 of them showed favourable cyst fluid bilirubin levels which was less than three times the serum level indicating that there was probably no significant fistulous communication between the cyst cavity and the biliary system and hence were favourable for injection of alcohol safely into the cyst cavity. Hence the fraction of cysts that proved to be favourable for alcohol injection was 13 / 23 and the percentage was 56.5 %.

Among the 13 patients who underwent successful injection of sterile absolute alcohol in to the cyst cavity, the age varied between 21 and 74 years, mean age being 50.1 years. Out of these 13 patients, 9 of them were males [69.2%] and 4 of them were females [30.7%]. Table 2 shown below illustrates the demographic profile of the 13 people that underwent successful percutaneous alcohol injection.

Table 2. Age and sex distribution of patients who underwent successful injection of alcohol

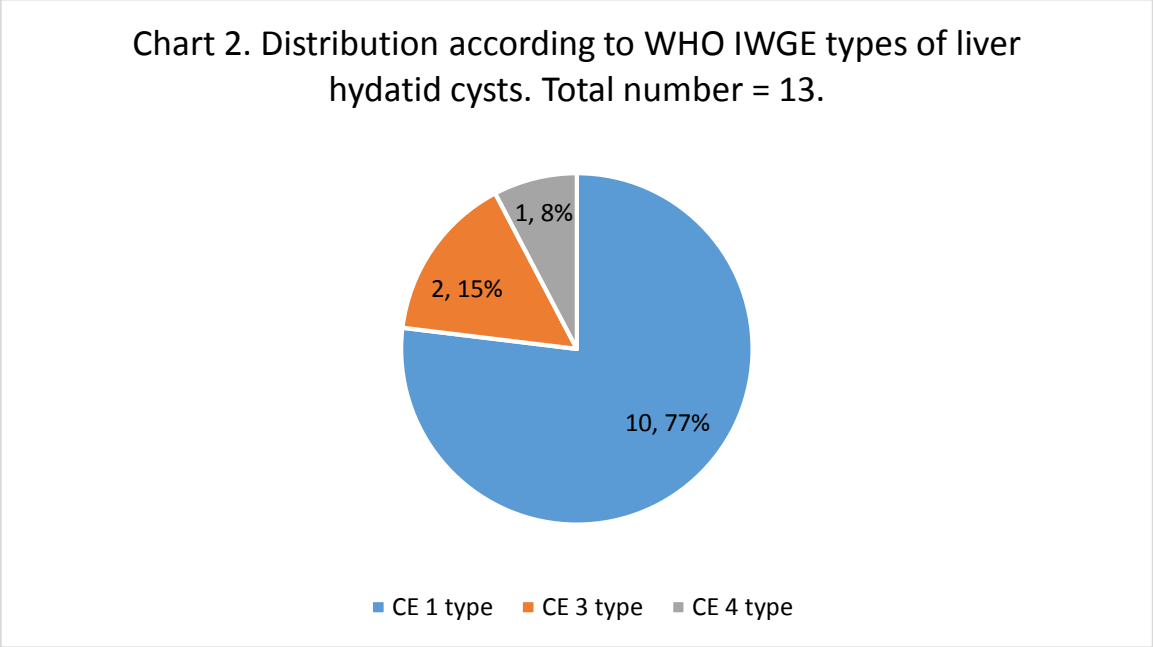
No	***Age in years***	***Gender***
1	48	Male
2	74	Male
3	48	Male
4	66	Female
5	27	Male
6	57	Male
7	60	Male
8	53	Male
9	57	Male
10	21	Female
11	57	Male

12	36	Female
13	48	Female
Total N = 13	Mean age = 50.1 years	Male = 9 [69 %] Female = 4 [31 %]



Pre - procedure imaging wise, all of them has had an ultrasound and CT imaging done. Four of them had also had magnetic resonance imaging done in addition to the USG and CT imaging. The types of cysts were again classified into the WHO IWGE types. Based on this, out of the 13 cysts, 10 of them were of the CE1 type [approximately 77%] being unilocular with mostly fluid with no internal echoes or some showing hydatid sand within them. Two of them were CE 3 type [approximately 15%], showing either floating membranes within the cyst fluid or showing multiple daughter cysts within the larger mother cyst. One of them was CE4 type [approximately 8%] showing a heterogeneous appearance. This patient although was showing an inactive cyst according to the WHO IWGE classification, since this was a recurrent cyst following surgery done elsewhere, was taken up for percutaneous alcohol injection

sclerotherapy. The pie chart shown below indicates the distribution of types of cysts among the patients.



Few examples of the cyst types in our study:

Fig 32. USG image showing CE 1 type in the WHO IWGE classification which is a single locule cyst with laminar membrane

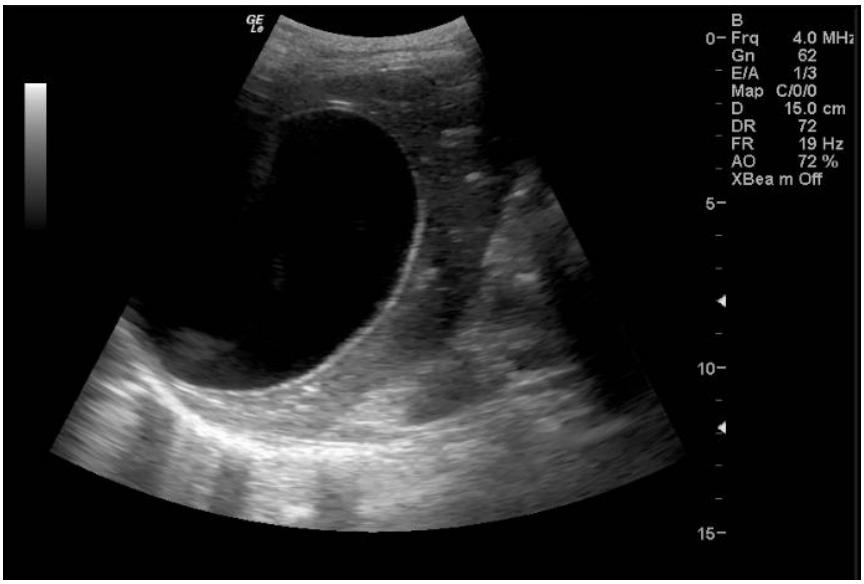


Fig 33: USG image showing a CE3 type of the WHO IWGE classification which is described as a liver hydatid cyst with multiple daughter cysts within.

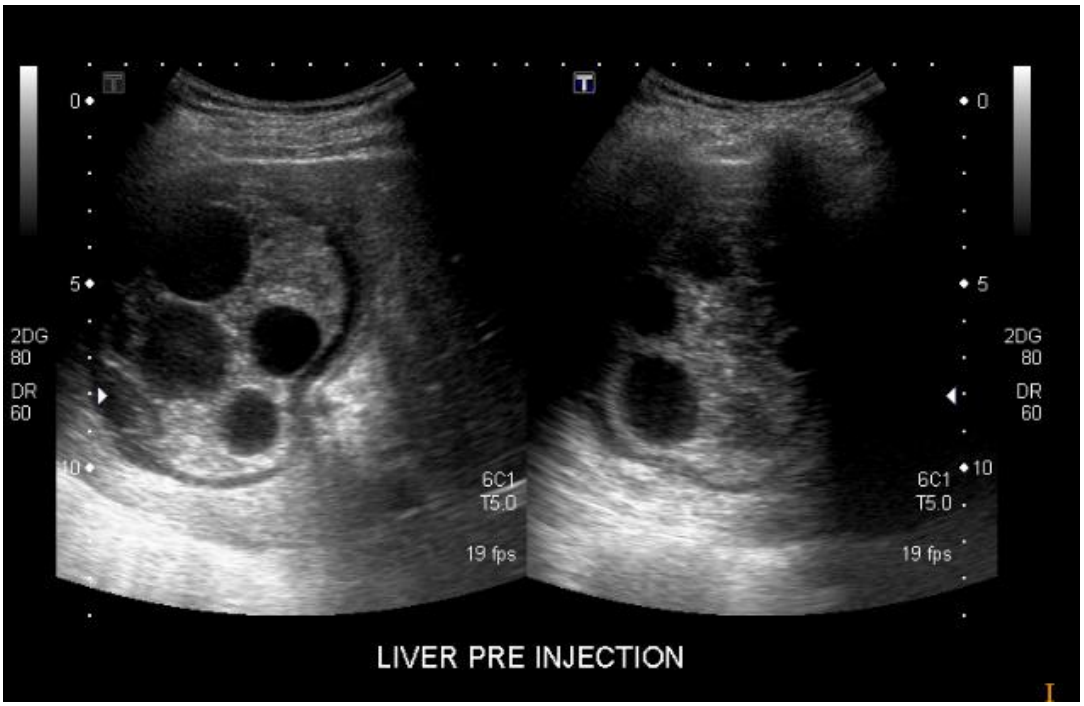
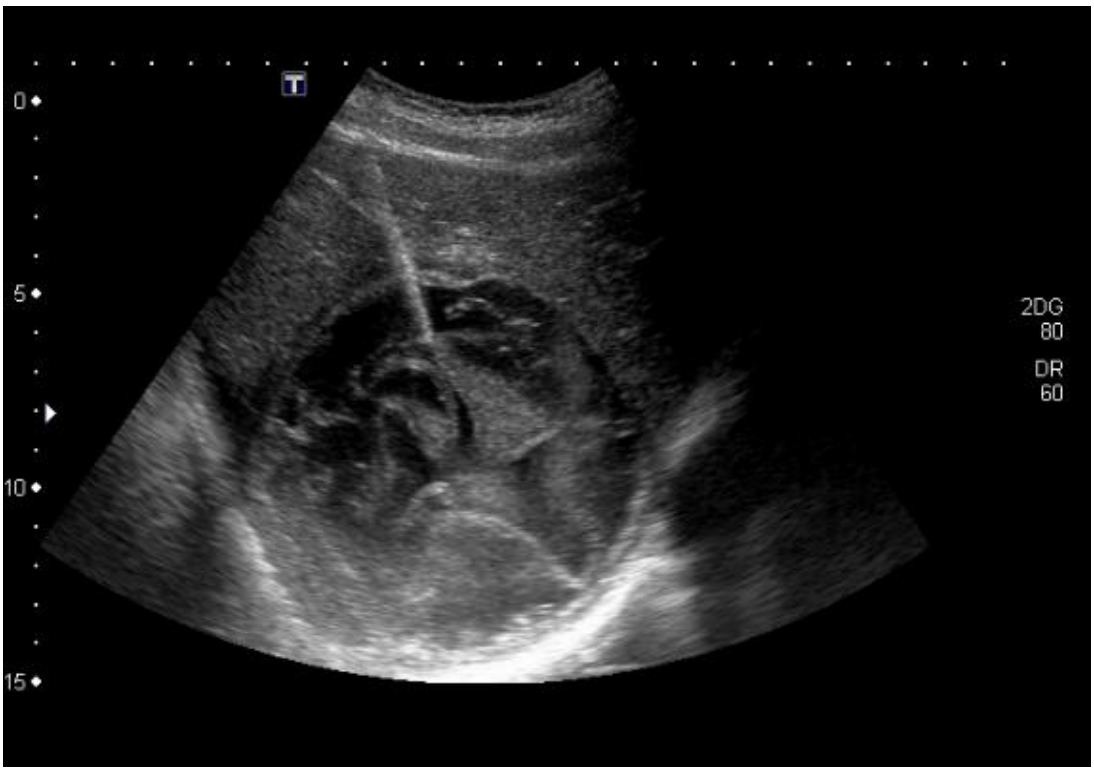


Fig. 34: USG image showing another CE3 type cyst according to WHO IWGE classification which demonstrated membranes within the cyst cavity.



The 13 cysts chosen for percutaneous injection of alcohol were of significantly different volumes. The smallest cyst was approximately 26 cc and the largest was a giant cyst of volume nearly 4000 cc. The mean volume of the cysts were approximately 744 cc. The table 3 given below shows the distribution of volumes of the cysts that were taken up for percutaneous alcohol injection.

Table 3. Pre - procedure volumes of the cysts taken up for alcohol injection

No	***Pre procedure cyst volume in cc***
1	313 cc
2	203 cc
3	80 cc
4	26 cc
5	71 cc
6	48 cc
7	3200 cc
8	180 cc
9	4000 cc
10	414 cc
11	210 cc
12	207 cc
13	720 cc
Mean volume	744 cc

During the procedure, a pigtail catheter was used in 9 [69.2%] of them while in the other 4 [30.7%] the needle alone was used.

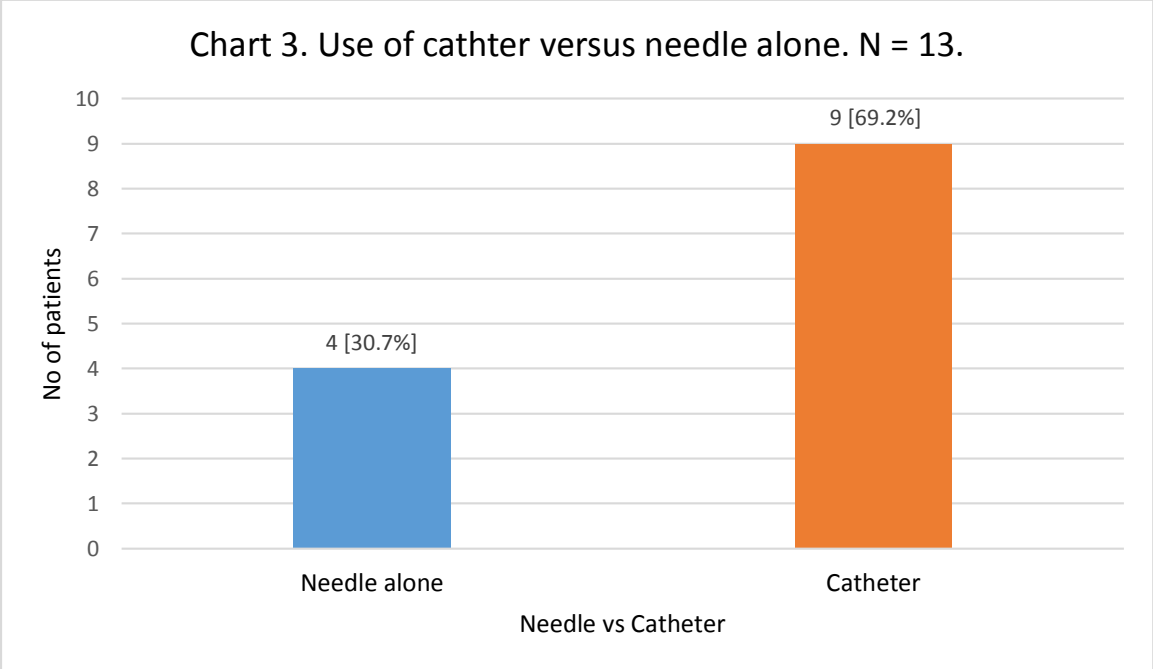


Fig 35. USG image showing placement of needle within the cyst cavity

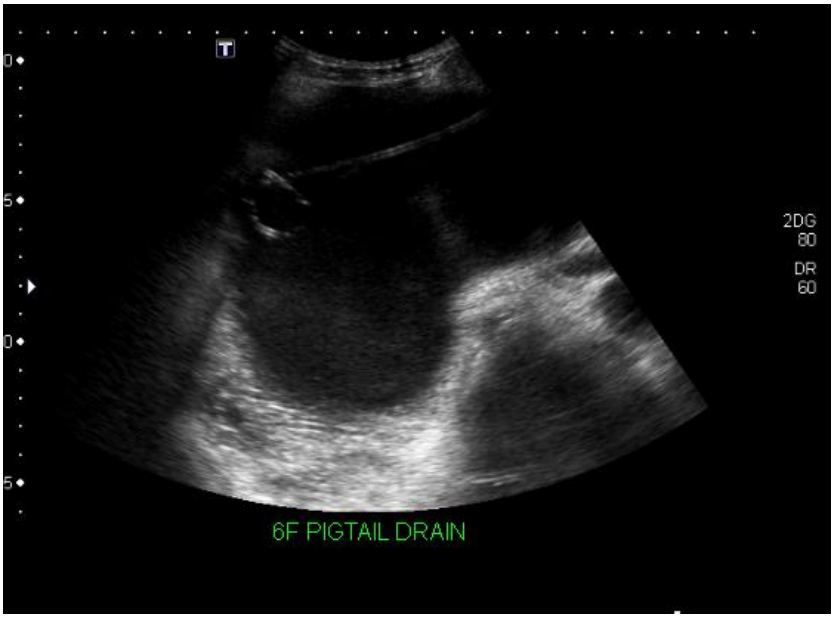


Fig 36: USG image showing a pigtail drain placed within the large cyst cavity.

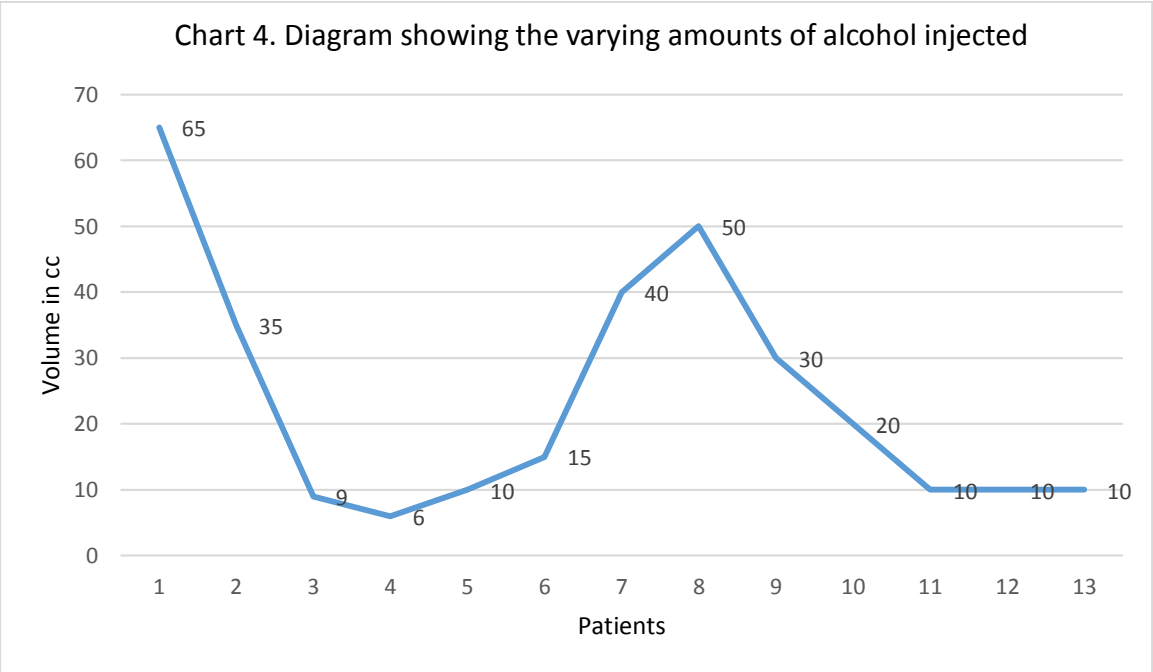
The aspirate was yellowish in colour for 9 of the patients while the other 4 showed clear aspirate. The cyst fluid bilirubin values ranged between 'nil' to 1.4 mg/dL. In 3 patients, the machine in the biochemistry lab was unable to process the sample because of the content being very thick. The volume of cyst fluid aspirated ranged between 15 cc to the largest cyst from which nearly 4000 cc of cyst fluid was aspirated. Table 4 below shows the volumes of cyst fluid that was aspirated.

Table 4. Distribution of volumes of the cyst fluid that were aspirated during the procedure.

No	***Volume of aspirated fluid in cc***
1	250 cc
2	150 cc
3	15 cc
4	20 cc
5	16 cc

6	35 cc
7	3200 cc
8	140 cc
9	4000 cc
10	180 cc
11	25 cc
12	100 cc
13	600 cc

This varied widely because the contents were not uniformly clear. Some of them showed very thick yellowish content and we were unable to aspirate fluid form them. The volume of alcohol injected varied from the lowest being approximately 9 cc and the highest being approximately 65 cc of absolute alcohol. The following chart 4 demonstrates the amounts of alcohol injected into the cysts.



All the patients tolerated the procedure well under local anaesthesia except one patient who experienced significant pain while the peritoneum and the liver capsule were punctured. He also co-operated well after being assured and later the pain reduced. The other sample that was sent to the parasitology lab for microscopic examination to look for Echinococcal scolices and or hooklets was also followed up. In this results, only 5 out of the 13 [~38.5 %] showed to be positive for Echinococcal scolices and hooklets while the other 8 out of 13 [61.5%] were negative and did not show any microorganisms in the cyst fluid. However these patients were treated with percutaneous alcohol injection because some of the patients had a history of previous surgery for liver Echinococcal cyst while the others were diagnosed as hydatid cysts based on the imaging findings and also as the patients were symptomatic and requested treatment. Another factor was that the microscopy results were mostly available only the next day and since the patient has already undergone an invasive procedure, alcohol injection was considered less risky than another sitting of the patient undergoing a second puncture of the cyst. Out of the other 10 patients in whom the procedure was stopped due to presence of very high bilirubin concentration in the aspirated fluid, 5 of them were positive for scolices and the other 5 were negative which accounts to 50 % in each category.

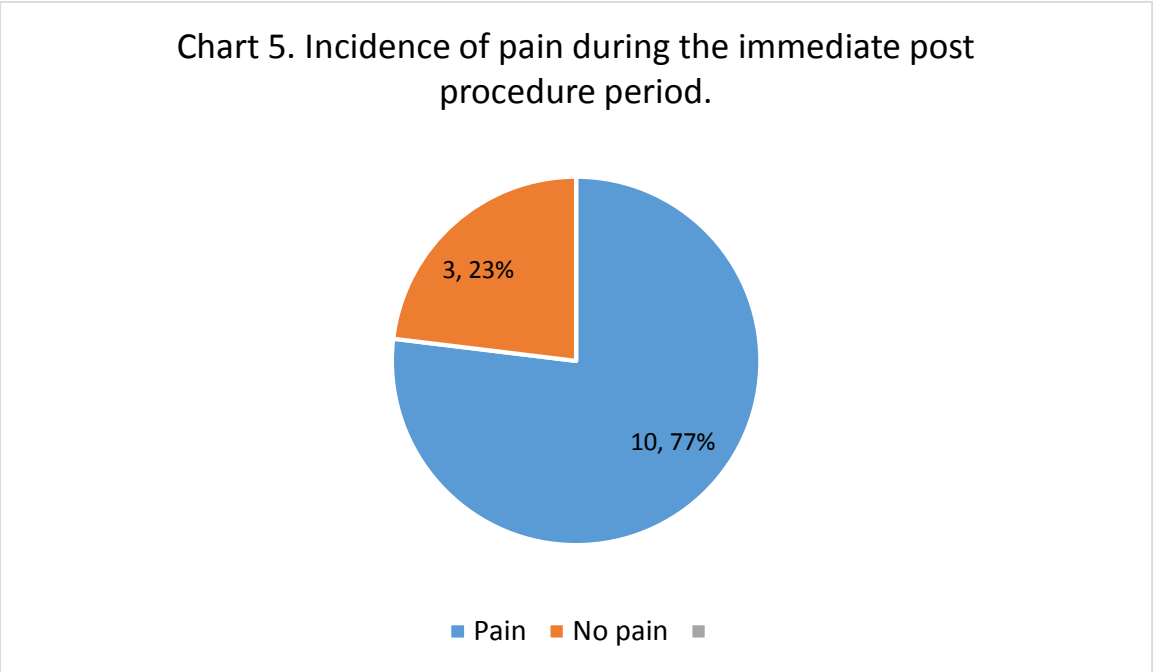
Table 5. Microscopy results of the patients in whom percutaneous alcohol injection was attempted.

	No of patients in whom alcohol was injected [N = 13]	No of patients in whom alcohol was **NOT** injected [N = 10]
Microscopy **+ve** for scolices and / or hooklets	5 [38.5 %]	5 [50 %]

Microscopy **-ve** for scolices and / or hooklets	8 [61.5 %]	5 [50 %]

Immediate post procedure observation:

Immediately after the procedure all the patients were shifted to the ward for observation. During this period, 10 [~ 77 %] patients complained of pain, 9 of them complained of mild pain at the puncture site and one complained of severe pain while the other 3[23%] did not complain of any pain. The duration of hospital stay depended on the patient's symptoms like pain and presence of fever. Chart 5 shows the duration of stay in the patients.



Four [~ 30 %] patients developed fever after injection of alcohol, one of them presenting with very high fever and required re-admission in the ward and observation for 24

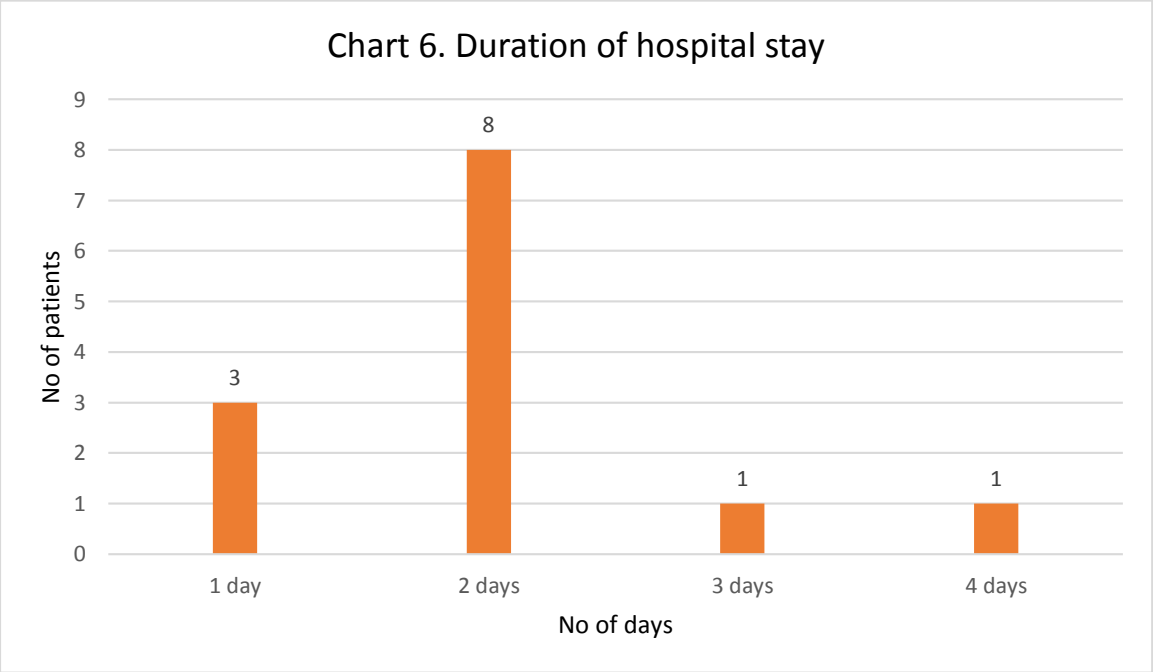
hours after which he was discharged in afebrile condition. The remaining 9 [70 %] patients had no fever during their stay in the hospital. Two patients had complications, one patient in whom the catheter after injection of alcohol was difficult to pull out and repeated attempts failed and finally a small fragment of the catheter got cut and had to be left inside the cyst cavity. All these patients were managed conservatively with analgesics and antipyretics and all of them recovered promptly. Documentations of the development of fever and the patient experiencing pain and its intensity were all recorded for data analysis. These are given as follows in Table 6.

Table 6. Incidence of fever in the immediate post procedure period.

S. No.	***Presence of fever and grade***
1	Present, low grade
2	Absent
3	Present, high grade and re-admitted in hospital
4	Absent
5	Absent
6	Absent
7	Present
8	Absent
9	Absent
10	Absent
11	Absent
12	Present
13	Absent

Total	Fever Present = 4 [30 %] Fever Absent = 9 [70%]

The duration of stay in the hospital varied from 1 to 4 days. Out of the 13 patients, 8 [61.5%] of them stayed for 2 days – this is because one of the earlier patients developed high fever after discharge following 24 hours of observation and hence the duration of observation was extended beyond 24 hours to avoid similar problems in future. Three [23%] patients stayed for a day in the hospital, 1 [~7%] patient stayed for 3 days and another 1 [~7%] patient stayed for 4 days in the ward. The reason for these two patients to have extended hospital stay is because they had persisting fever which was managed conservatively and they were discharged once they were afebrile. The mean hospital stay was 2 days. The following chart 6 represents the duration of stay of the patients.



The maximum number was 8 who stayed only 2 days in the hospital.

Follow up imaging and documentation:

All the 13 patients who underwent ultrasound guided percutaneous injection of alcohol into the liver Echinococcal cysts were asked to undergo follow up ultrasound imaging to assess the response to the treatment given. They were asked to come for multiple follow up imaging at specific times. The times prescribed were, soon after discharge, once at first month, once at third month, once at sixth month and the fourth visit at the first year from the date of injection. However since most of our patients were from a long distance away, they could not come for frequent visits as it would be very expensive and time consuming for them to travel and come to the institution. Hence imaging was done whenever the patients came back for review and the findings were documented.

Factors used in assessment of treatment response:

1) Clinical symptoms – persistence or relief from pain that was there prior to the procedure

2) Ultrasound imaging:
    a. Volume of the cyst – percentage reduction in the volume
    b. Sonographic appearance of the cyst to look for signs of response – features noted to show signs of response were reduction in size, detachment of membrane, heterogeneous appearance, solid or pseudotumor like appearance, presence of new foci of calcification

Follow up period and number of visits:

The follow up period of the patients who underwent percutaneous injection sclerotherapy for liver Echinococcal cysts with absolute alcohol in our study varied form 1 week to 11 months. One patient was lost for follow up. The number of follow up visits varied from 1 visit to 4 visits in this period of Although all the patients were advised to return for the follow up scans as many patients were from faraway places and it would be expensive for them to return for follow ups, they could not return for the post procedure follow up ultrasound scans and hence whenever they returned they were subjected to ultrasound examinations and findings recorded as mentioned earlier the features that suggested response to the therapy were recorded.

Table 7. Follow up duration of the patients

S. No.	***Follow up duration***
1	3 months
2	4 months
3	1 month
4	7 months
5	11 months
6	9 months
7	1 week
8	4 months
9	Lost for follow up
10	3 months
11	4 months

12	1 week
13	8 months
Mean follow up duration	4.6 months

Cyst volume reduction:

All the liver cysts that underwent injection sclerotherapy with sterile absolute alcohol were examined under ultrasound and the volumes reduction were documented. The volume of the cysts in their last follow up visit was calculated and compared with their volumes prior to the procedure and hence the percentage reduction in the volumes were derived. Considering the percentage reduction in volume as one of the predictors, the result of this parameter varied form 29.5 % to nearly 100 % [where in the cyst had completely disappeared and was replaced by solid tissue on imaging]. The cyst that showed the least percentage volume reduction measures approximately 210 cc before procedure and on follow up imaging showed a volume of approximately 148 cc of residual volume. The follow up period was approximately 4 months. The cyst that showed complete resolution and replacement with solid tissue measured approximately 71 cc prior to the procedure and at the end of the last follow up imaging was completely resolved. The smallest cyst that underwent percutaneous injection of alcohol measured approximately 26 cc which on follow up imaging measured approximately 6 cc with a reduction of 20 cc in volume and also showed a more solid ultrasound appearance. The percentage reduction was approximately 76.9 %. The follow up period for this patient was 7 months. The largest cyst that was injected with alcohol measured approximately 3200 cc [the largest cyst measuring approximately 4000 cc was the patient who was lost for follow up and

hence this is being described as the largest cyst injected with alcohol percutaneously] prior to the procedure and on follow up visit showed a markedly reduced volume and showed a volume of approximately 172 cc. The percentage reduction in volume was approximately 94.6 %. The follow up period of this patient was only a week. The mean reduction in the percentage volume was approximately 69.8% in 12 patients as one patient was lost for follow up. This value is also more than 2/3 volume reduction in the cysts indicating good treatment response. Among the 12 patients that returned for follow up, 10 [~ 83.3 %] of them showed a good reduction of more than 60 % volume reduction, 2 [~ 16.6 %] of them showed less than that and one patient as mentioned above was lost for follow up and the data is not available. The results are tabulated as follows in the given Table 8.

Table 8. Percentage reduction in volume of the cysts that underwent percutaneous alcohol injection.

S. No.	Pre procedure cyst volume	Volume at last follow up visit	Percentage reduction in volume
1	313 cc	270 cc	13.7 %
2	203 cc	5 cc	97.6 %
3	80 cc	25 cc	68.8 %
4	26 cc	6 cc	76.9 %
5	71 cc	Cyst not seen	100 %
6	48 cc	18 cc	62.5%
7	3200 cc	172 cc	94.6 %
8	180 cc	55 cc	69.4 %
9	4000 cc	Lost for follow up	Lost for follow up
10	414 cc	109 cc	73.6 %

11	210 cc	148 cc	29.5 %
12	207 cc	62 cc	70 %
13	720 cc	130 cc	81.9 %
Mean	744 cc	83.3 cc	69.8%

Image illustrations of some patients:

Case 1: A 74 year old gentleman with CE1 type cyst

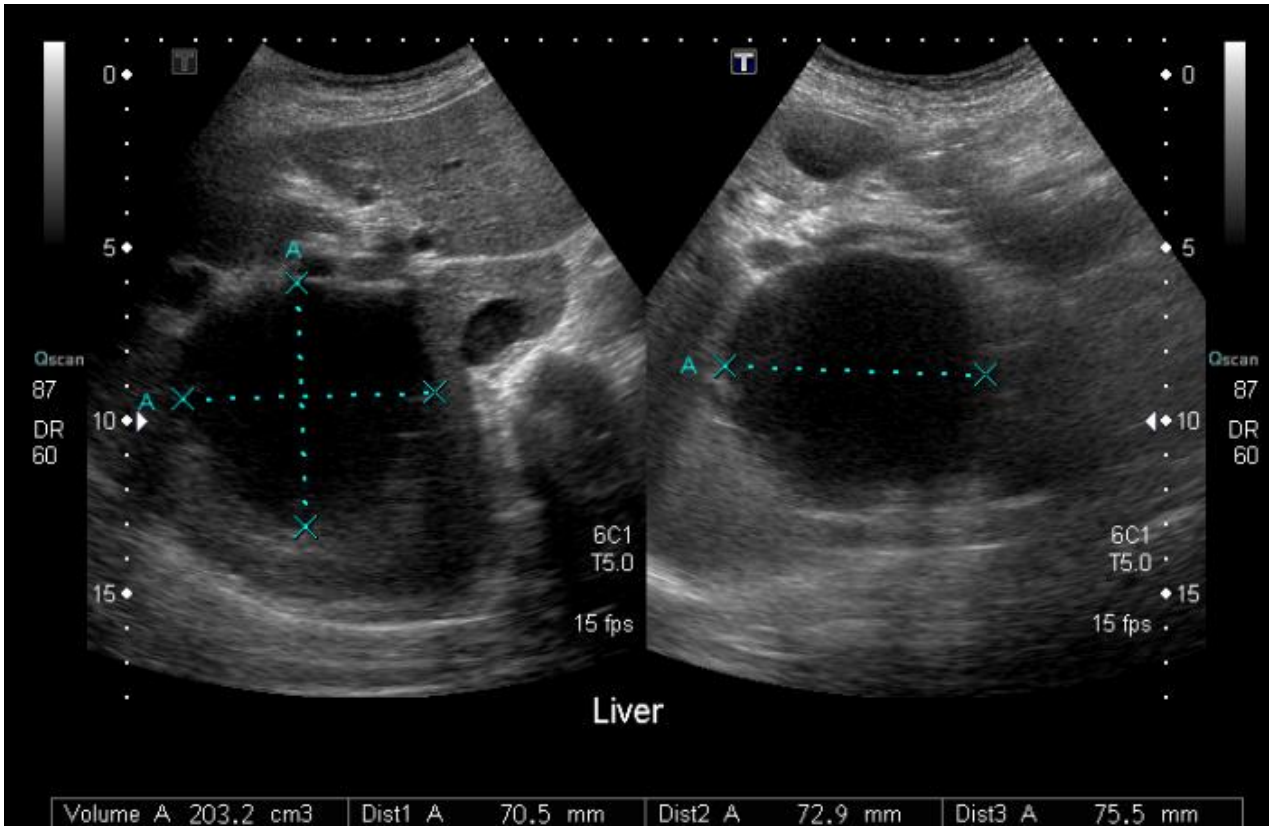


Fig 37: USG image showing a CE1 type cyst in the liver with a volume of approximately 203 cc.

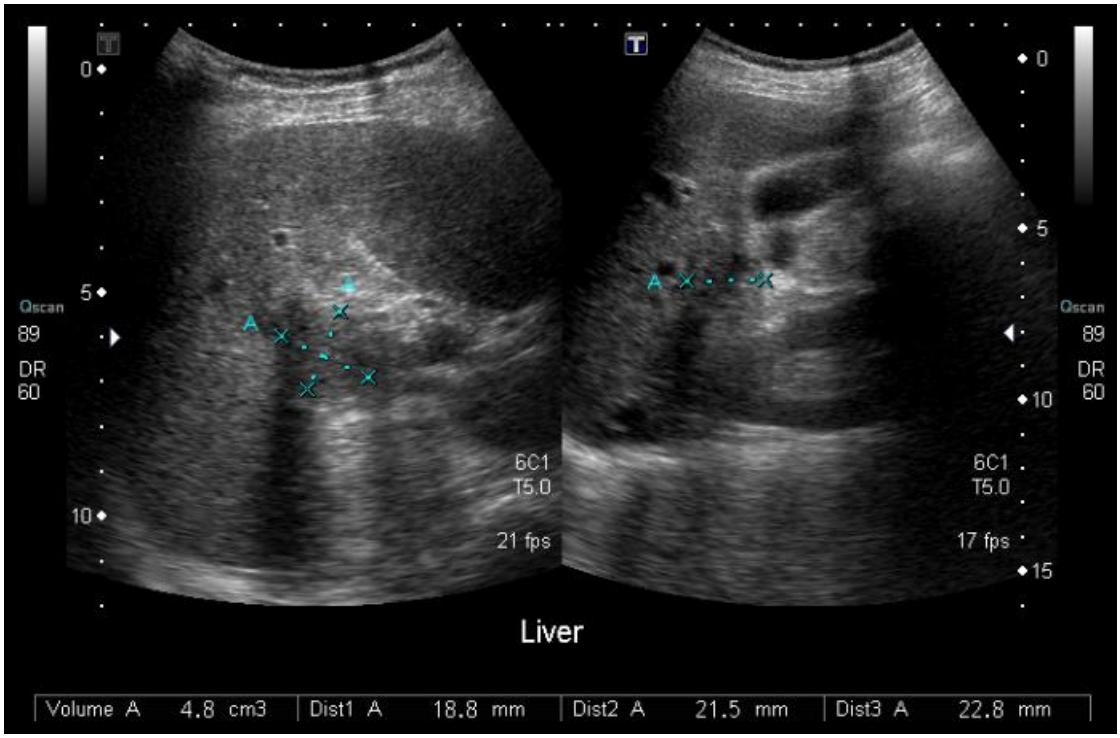


Fig 38: USG follow up image at 4 months showing near complete resolution.

Case 2: A 27 year old gentleman with a CE1 type cyst

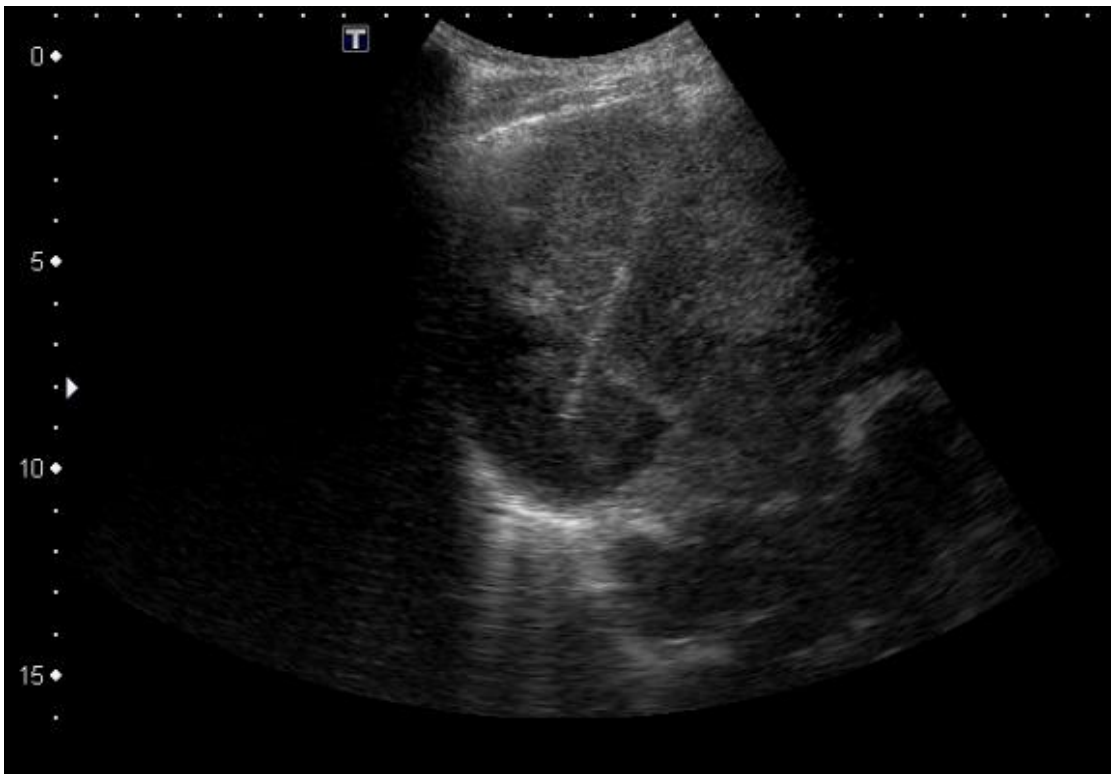


Fig 39: USG image showing a long needle advanced into the cyst in the right lobe of liver.

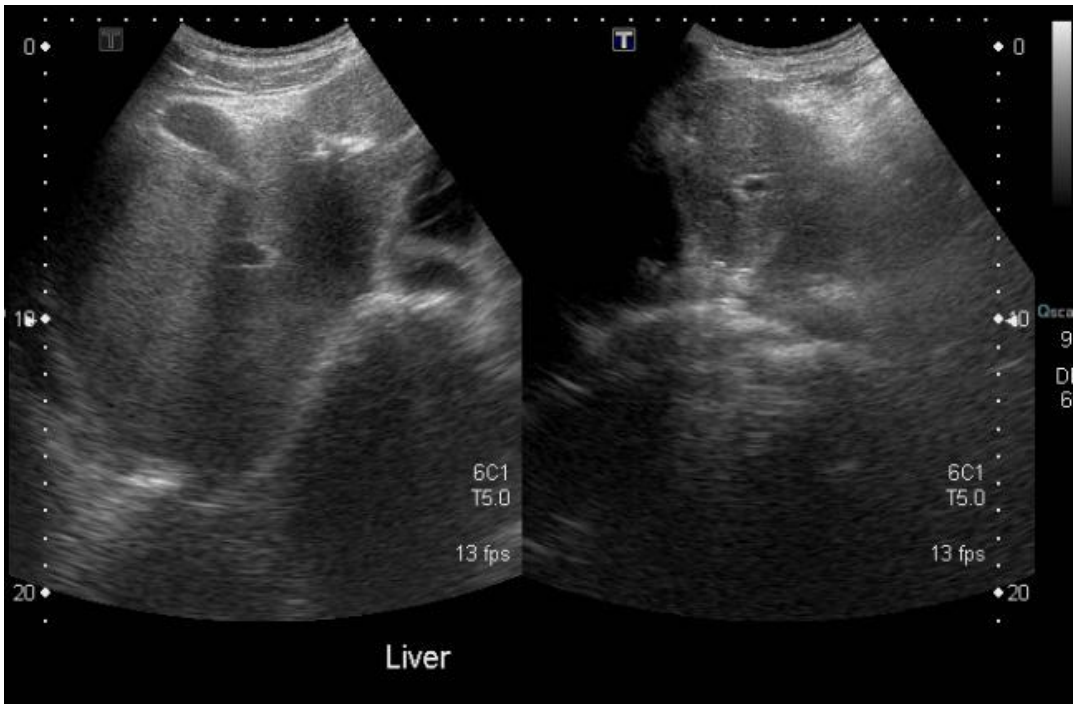


Fig 40: USG image showing the right lobe after 11 months - complete resolution of the cyst.

Case 3: A 21 year old lady with CE3 type cyst

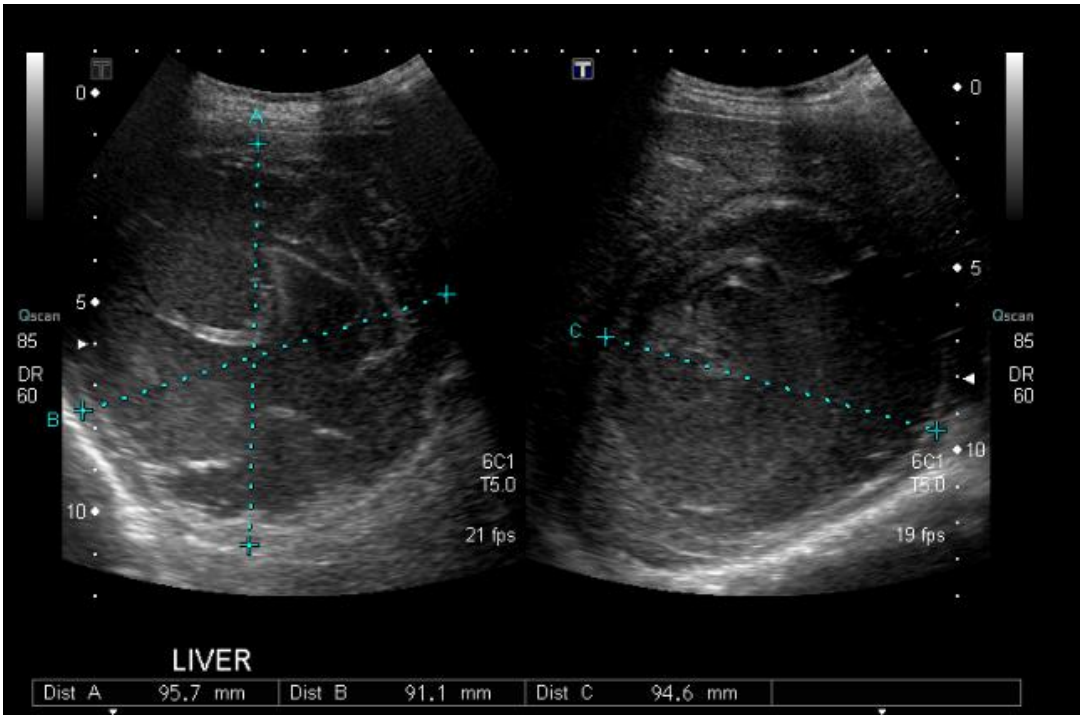


Fig 41: USG image showing CE3 cyst with membranes within.

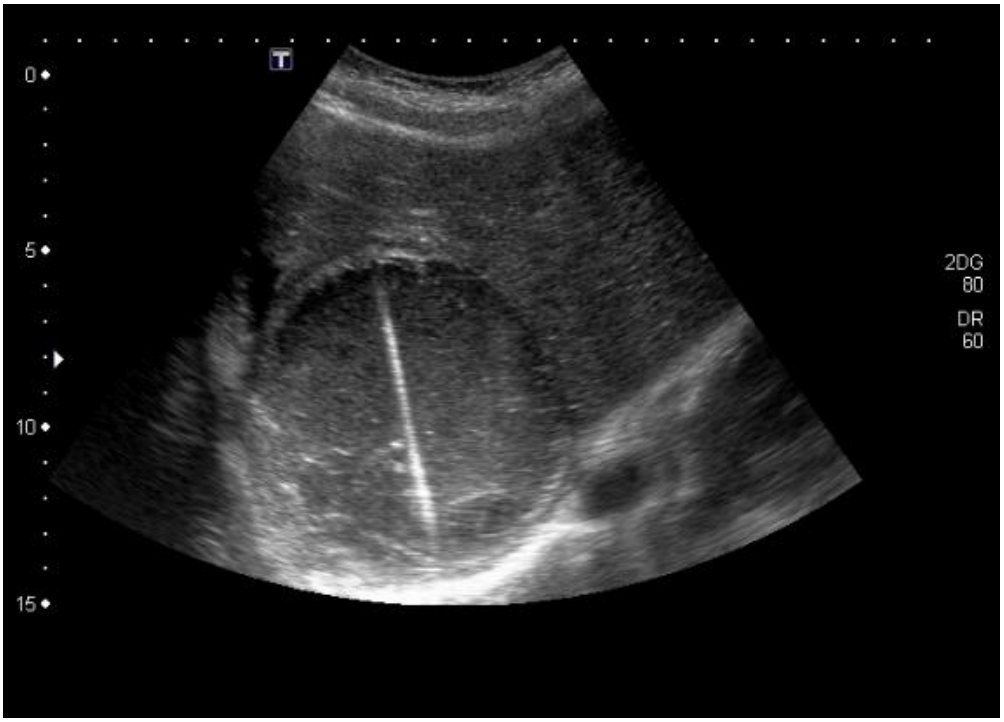


Fig 42: USG image showing guide wire being passed into the cyst

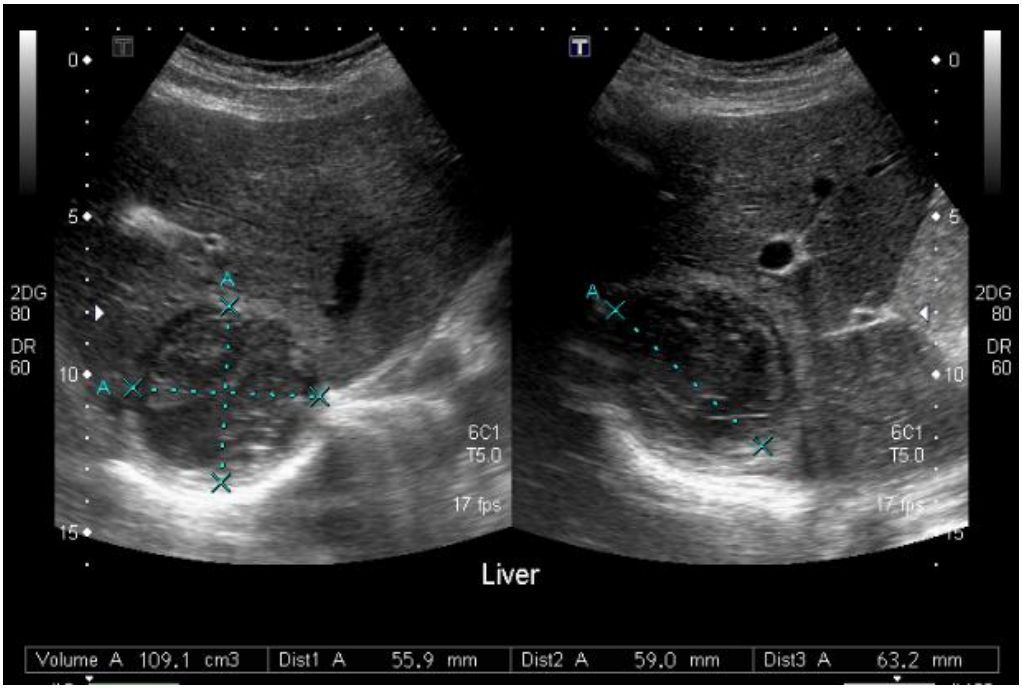


Fig 43: USG image showing marked reduction in the volume and more heterogeneous appearance of the cyst at the end of 3 months.

Changes in imaging appearance on follow up imaging:

The changes in the imaging appearance was also used as a predictor for response to percutaneous alcohol injection. These parameters included findings like reduction in size which is already described in detail above, detachment of the membrane, more heterogeneous appearance of the cyst, replacement of daughter cysts and appearing more heterogeneous, complete disappearance of the cyst and also a pseudotumor appearance where the cyst area is replaced by more solid appearing tissue in the liver. All these where considered good response to treatment and were recorded as positive changes following injection of absolute alcohol. Out of the 12 patients that came back for follow up, 2 [~16.6 %] of them showed detachment of membranes which is considered one of the good indicators for positive response to treatment. Three [25 %] patients showed that the cysts appeared more solid on follow up imaging. Three [25 %] other patients showed that the cysts had become more heterogeneous in appearance which again is considered as one of the indicators for good treatment response. One [8.3 %] patient showed a near complete resolution of the cyst with a percentage volume reduction of approximately 97.6%. Another patient [8.3%] showed a complete disappearance of the cyst which was totally replaced by solid tissue on follow up ultrasound imaging. The total number of patients who showed positive response to the treatment were 10 out of 13 which is approximately 83.3% of the patients. The other 2 [approximately 16.6%] patients in whom the cysts remained cystic even after injection showed marked reduction in volume of more than 60 %. Hence this was also considered good therapeutic response.

Table 9. Follow up USG imaging appearance of the cysts

S. No.	***Ultrasound appearance***
1	Detached membrane

2	Near complete resolution
3	More solid appearance
4	More solid appearance
5	Lesion not seen; complete resolution
6	Heterogeneous appearance with minimal residual fluid
7	Collapsing walls of the cyst seen
8	More solid appearance
9	Lost for follow up
10	Heterogeneous appearance
11	Disappearance of daughter cysts and more heterogeneous content
12	Residual cystic with significant reduction in size
13	Residual cystic lesion with retained catheter fragment within the residual cyst

Analysing the table, we make an inference that all of them showed some positive response to the treatment given.

Few examples to show the changes indicating good therapy response:

Three of these features, detachment of membranes, disappearance of daughter cysts and the cyst becoming more heterogeneous a thirdly the cyst becoming more solid in appearance are shown.

Detachment of membranes:

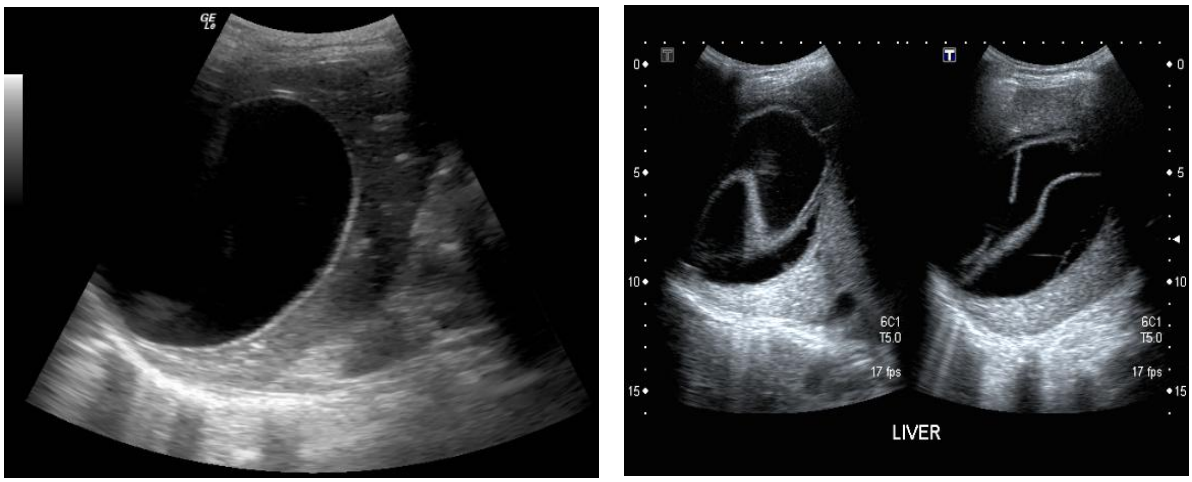


Fig 44 & 45: USG images showing a well-defined CE1 cyst with trilaminar membrane and following injection, there is detachment of membranes. This is a good indicator of positive response.

Disappearance of daughter cysts and more heterogeneous appearance:

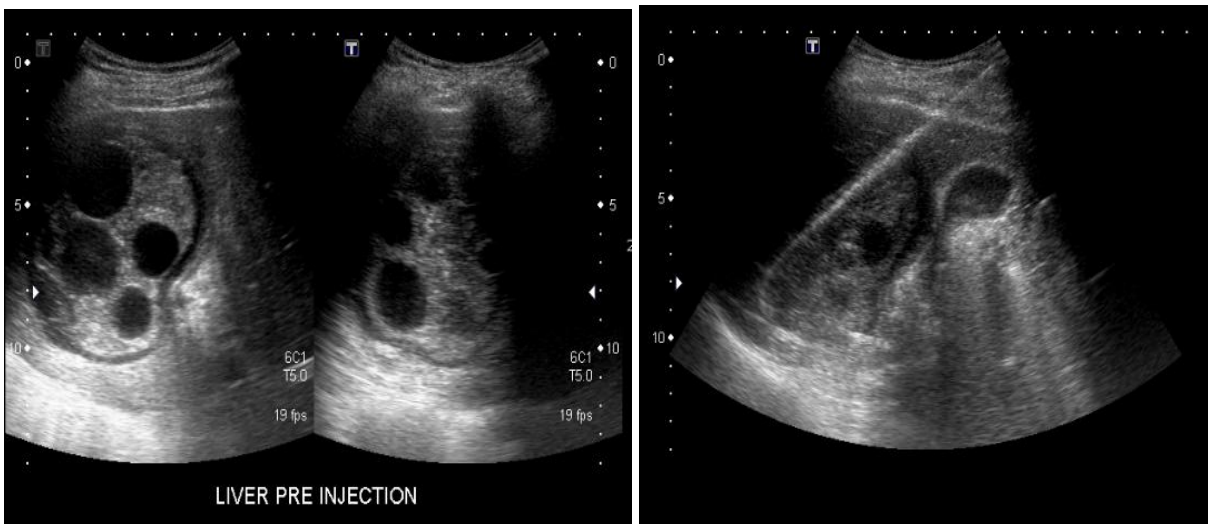


Fig 46 & 47: USG images showing cyst with daughter cysts and placement of guide wire.

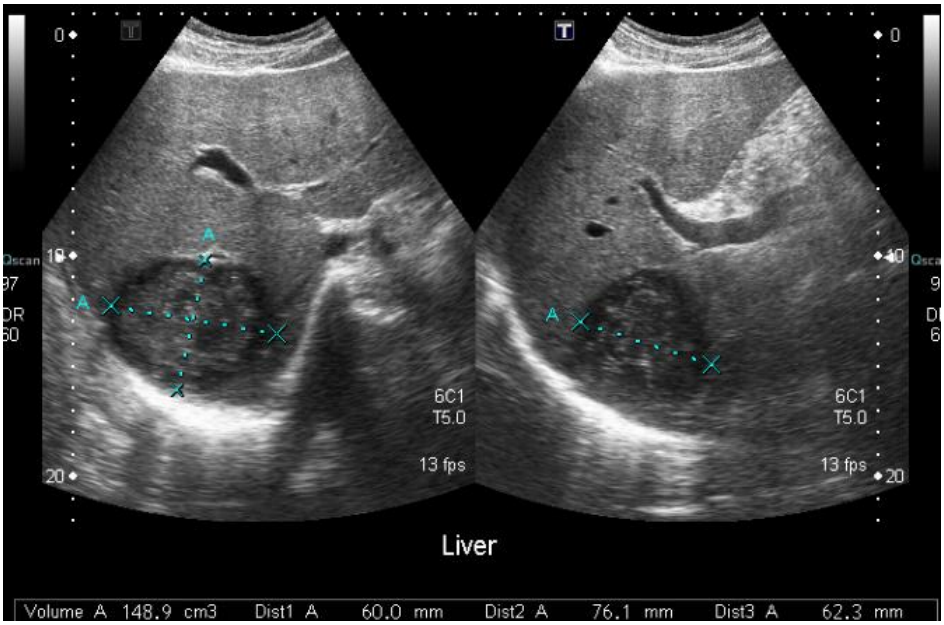


Fig 48: USG follow up image showing disappearance of daughter cysts and heterogeneous appearance with reduced volume of the cyst.

Change of appearance form cystic to more solid appearance:

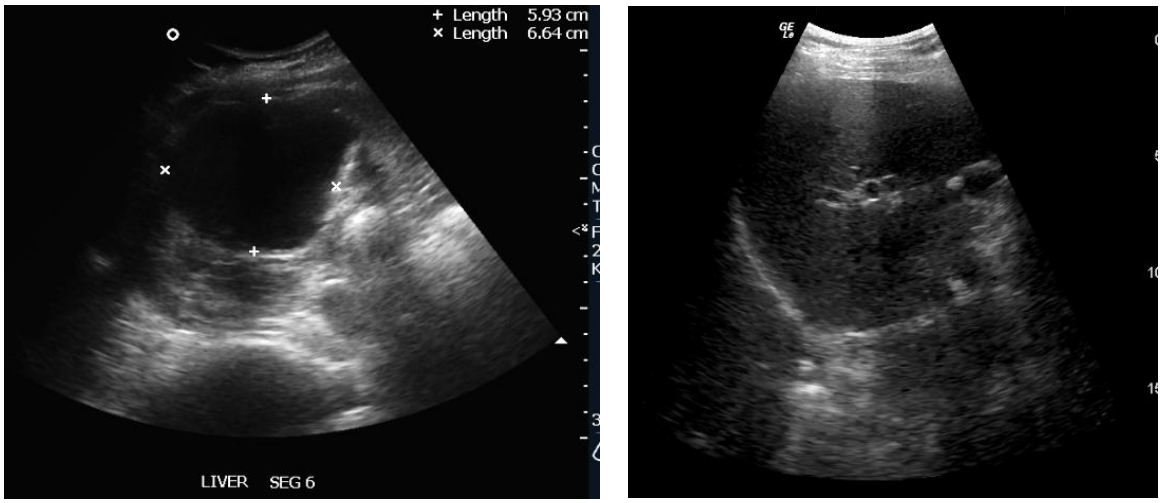


Fig 49 & 50: USG images showing a CE1 type cyst and during follow up after 4 months showed solid appearance in the region of the cyst.

Post procedure events and complications:

Minor complications:

During the immediate post procedure period, the two expected complications were fever and pain. These were seen in our patients also who underwent percutaneous injection of alcohol into liver cysts. As details were mentioned above 10 patients [76%] out of 13 had mild pain, 9 patients with mild pain and the other 1 patient had severe pain and both of which were managed with medication and did not lead to any further complication. Three out of 13 patients [23%] had no pain.

Fever is another expected complication in the patients who have had percutaneous injection of alcohol. In our study, 4 patients out of 13 patients [30%] had fever, 3 of them with mild fever while the fourth patient had severe fever requiring re-admission into the hospital and was treated with antipyretics and was discharged in afebrile condition. The other 9 patients [approximately 69 %] did not have fever.

Other major complications:

There were two major complications that occurred during the study. The details of these patients are as given below.

1) The retained catheter fragment:

In one patient, who was taken up for percutaneous absolute alcohol injection, we encountered an unexpected complication. The patient was a female patient, 48 years old and

had a large left lobe Echinococcal cyst of volume approximately 720 cc. The WHO IWGE classification of the cyst was CE1 type. A 6F Devon polyurethane pigtail catheter was used. The bilirubin levels were favourable and hence absolute alcohol was injected into the cyst. After completion of the injection, the pigtail catheter was about to be taken out and while it was being pulled, there was significant resistance more than the usual amount of resistance that is encountered. Pulling out the catheter was progressively more difficult and at one point suddenly the catheter snapped and a part of the catheter was retained inside the cyst cavity. The patient was taken to the fluoroscopy machine and was screened. The retained part of the catheter was seen. A snare was passed and an attempt to snare out the fragment was made however the attempt was unsuccessful. Finally since the catheter fragment was very difficult to be taken out, decision was made to leave it behind inside the cyst cavity and to follow up regularly for symptoms and other imaging features. The situation was discussed with the patient and her husband and after knowing about the condition, the options of follow up and surgical removal in case they wanted it removed were given to them and they had agreed for observation and the patient was shifter to the ward under Hepatobiliary surgical unit's in-patient care. The patient had an uneventful post procedural period and was discharged in stable condition.

On follow up, this particular patient had no symptoms related to the complication. Follow up ultrasound imaging was last done approximately 7 months after the procedure showed the presence of the retained fragment of the pigtail catheter was seen within the residual cyst cavity. The volume of the cyst measured approximately 130 cc during the last follow up and showed a percentage volume reduction of approximately 81.9 %. There were no other imaging findings in this patient. The patient and her husband were explained about the status and were advised on further follow up scans.

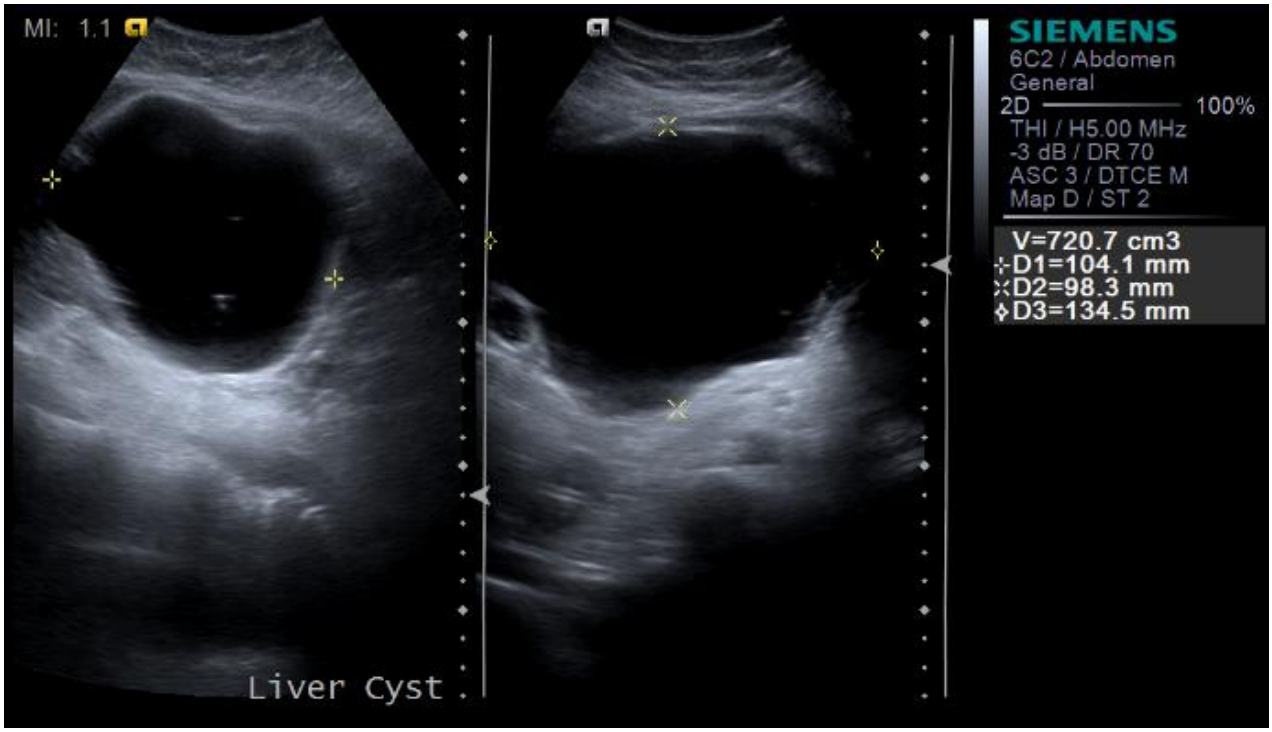


Fig 51: USG image of the cyst prior to procedure showing a CE 1 type cyst of volume ~ 720 cc.

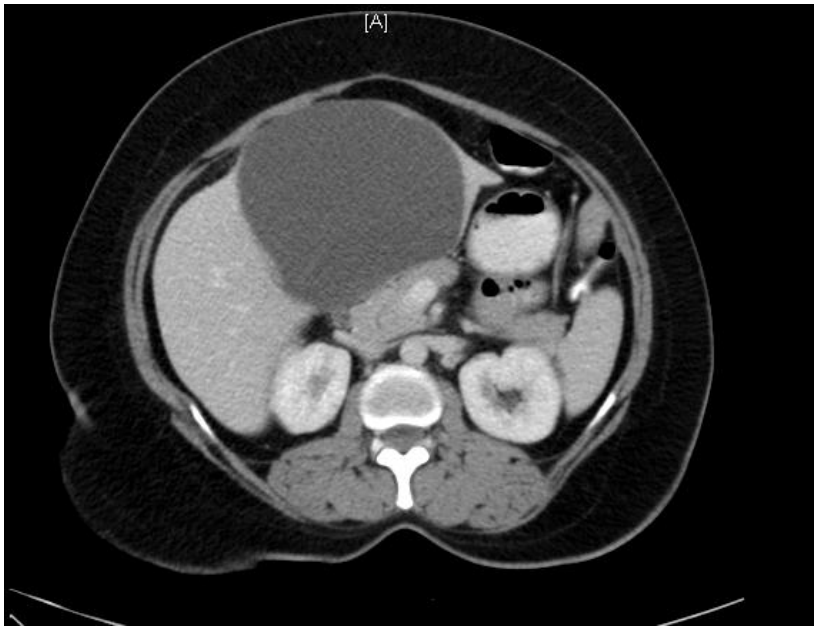


Fig 52: CT image prior to the procedure. The cyst is partly exophytic and is mostly seen in the left lobe.

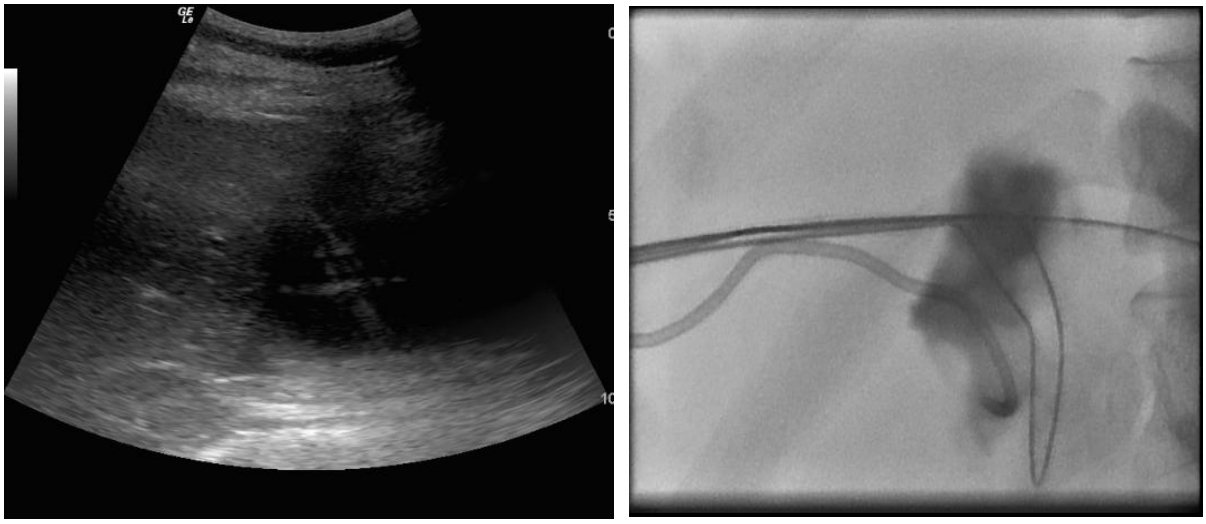


Fig 53 & 54: USG and Flouroscopy images showing that a part of the catheter has been retained within the cyst cavity and in the fluoroscopy image, a snare is being passed and an attempt is made to retrieve the retained fragment of the catheter. Attempts failed despite repeated tries and hence decision was made to leave the part of catheter inside and follow up the patient.

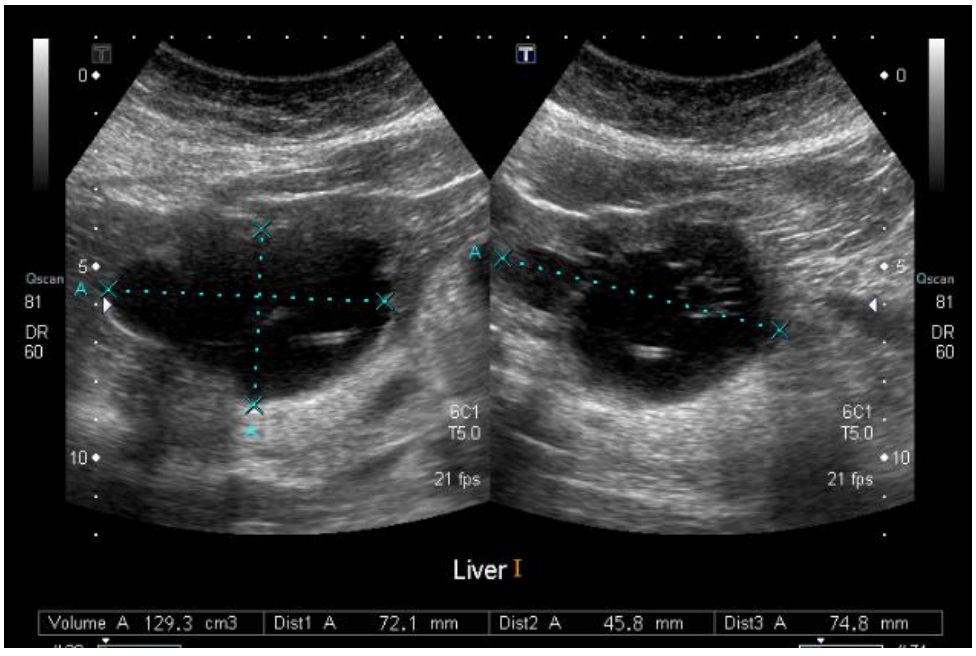


Fig 55: USG imaging during 7 month visit. There is reduction in volume of the cyst to approximately 130 cc at present.

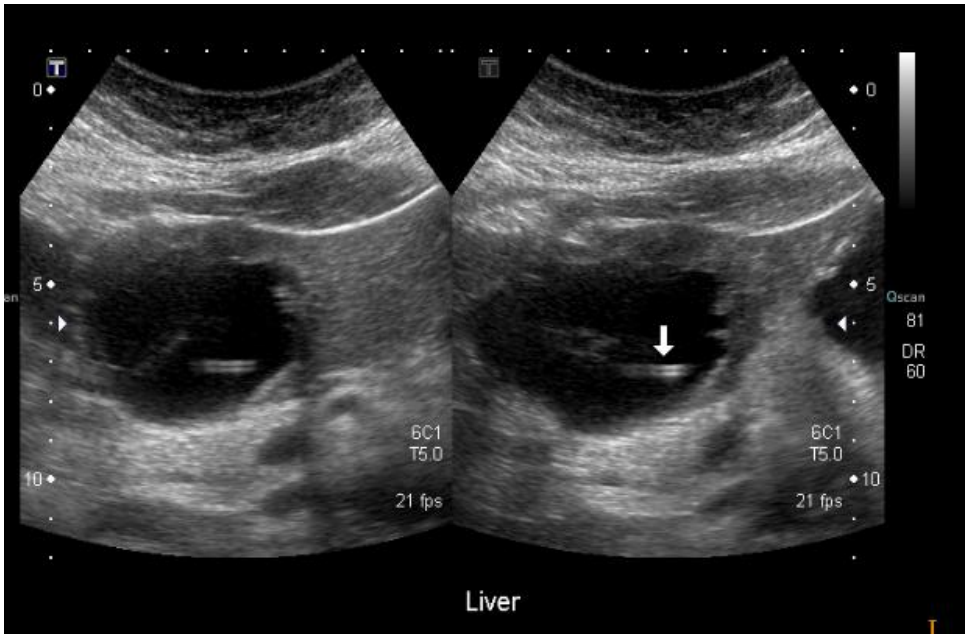


Fig 56: USG images during follow up showing retained catheter fragment within the cyst cavity. Clinically the patient did not have any symptoms.

2) Severe hypotension:

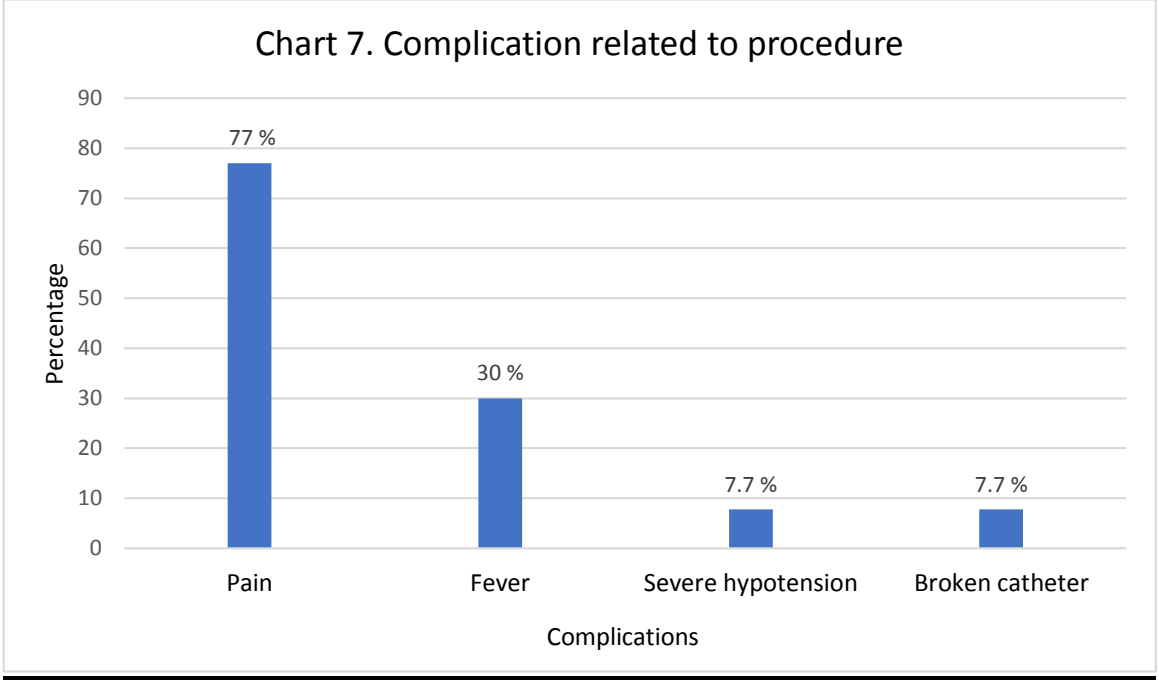
Another patient developed severe systemic hypotension during the procedure and required advanced medical care and life support in the surgical intensive care unit. The details of this patient and the procedure are as follows:

The patient was admitted under the Hepatobiliary surgical unit and was adequately sedated in the ward and was shifted to radiology department for the percutaneous injection sclerotherapy of the liver hydatid cyst. The patient was a female patient and was 35 years old. There was a large cyst in the left lobe of the liver. Volume of the cyst was approximately 650 cc. The WHO IWGE classification of the cyst was CE 1 type. During the procedure, the patient was given local anaesthesia and then the cyst was punctures under constant ultrasound guidance

an 18 gauge Chiba needle as passed into the cyst. Clear fluid was seen gushing through the needle when the stylet was taken out and approximately 10 cc of the clear aspirate was sent for examination. The bilirubin level in the fluid was <0.1 mg/dL. Hence decision to inject alcohol into the cyst cavity was made.

An Amplatz guide wire was passed into the needle and the aspiration needle was exchanged for a 6F pigtail catheter over the guide wire. Soon after the pigtail was placed, the patient started complaining of burning sensation all over her body and had an episode of vomiting. Clear fluid continued to flow out of the catheter. The vitals were stable at this point of time. Sooner, the patient's response decreased and the systolic blood pressure started falling to below 80 mm Hg. Intravenous fluids were rushed and since she became more unresponsive and the systolic blood pressure was not picking up, she was wheeled in to the Accident and Emergency Department which is located right next to the Radiology department. The time interval between the development of hypotension and shifting into Accident and Emergency department was approximately 5 minutes. In the Accident and Emergency department, she was provisionally diagnosed to have developed anaphylactic reaction to the hydatid contents during the puncture and hence was treated with anti-anaphylactic treatment. Since she was unable to sustain self-breathing, she was also intubated and ventilated. Within fifteen minutes, she recovered and regained her consciousness. She has stabilized vitals. However she was restless and hence she was sedated further with intravenous Diazepam. The Hepatobiliary surgical unit was informed about the patient and after stabilizing her, decision was made to shift her to the surgical intensive care unit for monitoring. The percutaneous pigtail catheter was left in place. After a day of monitoring in the surgical intensive care unit, she was extubated and was off the ventilator. She was shifted back to the ward and was stable. She was observed in the ward for 4 days during which time there was drainage of clear fluid. The total fluid drained was

approximately 600 cc. On the fifth day, as she was symptom free and stable, a decision was made to inject alcohol into the cyst cavity through the pigtail catheter which was in place. However when the patient was re-assessed prior to the injection, the drain showed a yellowish fluid and the drain fluid bilirubin when sent for biochemical analysis was 10.18 mg/dL. Hence a newly developed probable biliary communication was considered and the injection was abandoned. She later underwent open hydatid cyst operation and was later discharged at stable condition. She is on follow up and is currently asymptomatic.



In the above chart we can see that there were many patients who had pain, mostly mild and fever was also seen in few patients. All were managed conservatively with no requirement of major intervention.

DISCUSSION:

In our study which was carried out for a period of approximately 17 months, we had a total of 30 patients referred to the department of Radiology in our institution for percutaneous injection therapy of liver Echinococcal cysts. Out of these 30 patients, 7 of them did not receive the percutaneous alcohol injection therapy due to different reasons mentioned above. The remaining 23 patients were taken up for percutaneous injection of alcohol into the liver cysts. Since injection of alcohol would cause more problems like cholangitis in case there is biliary communication with the cyst cavity, bilirubin levels in the aspirate from the cyst cavity was estimated biochemically and a level that was more than thrice the serum bilirubin values was considered to be a contraindication. During the procedure, 10 patients out of 23 had a cyst fluid aspirate bilirubin level of more than thrice their serum bilirubin values. Hence further injection of alcohol into the cyst cavity was not carried out and these patients were sent to the Hepatobiliary surgical unit for other methods of treatment like laparoscopic or open surgery for liver hydatid cysts. Then finally 10 patients underwent successful treatment for the liver Echinococcal cysts and their results were documented and have been presented earlier. Hence the percentage of favourable bilirubin levels was 76.9%. Out of these 13 patients who underwent percutaneous injection of absolute alcohol into the liver Echinococcal cysts, there were minor complications like pain and fever which have already been well documented in literature. In our study, the statistics show that 10 patients [76%] out of 13 had mild pain, 9 patients with mild pain and the other 1 patient had severe pain and both of which were managed with medication and did not lead to any further complication. Three out of 13 patients [23%]

had no pain. Fever has also been described in the literature as one of the known complications of this procedure and in our study, 4 patients out of 13 patients [30%] had fever, 3 of them with mild fever while the fourth patient had severe fever requiring re-admission into the hospital and was treated with antipyretics and was discharged in afebrile condition. The others did not have fever. The fever and pain rated were higher than the results that were published in meta analysis results published by Smego et al.(7)

Two patients had major complications, in one patient the catheter got cut off and a fragment had to be left behind as all attempts including snaring it out under fluoroscopy failed. The patient underwent injection of alcohol however. She is asymptomatic at present, about eight months post procedure follow up while the catheter fragment is clearly visible on follow up examination within the residual cyst cavity.

The other patient is a female patient who developed severe hypotension soon after the placement of a 6F pigtail within the cyst cavity and required intensive care in the surgical ICU for a day following which she was stable and discharged. In her case again since the fluid changed to yellowish colour on the fourth day and since the fluid bilirubin at that time was very high, decision was made not to inject alcohol into the cyst cavity and later the patient underwent surgical treatment for the same during the same period of hospitalization and is currently asymptomatic and doing well. This was in retrospect thought to be due to anaphylaxis and the complication rate was 7.7 % which matches with the meta analysis results that were published by Smego at al who showed an anaphylactic reaction rate of 7.9 %. (7)

The protocol for patient selection, indications, contraindications, technical aspects and all the equipments required have been described in detail in this study description. The

complications that occurred in our study, both major and minor complications are described and also the way they were handled also has been described in the description. The follow up imaging protocol, the parameters described like percentage volume reduction in the cysts that underwent the percutaneous alcohol injection therapy and also change in the ultrasound imaging appearance of these cysts were described.

One of the major parameters that indicated the response to percutaneous alcohol injection therapy, reduction in size which was objectively calculated and documented as percentage reduction in the cyst volume was used to indicate good therapeutic response. Out of the 13 patients that underwent percutaneous alcohol injection, 12 of them returned for follow up. The mean reduction in the percentage volume was approximately 69.8% in 12 patients as one patient was lost for follow up. Among the 12 patients that returned for follow up, 10 [approximately 83.3 %] of them showed a good reduction of more than 60 % volume reduction, 2 [approximately 16.6 %] of them showed less than that and one patient as mentioned above was lost for follow up and the data is not available.

While the other parameters considered were change in ultrasound imaging appearance as detachment of membranes, change in the cystic appearance and becoming more solid like appearance or more heterogeneous appearance and also disappearance of daughter cysts were also considered good therapeutic response. In this imaging assessment, 2 [approximately 16.6 %] of them showed detachment of membranes which is considered one of the good indicators for positive response to treatment. Three [25 %] patients showed that the cysts appeared more solid on follow up imaging. Three [25 %] other patients showed that the cysts had become more heterogeneous in appearance which again is considered as one of the indicators for good treatment response. One [16.6 %] patient showed a near complete resolution of the cyst with a

percentage volume reduction of approximately 97.6%. Another patient [16%] showed a complete disappearance of the cyst which was totally replaced by solid tissue on follow up ultrasound imaging. Hence the percentage of patients showing good response change in imaging appearance was 10 out of 12 which is approximately 83.3% of the patients. The other 2 [approximately 16.6%] patients in whom the cysts remained cystic even after injection showed marked reduction in volume of more than 60 %. Hence that was also considered a positive therapeutic response.

In our study, the scolicidal agent used was 95% ethanol [absolute alcohol] which has already been proven in the literature to be an effective scolicidal agent. The other commonly used scolicidal agent is 20 % hypertonic saline which has also been proven as a safe and effective scolicidal agent for Echinococcal cysts in and outside the liver. Comparing these two agents, we found that alcohol is a very safe and cheaper scolicidal agent as compared to the 20 % hypertonic saline that has been commonly used however is cumbersome to produce.

Complication rates that we had in our study were divided into minor and major complication rates. Minor included pain and fever. In this study, 10 patients [76%] out of 13 had mild pain, 9 patients with mild pain and the other 1 patient had severe pain and both of which were managed with medication and did not lead to any further complication. Three out of 13 patients [23%] had no pain. In our study, 4 patients out of 13 patients [30%] had fever, 3 of them with mild fever while the fourth patient had severe fever requiring re-admission into the hospital and was treated with antipyretics and was discharged in afebrile condition. The other 9 patients [approximately 69 %] did not have fever. The minor complication rates were more in our study than the published data in literature however our patients did not require any major intervention because of that and they recovered with conservative management. One

patient [approximately 7.6 %] had a major complication, a severe hypotension during the procedure. Another patient had an unexpected complication of the catheter breaking while being taken out with a retained fragment of the catheter being inside the cavity however has not caused any further complications till the last follow up of 8 months duration.

Another advantage of the percutaneous alcohol injection procedure for liver hydatid cysts is that the duration of hospital stay decreases significantly compared to the open surgical procedure or even the laparoscopic surgery. The duration of stay in the hospital varied from 1 to 4 days. Out of the 13 patients, 8 [61.5%] of them stayed for 2 days. The mean hospital stay was 2 days.

LIMITATIONS

The major limitation of this study is that the sample size is small. Only 13 patients underwent successful percutaneous injection therapy for liver hydatid cysts with absolute alcohol. This is partly because the procedure is still not well established and less patients get referred to the Radiology department for this mode of therapy. The same is also partly because once the patient is posted for the procedure, the bilirubin values that come back after the initial aspirate is sent for biochemical analysis cuts down the number of patients significantly. Since presence of biliary communication is a contraindication to injection of alcohol, the procedure cannot be carried out further. The second major limitation of the study is that not all the patients come for regular follow up visits. The reason for this is that many patients come from far off places and frequent visits would be very expensive especially in our country where many of patients are from low socioeconomic status group. Another newly encountered limitation was

availability of absolute alcohol for clinical use. Since the government regulates the usage of absolute alcohol, sometimes adequate quantities of alcohol was not available for injection sclerotherapy. The duration of follow up was another limitation. Since it is well known that hydatid cysts in the liver take a longer time to show good response to treatment, a longer follow up period is required to see the actual efficacy and the long term effects of this mode of treatment.

CONCLUSIONS

In conclusion, in our experience of treating patients with liver Echinococcal cysts with percutaneous injection of absolute alcohol using either aspiration needles or pigtail catheters, we showed that this procedure has been a very safe and effective procedure for this condition. However this has to be done as an in-patient procedure and not as an out-patient procedure as complications need to be managed promptly and some might require intensive management. The World Health Organization – Informal Working Group on Echinococcosis [WHO - IWGE] described the various types of the liver Echinococcal cysts and the recommended guidelines on how to perform the procedure. Various techniques have been studied and practiced by different centres, some involving percutaneous puncture, aspiration, injection and reaspiration [PAIR], the same with catheter drainage [PAIRD], just injection of scolicidal agent without reaspiration [PAI] etc. with good comparable results. Any of these techniques could be followed. Different scolicidal agents are also being used for the purpose varying from 20% hypertonic saline, absolute alcohol [95% ethanol], povidone iodine solution, and Albendazole solution etc. all of them showing reasonably good results. This study shows that absolute alcohol can be used as a very good scolicidal agent for the same purpose. However

the procedure requires certain skill in performing ultrasound guided liver puncture and should be carried out only by personnel with proper training in performing ultrasound guided procedures. All the necessary equipments and a good surgical unit specialized in Hepatobiliary surgery and also a good intensive care unit should also be present in the centre where such procedures are carried out for backup in case the patient needs to be taken to theatre immediately or needs intensive care in an ICU setting if major complications arise as was seen in one of our patients. Although this procedure has been described well in the literature, it is still not well established and more prospective studies are required to establish the efficacy and safety of the procedure. More studies in future will also show that the percutaneous injection therapy for liver Echinococcal cysts is also very cheaper compared to surgical therapy, lessens the duration of hospital stay and is also more tolerable for the patients. Hence more prospective studies with long duration follow ups are required to show the long term efficiency and other long term outcomes of this method of treatment for liver Echinococcal cysts.

BIBLIOGRAPHY

1. Raymond A. Smego, Jr.,. Percutaneous Aspiration-Injection-Reaspiration Drainage Plus Albendazole or Mebendazole for Hepatic Cystic Echinococcosis: A Meta-analysis. Clin Infect Dis. 2003;37:1073–83.

2. Kammer WS. Echinococcal disease. Infect Dia Clin North Am. 1993;7:605–18.

3. Reddy CRRM. Epidemiology of hydatid disease in Kurnool. Ind J Med Res. 1986;56:1205–20.

4. S Nepalia. Management of Echinococcosis. JAPI. 2006 Jun;54.

5. Echinococcosis / Hydatidosis. OIE Terrestrial Manual. 2008.

6. WHO. PAIR: Puncture, Aspiration, Injection, Re-Aspiration An option for the treatment of Cystic Echinococcosis [Internet]. 2001. Available from: http://whqlibdoc.who.int/hq/2001/WHO_CDS_CSR_APH_2001.6.pdf

7. Smego RA, Bhatti S, Khaliq AA, Beg MA. Percutaneous Aspiration-Injection-Reaspiration Drainage Plus Albendazole or Mebendazole for Hepatic Cystic Echinococcosis: A Meta-analysis. Clin Infect Dis. 2003 Oct 15;37(8):1073–83.

8. Fìlice C, Brunetti E, Bruno R, Crippa FG. Percutaneous drainage of echinococcal cysts (PAIR—puncture, aspiration, injection, reaspiration): results of a worldwide survey for assessment of its safety and efficacy. Gut. 2000 Jul 1;47(1):156–7.

9. Paksoy Y, Ödev K, Şahin M, Arslan A, Koç O. Percutaneous Treatment of Liver Hydatid Cysts: Comparison of Direct Injection of Albendazole and Hypertonic Saline Solution. Am J Roentgenol. 2005 Sep;185(3):727–34.

10. Hepatic Cysts Treatment & Management. 2012 Oct 15 [cited 2013 Dec 8]; Available from: http://emedicine.medscape.com/article/190818-treatment

11. Schipper HG, Laméris JS, van Delden OM, Rauws EA, Kager PA. Percutaneous evacuation (PEVAC) of multivesicular echinococcal cysts with or without cystobiliary fistulas which contain non-drainable material: first results of a modified PAIR method. Gut. 2002 May;50(5):718–23.

12. Dwivedi M, Misra SP, Dwivedi S, Kumar S, Misra V. Percutaneous treatment of hepatic hydatid cysts using hypertonic saline. J Assoc Physicians India. 2002 May;50(5):647–50.

13. Giorgio A, Tarantino L, Stefano G de, Francica G, Mariniello N, Farella N, et al. Hydatid liver cyst: an 11-year experience of treatment with percutaneous aspiration and ethanol injection. J Ultrasound Med. 2001 Jul 1;20(7):729–38.

14. Ustünsöz B, Akhan O, Kamiloğlu MA, Somuncu I, Uğurel MS, Cetiner S. Percutaneous treatment of hydatid cysts of the liver: long-term results. AJR Am J Roentgenol. 1999 Jan;172(1):91–6.

15. Varro J, Mathew L, Athyal RP, Khafagy AH. Percutaneous alcohol sclerotherapy of a hepatic hydatid cyst after balloon occlusion of a large biliary communication. Med Princ Pract Int J Kuwait Univ Health Sci Cent. 2011;20(5):477–9.

16. Patel IJ, Davidson JC, Nikolic B, Salazar GM, Schwartzberg MS, Walker TG, et al. Consensus Guidelines for Periprocedural Management of Coagulation Status and Hemostasis Risk in Percutaneous Image-guided Interventions. J Vasc Interv Radiol. 2012 Jun;23(6):727–36.

APPENDIX 1: PROFORMA

PATIENT INFORMATION:

S. No:

Name:

Age:

Sex:

Address:

Phone number:

Email ID:

PRE PROCEDURE:

Imaging: USG / CT / MRI

Imaging Findings including WHO Type of cyst:

Pre-procedure cyst volume:

Completed medical therapy: yes / no

PROCEDURE:

Bleeding parameters:

- PT / INR
- aPTT
- Platelet count

Blood borne viral screen: HIV / HBsAg / HCV

LFT & Total bilirubin:

Catheter / needle only:

Volume of fluid aspirated:

Cyst fluid bilirubin:

Microscopy:

Volume of alcohol injected:

Intraprocedural complications:

IMMEDIATE POST PROCEDURE PERIOD:

Pain: mild / severe / no pain

Fever: low grade / high grade / no fever

FOLLOW UP:

Date:

Interval between procedure and last follow up:

Imaging: USG / CT / MRI

Volume of cyst:

Percentage reduction in volume:

Change in imaging appearance:

OTHER COMMENTS:

APPENDIX 2: CONSENT FORM

CHRISTIAN MEDICAL COLLEGE & HOSPITAL, VELLORE

RADIOLOGY DEPARTMENT

CONSENT FOR USG GUIDED THERAPEUTIC RADIOLOGICAL PROCEDURES

Patient Name: **Age / Sex:**

Hospital Number:

Name of the procedure: Ultrasound guided percutaneous alcohol injection into liver hydatid cyst

I confirm that I have explained the risks and benefits of the USG guided therapeutic radiological procedure in terms and language which in my judgement are suited to the understanding of the patient and / or one of the parents / responsible relative of the patient. The type of anaesthesia will be as deemed appropriate by the doctor.

Name of the Doctor:

Signature of the Doctor:

Employment number:

Date:

Patient / Parent / Guardian:

I agree to the proposed procedure and anaesthesia. The doctor whose name is on this form has explained the risks and benefits of the same to me. I have understood the risks and benefits of the procedure.

Name:

[Patient / Parent / Relative]

Signature:

Date:

This form must be filed with the in-patient chart.