Minimally invasive techniques:

Feedback on the implementation of PAIR

Retours d'expérience sur la mise en oeuvre du PAIR

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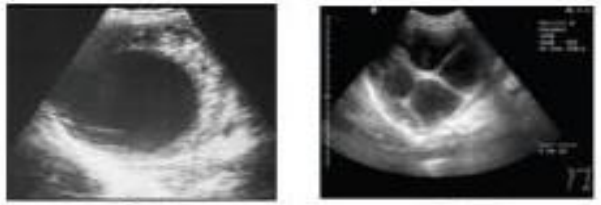
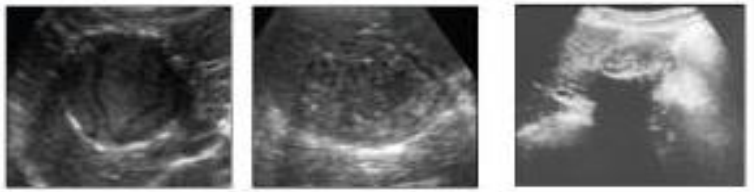
The ultrasonography remains the most used diagnostic method
Appropriate staging of the hydatid cysts needs
the standard classification WHO-IWGE on Cystic Echinococcosis ,
which modifies the older Gharbi's classification :

Gharbi 1981	WHO classification (cyst types)		
Type I	Univesicular anechoic cystic lesion with double line sign (CE1)	Active	 CE 1 CE 2
Type III	Multiseptated, "rosette-like"/ "honeycomb" cyst (CE2)		
Type II	Cyst with detached membranes "water-lilly-sign" (CE3a) Cyst with daughter vesicles in solid matrix (CE3b)	Transition	 CE 3a CE 3b
Type IV	Cyst with heterogenous content (hypoechoic/hyperechoic). No daughter vesicles (CE4)	Inactive	 CE 4 CE 5
Type V	= CE4 plus calcified wall (CE5)		

In the last 3 decades, minimally invasive techniques (percutaneous) have been applied more and more, gaining a larger field from the classic surgical procedures

THE GOAL OF THE TREATAMENT IN CYSTIC ECHINOCOCCOSIS

CONSERVATIVE OPEN SURGERY	PERCUTANEOUS METHODS
Inactivate the parasite	Use hipertone NaCl solution (ideal 30-33%)
Evacuate the cyst's cavity	Percutaneous drainage
Remove the germinative membrana	Percutaneous drainage
Obliterate the restant cavity in time	Mantaining the drainage in place as in the conservative open surgery

Minimally invasive procedures:

Percutaneous technique

PAIR
(Punctioning, Aspiration, Injection, Re-aspiration)

P A I R

(*Puncture, Aspiration, Injection, Re-aspiration*)

Ben Amor N., Margouri M., Gharbi H.A.

Treatment of hepatic hydatid cyst in sheep by echografic puncture. 1986; La Tunisie medicale 64(4): 325-331

Filice C., Pirola F., Brunetti E.

A new therapeutic approach for hydatid liver cysts. 1990; Gastroenterology, 98: 1366 -1368

WHO/CTD/SIP/97.3
ENGLISH ONLY
DISTR.: LIMITED

Minimal invasive treatment for hydatid abdominal cysts: PAIR (Puncture, Aspiration, Injection, Reaspiration) - state of the art

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PAIR

- Punctioning the cyst in stage CE1 or CE3a using a 19-20 Gauge Chiba needle under ultrasound guidance; useful also for CL lesions (cystic lesions without criteria of CE)

- Aspire 80-90% from the cyst's amount

- inject 20% from the cyst's amount with radioopaque contrast compound (checking the biliary communications) and aspiration

- Inject 60-70% from the cyst's amount with NaCl 30% for 10-15 min. (parasiticide) or alcohol 96% (if no communication with biliary tree is seen)

- Re-aspiration

STEPS OF THE PERCUTANEOUS APPROACH

(A) PAIR (Puncture, Aspiration, Injection, Re-aspiration or Catheterization)

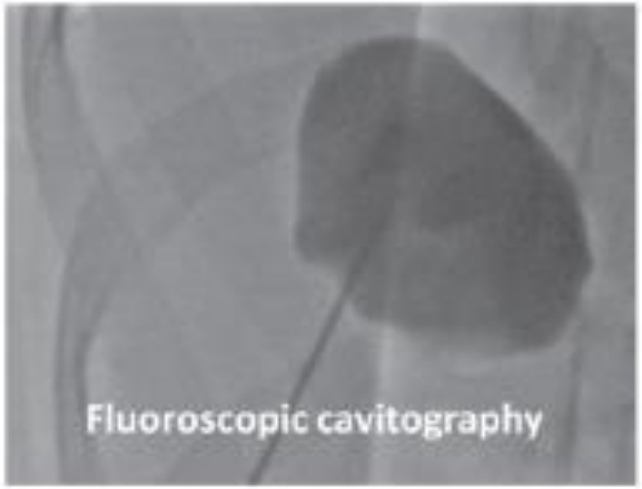

Table 11. PAIR Protocol (Western Countries)

1) Patient's informed consent
2) Serological (IHA, ELISA) tests; US, CT, ERCP controls. MR for research purposes only.
3) Treatment with albendazole (or albendazole + cimetidine) 4 hours before procedure and over the following first week or month (length of treatment depending on cyst size and US appearance, more or less solid).
4) Presence of an anesthesiologist - Patient has an intravenous line.
5) Puncture under US guidance with or without catheter
6) Aspiration of cystic fluid (10-15 cc) for parasitological examination and biochemical (Na, K, Cl, Ca, Glucose, Proteins) evaluation.
7) If protoscolices are present and are still viable ---> aspiration of as much hydatid fluid as possible
8) If protoscolices are absent: a) If clinical and epidemiological data, and biochemical fluid data are positive -------> proceed to next steps. b) If clinical and epidemiological data, and biochemical fluid data are negative ---------> stop procedure (probably non-parasitic cyst). (Non-parasitic cysts are treated with alcohol injection only when symptomatic).
9) Intracystic injection of contrast medium and reaspiration
10) Injection of 95% Ethanol solution (1/3 of amount of aspirated fluid)
11) Reaspiration of alcohol solution after 15 minutes
12) New parasitological control (to check protoscolices viability)
13) Assessment of alcohol blood level (Gascromatography) (optional).
14) Parasitological, biochemical, serological (IHA, ELISA) and US monitoring every week over 1 month and every other month over 6 months, every year over 5 years
15) Chest X-Ray one year after and then every other year. CT (Total body) after 5 years

Table 12. PAIR Protocol modified for district hospital in developing countries.

Same as table 11, except:
2) No ERCP, CT or MR.Serological control if possible
3) Treatment with albendazole if possible
6) Parasitological examination if possible- No biochemical evaluation Points 7) and 8) modified accordingly
No 9) Control of the bilirubin presence in the fluid by *quick test*
12) If possible
14) Parasitological and serological examinations if possible. No biochemical and immunological monitoring. US monitoring when possible.
15) Chest X-Ray when possible. No CT control.

When P. A. I. R. technique could be used?

a) Cyst-related criteria: according the WHO-IWGE Classification:

PAIR: CE1 and CE3a or CL

b) Pacient – related criteria:

- Children (over 3 y o)
- Pacients who do not respond at or do not support ABZ therapy
- Pacients to whom the open / laparoscopic surgery is not feasible
- Pacients who deny a classic surgical approach
- Relapses of CE

BOX 2. CLINICAL MANAGEMENT OF CE (CONTINUED)

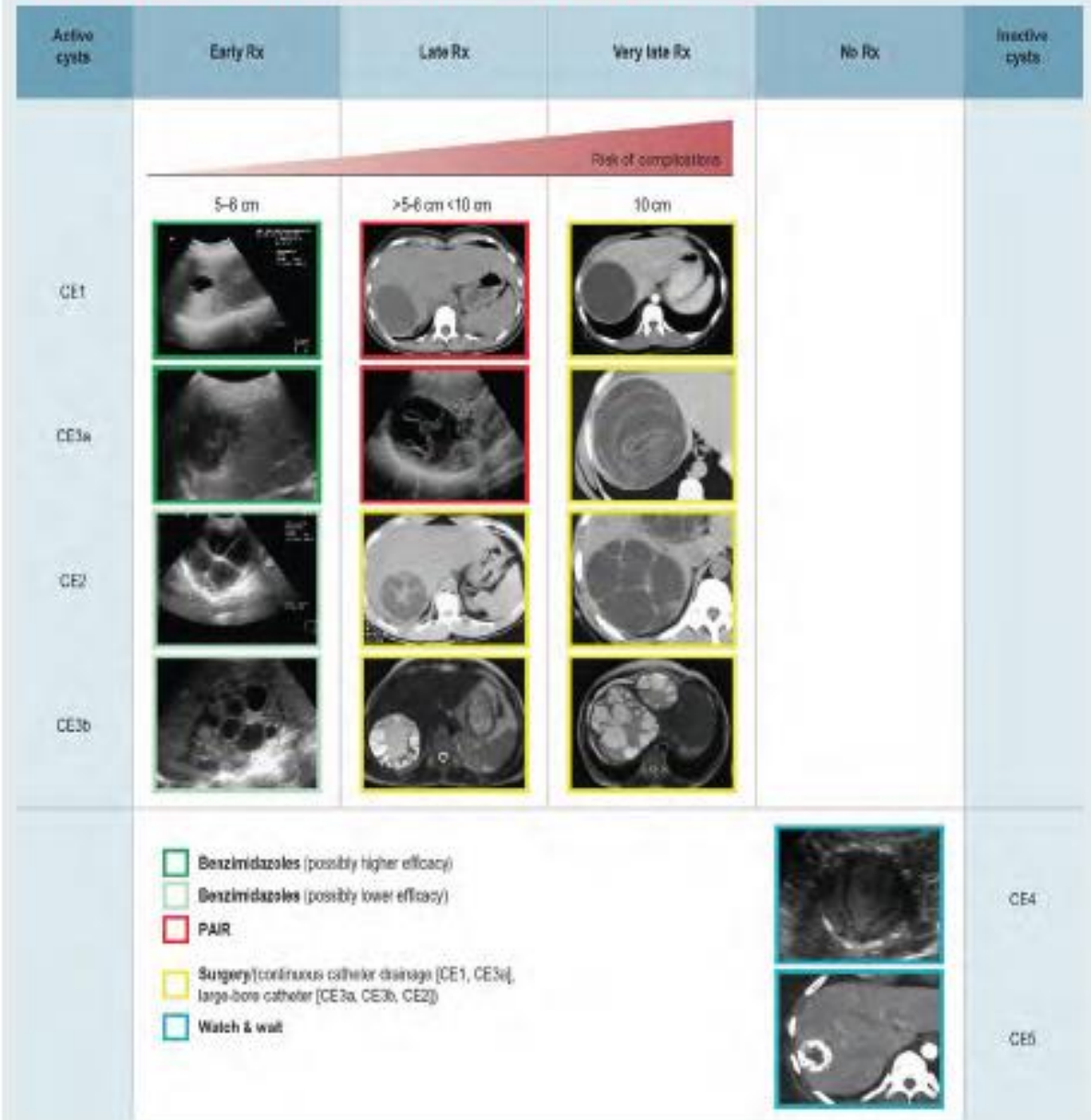

Figure 3[1]. Assignment of treatment modalities to individual CE cyst stages and risks for complications by cyst stage and size

Contraindications

Pacients who are not able to cooperate

Inaccesible / risky location of the hydatid cyst

Medullar / Cerebral / Cardiac/ Transdiaphragmatic hydatid cysts

Calcified cysts

Cysts which are opened in **abdominal cavity, biliary tree**
bronchiae
urinary tract

Do the P.A.I.R. procedure have risks?

It has the same risks as any punctioning technique: bleeding, tissue lesions, infection

If the communication with the biliary tree is seen, it is forbidden to use alcohol 96% as parasiticide compounds

The anaphylactic shock when the cyst is penetrated / other alergic reactions at the contrast compound !!

Do the minimally invasive procedures have risks?

The anaphyilactic shock or other alergic reactions at the contrast compound NEED PREVENTION MEASURES AS:

- Test the pacient sensibility at contrast compound
- Use Dexametasone 4mg / day 1-2 days including the procedure's day
- Always General Anesthesy with Oro-Traheal Intubation including venous line
- Injecting 10mg/kgc Hidrocortisone Hemisuccinate when we are going to penetrate the cyst
- The anesthesiologist must know the risc of severe alergic reactions and should be prepared to act at once (epinephrine, adrenaline, HHC, etc.)

HE MINIMALLY INVASIVE APPROACH / P.A.I.R. – COULD BE FIRST OPTION?

Akhan O. et al. Liver hydatid disease: long-term results of percutaneous treatment. **1996**, Radiology; 198, 259–264.

Khuroo M.S. et al. Percutaneous drainage compared with surgery for hepatic hydatid cysts. **1997**, N Engl J Med 33, 881-887

Akhan O. Et al. Percutaneous treatment of liver hydatid cysts. **1999**, Eur J Radiol. 32, 76–85.

Brunetti E. et al. Twenty years of percutaneous treatments for cystic echinococcosis: a preliminary assessment of their use and safety. **2004**, Parasitologia; 46, 367–370.

Kaabalioglu A. et al. Percutaneous imaging-guided treatment of hydatid liver cysts: do long-term results make it a first choice? **2006**, Eur J Radiol. 59(1), 65-73

Koroglu M. et al. Hepatic cystic echinococcosis: percutaneous treatment as an outpatient procedure. **2014**, Asian Pac J Trop Med. 7(3), 212-215

Clinical Management of Cystic Echinococcosis: State of the Art, Problems, and Perspectives.

Junghanss T, da Silva AM, Horton J, Chiodini PL, Brunetti E.

Am. J. Trop. Med. Hyg 2008; 79(3): 301–311

Treatment modalities stratified by cyst stage (uncomplicated) and level of health care

WHO classification 2001	Current practice: Surgery	Current practice: Percutaneous techniques	Current practice: Medical treatment	Suggested	Resource setting
CE1	■	■	■	PAIR + ABZ, if > 5 cm	Rich
	■	■		ABZ alone, if < 5 cm	
				‡	Poor
CE2	■	◆	■	Non-PAIR PT + ABZ	Rich
	■			Surgery + ABZ	
				‡	Poor
CE3a*	■	■	■	PAIR + ABZ, if > 5 cm	Rich
	■			ABZ alone, if < 5 cm	
				‡	Poor
CE3b†	■	◆	■	Non PAIR PT + ABZ	Rich
	■			Surgery + ABZ	
				‡	Poor
CE4 and 5	Regarded as inactive and, unless complicated, they should not be treated Watch and wait				

* Cyst with detached membranes ("water-lily" sign).
† Cyst with daughter cysts in solid matrix.
‡ All three current suggestions (i.e., percutaneous treatment, surgery, and albendazole) are, for obvious reasons (see text), equally difficult to implement in resource-poor settings at acceptable quality and affordable cost. CE shares these problems with other neglected diseases, and this urgently calls for setting specific development of treatment approaches and strategies.
■ = practiced; ◆ = rarely practiced.

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Review

Expert consensus for the diagnosis and treatment of cystic and alveolar echinococcosis in humans☆

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Table 2
Suggested stage-specific approach to *uncomplicated* cystic echinococcosis of the liver.

WHO classification	Surgery	Percutaneous treatment	Drug therapy	Suggested	Resources setting
CE1				<5 cm ABZ	*Optimal*
				PAIR	*Minimal*
		✓	✓	>5 cm PAIR + ABZ	*Optimal*
				PAIR	*Minimal*
CE2			✓	Other PT + ABZ	*Optimal*
	✓	✓			
				Other PT	*Minimal*
CE3a				<5 cm ABZ	*Optimal*
		✓	✓	PAIR	*Minimal*
				>5 cm PAIR + ABZ	*Optimal*
				PAIR	*Minimal*
CE3b				Non-PAIR PT + ABZ	*Optimal*
	✓	✓	✓		
				Non-PAIR PT	*Minimal*
CE4				*Watch and Wait*	*Optimal*[a]
CE5				*Watch and Wait*	*Optimal*[a]

[a] "Minimal" may not be applicable here because in low resources, remote endemic areas, it may be impossible or too expensive to travel to the nearest hospital just to get a diagnosis.

Journal of Surgery and Surgical Research

Peertechz

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General Surgeon; President of the World Association of Echinococcosis, Member of the Directive Council of the Portuguese College of General Surgery, Portugal

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ISSN: 2454-2968

Keywords: Cystic Echinococcosis; Hydatid Cyst; Cyst sterilization; Hydatidectomy; Cystectomy

Case Report

Cystic Echinococcosis in the Liver: Nomenclature and Surgical Procedures

Abstract

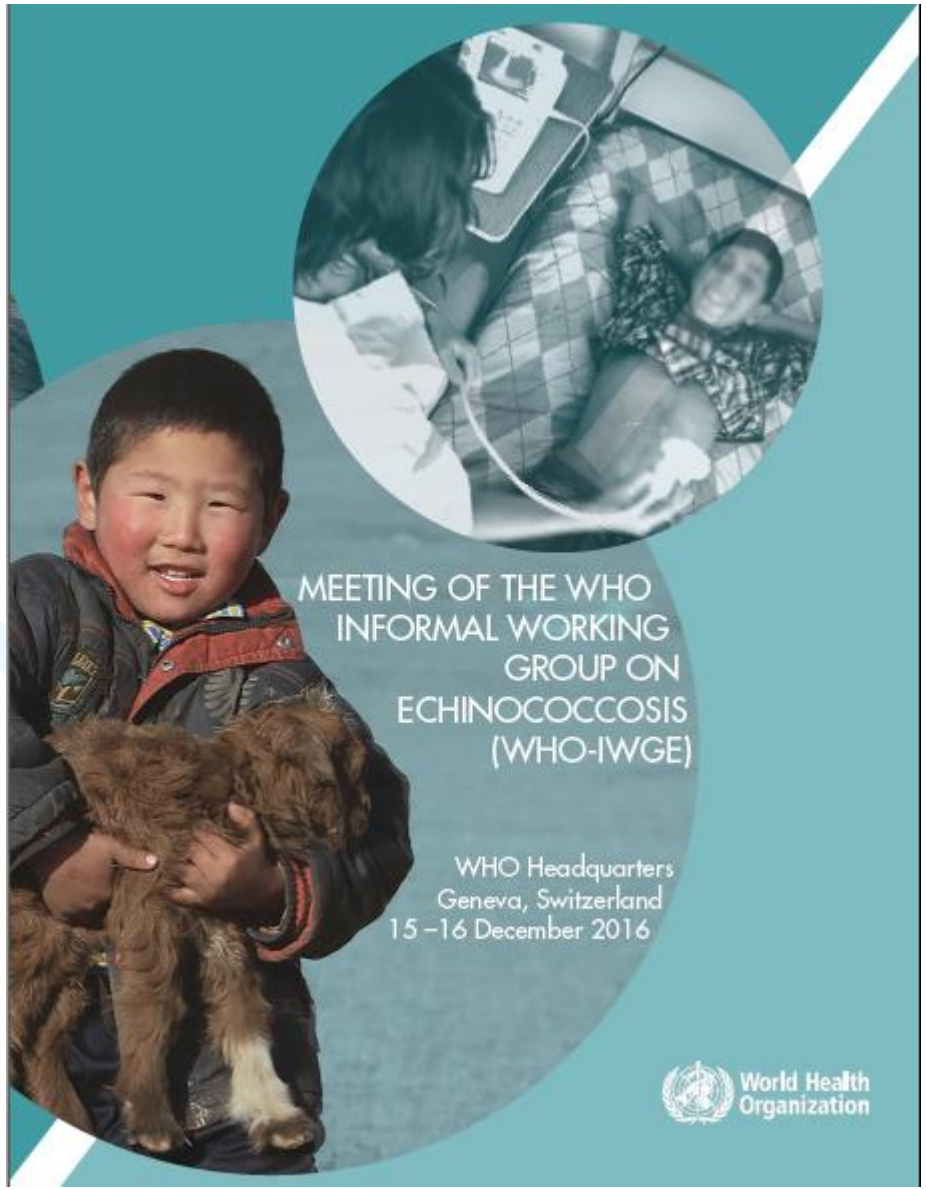
Cystic Echinococcosis (CE) is a zoonotic infection caused by larval form of the parasite *Echinococcus granulosus*. The adult tapeworm inhabit the small intestine of some carnivores (called definitive or final hosts), and the larval phase, or "metacestode" develops in the herbivores (intermediate hosts). The presentation form of the larval phase is the development of cysts, called hydatid cysts. Although all of us know the vital cycle of the parasite and the different aspects of the disease, the designations around the parasite, its evolution and some therapeutic procedures is not uniform. In fact we frequently see the use of inappropriate terms, based on incorrect concepts. It would be useful to use the same nomenclature and it is absolutely necessary that the nomenclature is correct and universally accepted. So, it is pertinent to remember some important points related to the CE and, above all, to clarify some aspects concerning its nomenclature, in order to understand better the therapeutic options, particularly the different surgical approaches.

Table 2: Treatment modalities suggested by cyst stage (uncomplicated cysts).

Stage/type*		Suggested		Recommendation/evidence**
Active	Type 1	< 5 cm	ABZ alone	A / I
		> 5 cm	PAIR + ABZ	A / I
	Type 2	PEvac/MoCat/Surgery + ABZ		A / II
Transitional	Type 3a	< 5 cm	ABZ alone	A / I
		> 5 cm	PAIR + ABZ	A / II
	Type 3b	PEvac/MoCat/Surgery + ABZ		A / II
Inactive (type 4 / 5)		No treatment: Wash & wait		B / III

*WHO US classification, 2001.
**Infectious Diseases Society of America grading system (strength of recommendation/quality of evidence).

Citation: *da Silva AM (2015) Cystic Echinococcosis in the Liver: Nomenclature and Surgical Procedures. J Surg Surgical Res 1(3): 059-065. DOI: 10.17352/2454-2968.000015*



BOX 2. CLINICAL MANAGEMENT OF CE (CONTINUED)

Active cysts	Early Rx	Late Rx	Very late Rx	No Rx	Inactive cysts
			Risk of complications		
	5–6 cm	>5-6 cm <10 cm	10 cm		
CE1					
CE3a					
CE2					
CE3b					
					CE4
					CE5

- **Benzimidazoles** (possibly higher efficacy)
- **Benzimidazoles** (possibly lower efficacy)
- **PAIR**
- **Surgery** (continuous catheter drainage [CE1, CE3a], large-bore catheter [CE3a, CE3b, CE2])
- **Watch & wait**

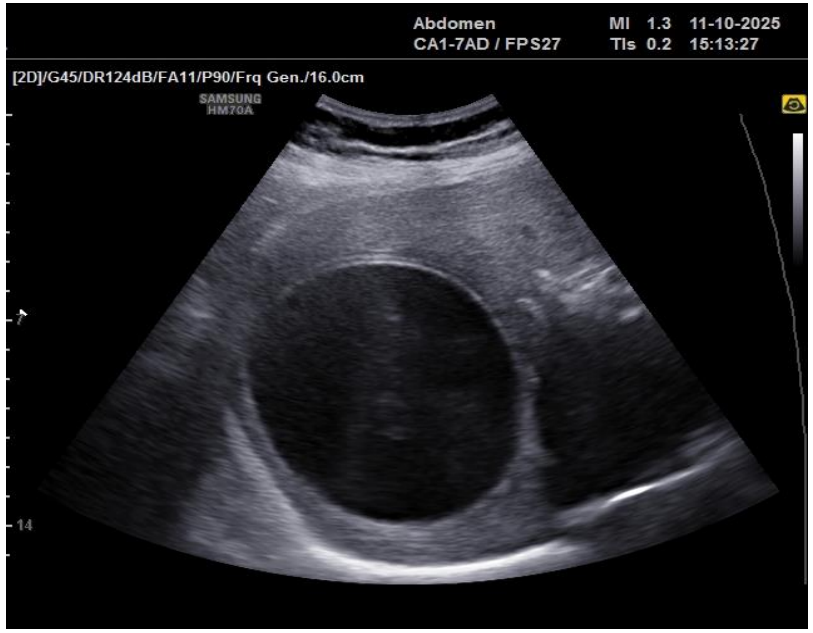
Figure 3[1]. Assignment of treatment modalities to individual CE cyst stages and risks for complications by cyst stage and size

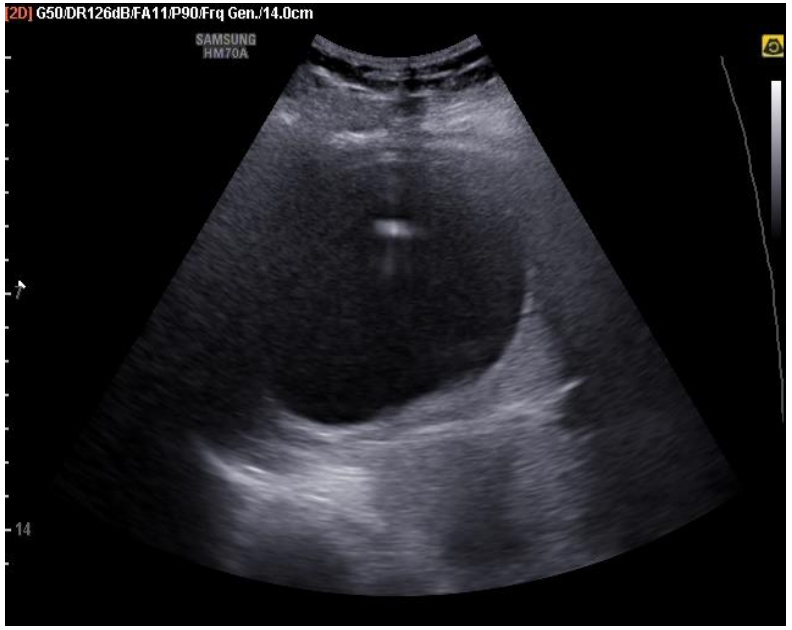
“Colentina” Clinic Hospital Bucharest
General Surgery Clinic

OUR EXPERIENCE

Feedback on the implementation of PAIR

Retours d’expérience sur la mise en oeuvre du PAIR


Abdomen
CA1-7AD / FPS27
MI 1.3
TIs 0.2
11-10-2025
15:13:27
[2D]/G45/DR124dB/FA11/P90/Frq Gen./16.0cm
SAMSUNG
HM70A
14


[2D] G50/DR126dB/FA11/P90/Frq Gen./14.0cm
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[2D] G50/DR126dB/FA11/P90/Frq Gen./14.0cm
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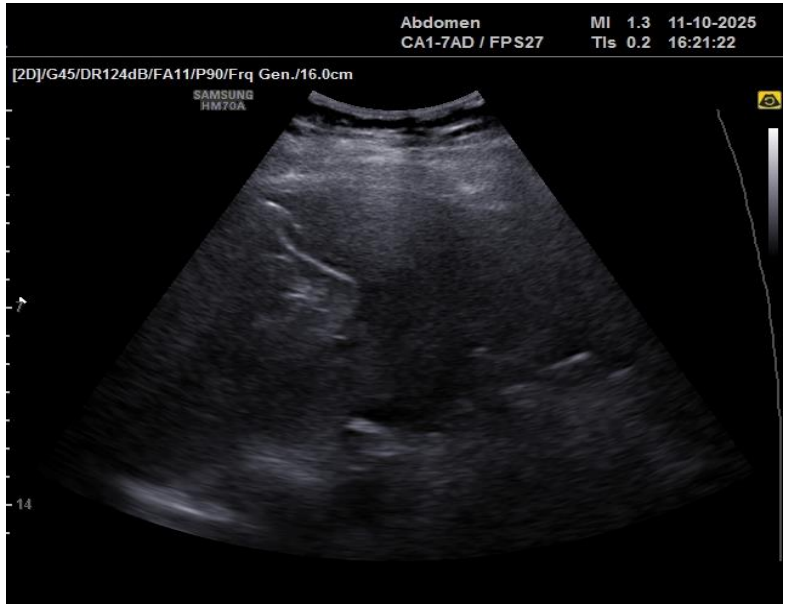
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CA1-7AD / FPS27
MI 1.3
TIs 0.2
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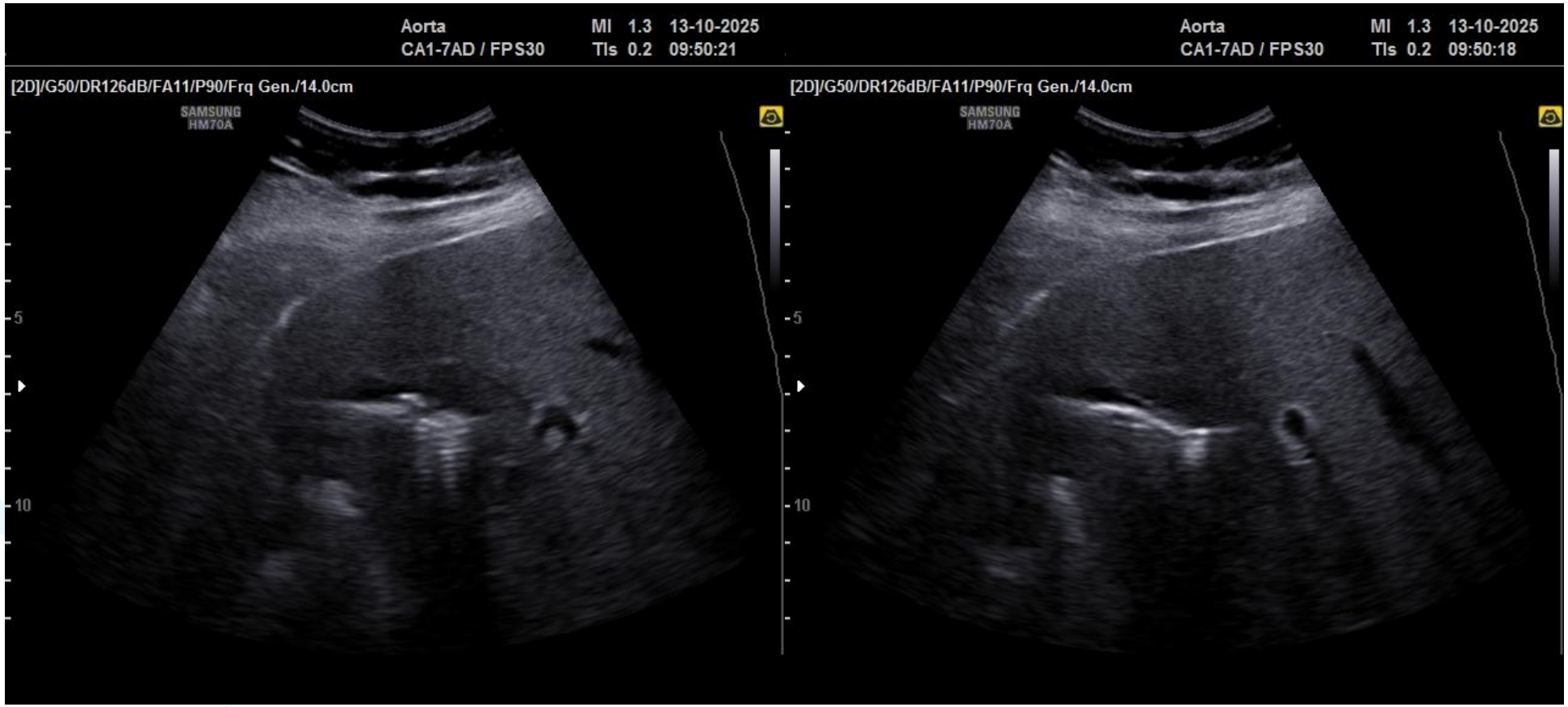
16:21:22
[2D]/G45/DR124dB/FA11/P90/Frq Gen./16.0cm
SAMSUNG
HM70A
14



Day 2 after PAIR

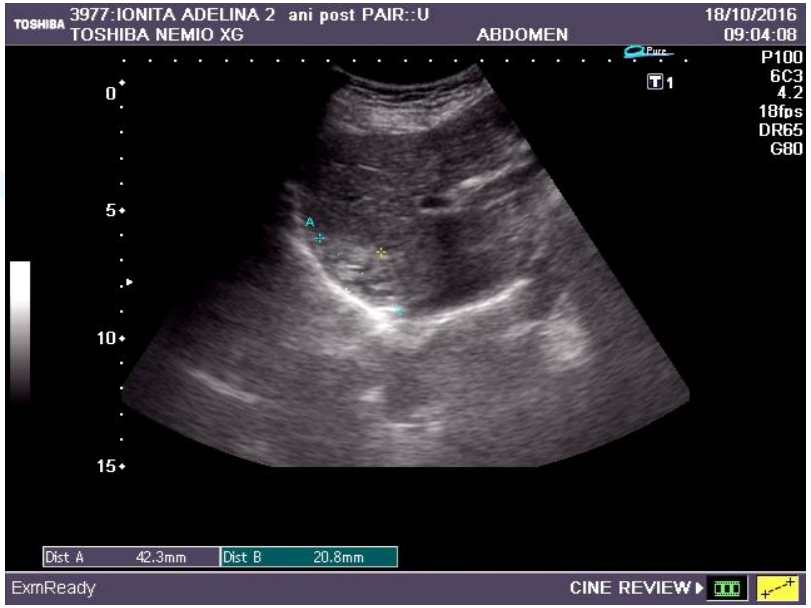

[2D] G50/DR126dB/FA11/P90/Frq Gen./14.0cm
SAMSUNG
HM70A
14


Valleylab

Initial image of CHH CE1

4 months after PAIR

2 years after PAIR

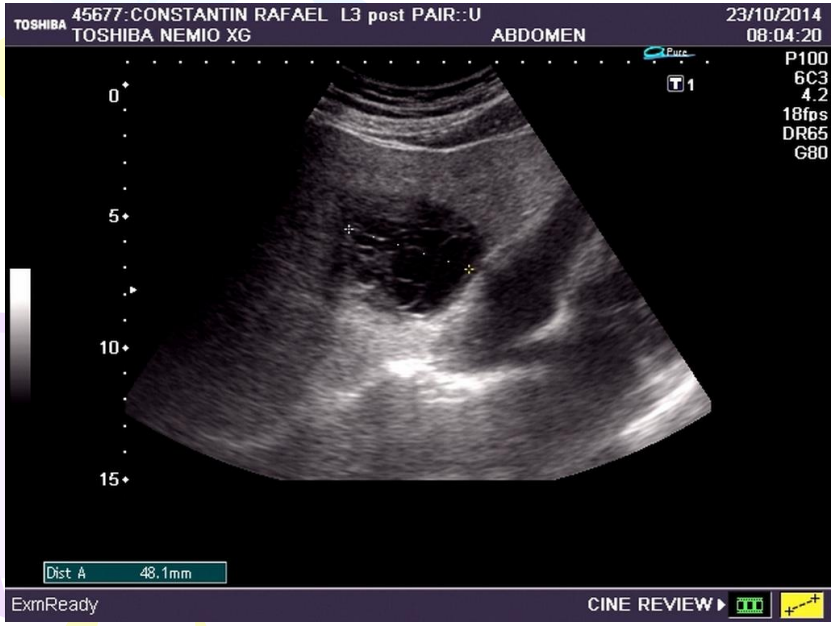


Initial image of CHH CE1

2 months after PAIR

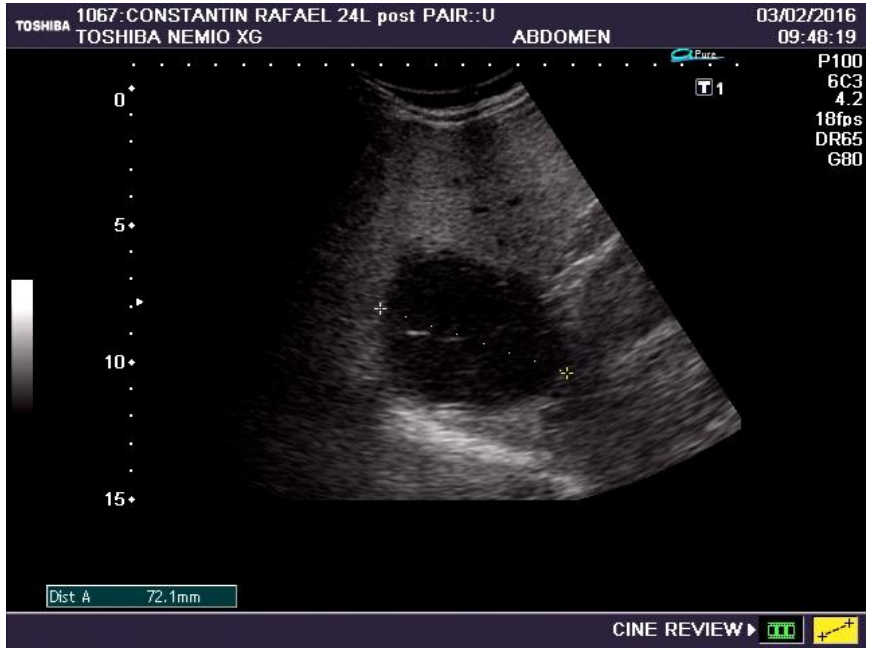
After 9 months

Initial image of CHH CE1

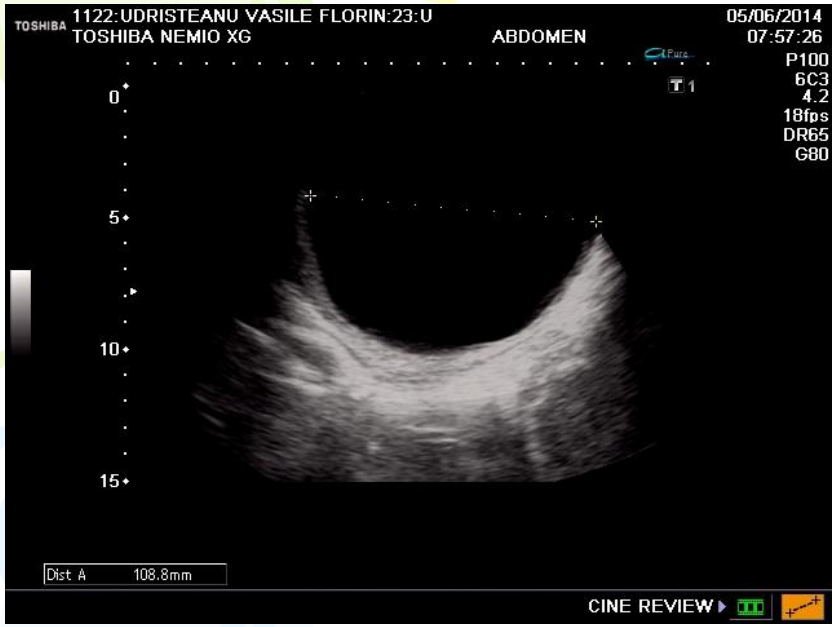


3 months after PAIR

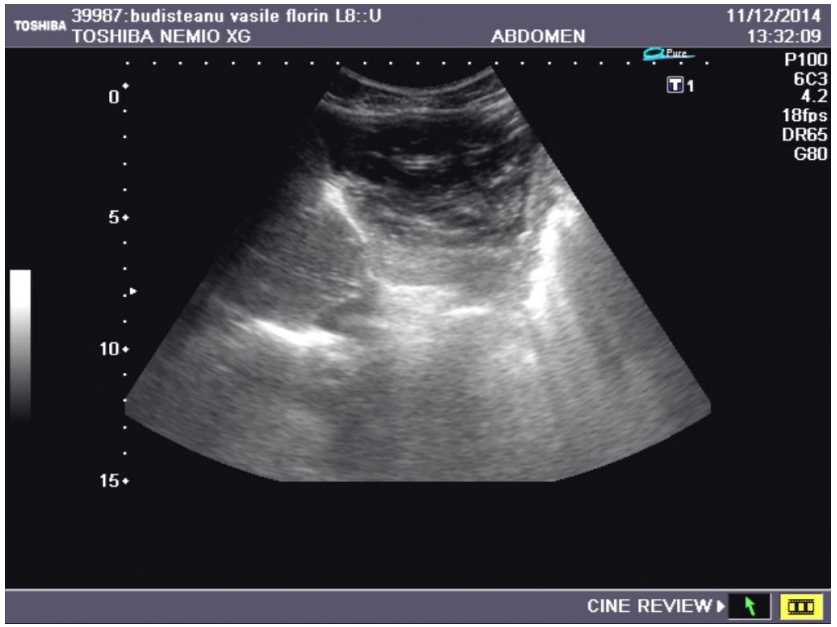
1 year after PAIR



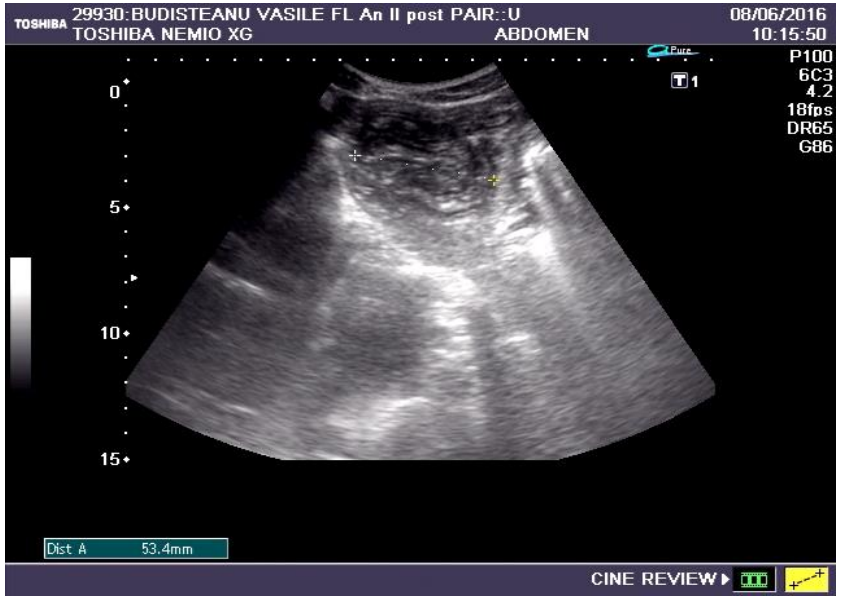
2 years after PAIR



Initial image of CHH CE1



6 months after PAIR



1 and 2 years

after PAIR

The most important issue was rised by the CE1 and CE3a large (> 10 cm) cysts:

1.CE1 is the most active type, and the relapse after spillage during the surgical procedure is significant. For this reason using laparoscopic procedures remains controversial, even with an easy approach.

2.The proligerous membrana is usually thick and follows the cyst shape, which doesn't allow an efficient percutaneous drainage technique.

3.The only percutaneous technique assigned for CE1 remains PAIR, but the larger the cyst is, the most clear is that we will obtain a cyst with a CE3a appearance; the single benefit is to inactivate (kill) the cyst

4. The CE3a cysts don't have often thin membranae, so they could not be removed through a pigtail catheter

We decided to use PAIR to inactivate those large CE1/CE3a cyst and we have obtained

the CE3a image

(after a CE1 cysts we called this CE3a-like, because this evolution is post-procedural) – 13 cases

1 case did not tolerate PAIR procedure – conversion to surgery

After 3-6 months we evaluated the lesions

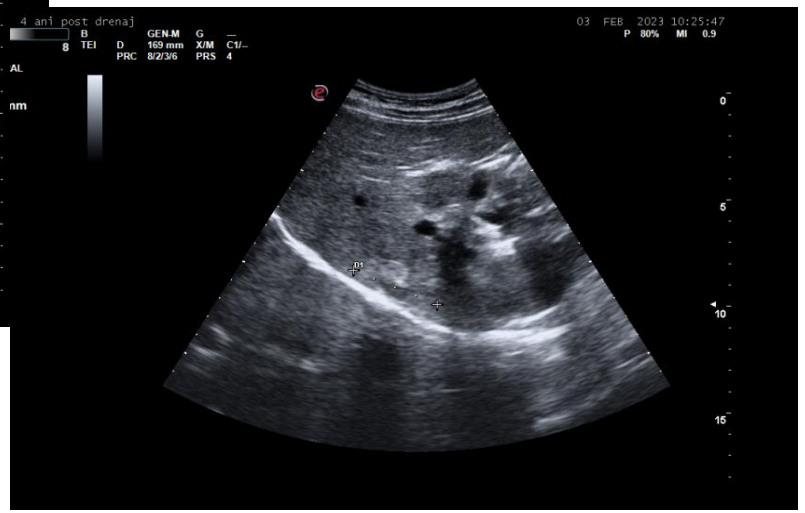
(12 cases)

If the detached germinative membranae are thin, percutaneous drainage procedure (MoCaT) could evacuate the whole content and drain the restant cavity (8 cases 6 derived from CE1 cysts / 2 derived from CE3a cysts)

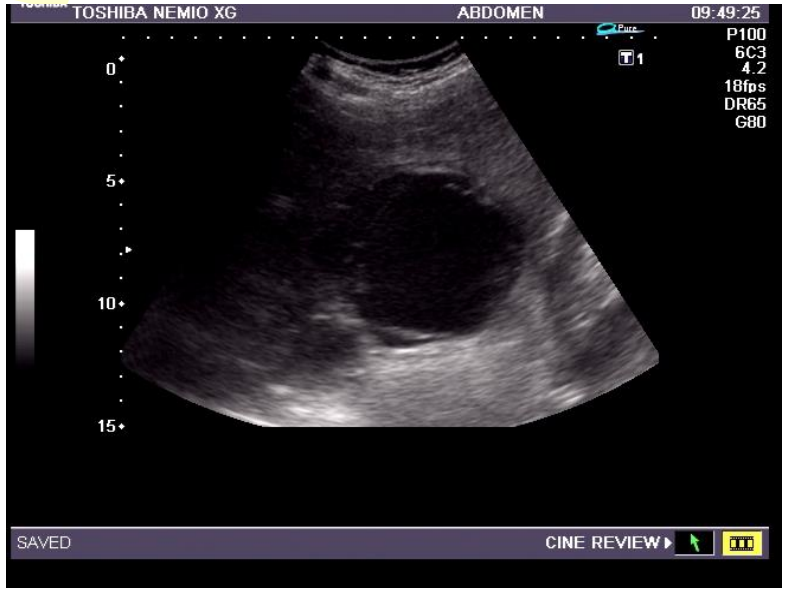
3 of them (33%) needed SE with ERCP (large biliary fistula)

CE1 cyst – initial appearance

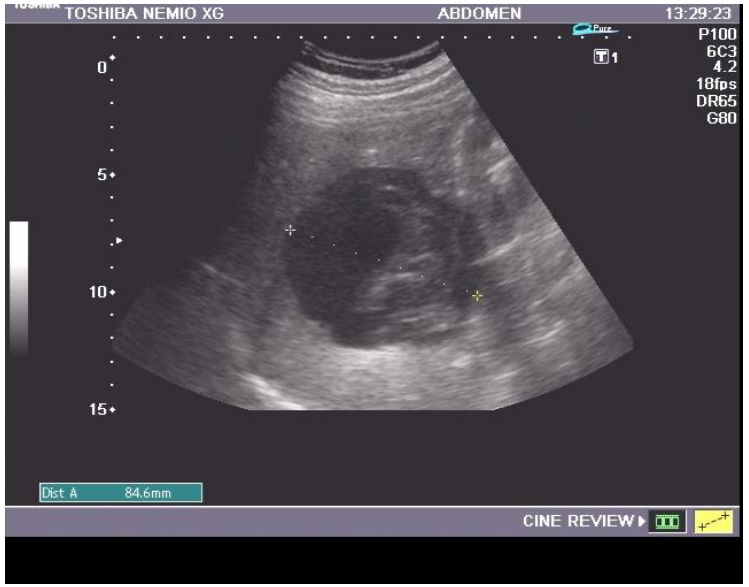
3 months after PAIR = CE3a-like appearance, with detached thin membrana



1 year after MoCaT – only a small white scar is seen



Initial CE1 cyst – thick proligerous membrana
PAIR was used first to destroy the viability of the cyst



Initial CE1 become CE3a hepatic cyst 3 months after PAIR procedure – typical aspect with liquid and detached floating membrana. Inactivation made by PAIR led to a thin, altered membrana

Scar is forming 1 month after MoCaT procedure. There is nor liquid, neither membranae

1 particular case was an CE1 giant SPLENIC cyst in which the cavity with detached membranae was filled with liquid after an initial PAIR used for inactivation

1 month after PAIR for CE1 giant splenic hydatid cyst
Note CE3a-like aspect

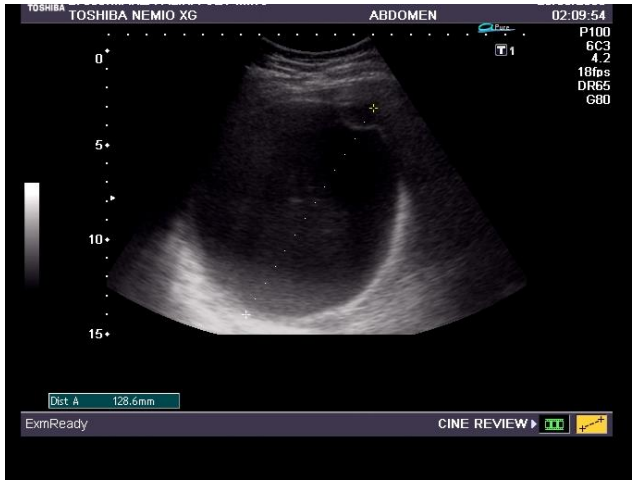
3 months after MoCaT for CE3a-like splenic cyst

18 months after MoCaT for CE3a-like splenic cyst

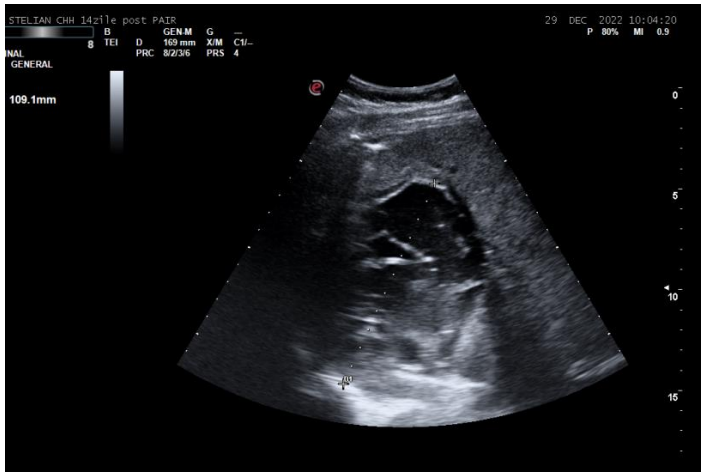
- If the detached membranae are thick, or the cyst is over 15 cm, we use laparoscopic procedure performing operculectomy / partial cystectomy, removal of the germinative membrana and drainage of the cavity, including suture of the biliary pedicles if they are seen

  (4 cases) – all derived from CE1 cysts

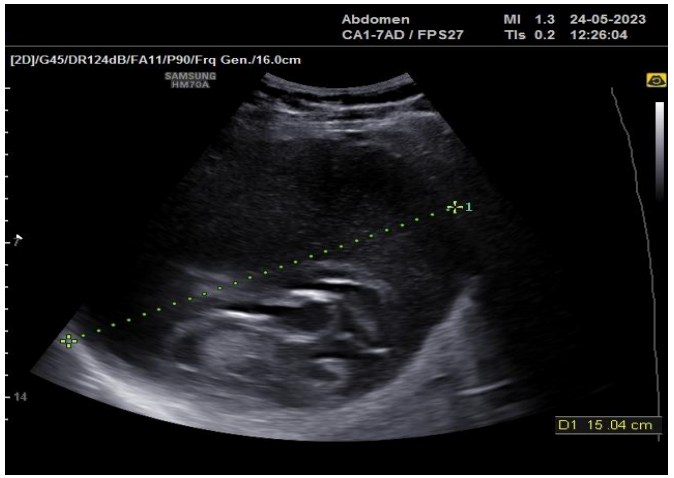
  3 of them (75%) needed SE, ERCP, and even biliary stent in 1 case



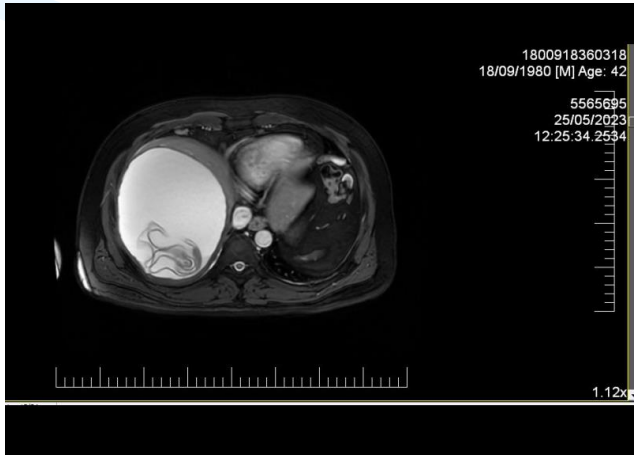
Initial CE1 hepatic cyst – PAIR was used first to inactivate the cyst



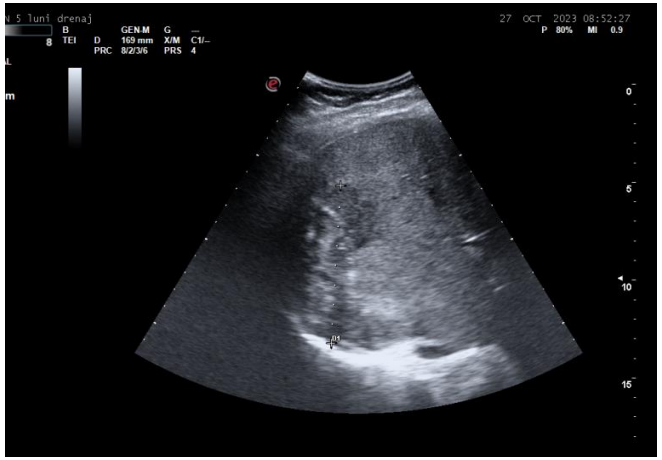
14 days after PAIR procedure – liquid and detached floating thick membrana.



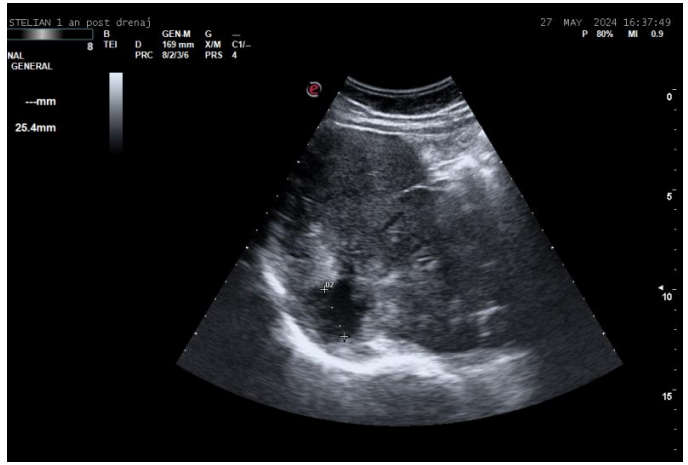
7 months after PAIR procedure – liquid and detached floating thick membrana.



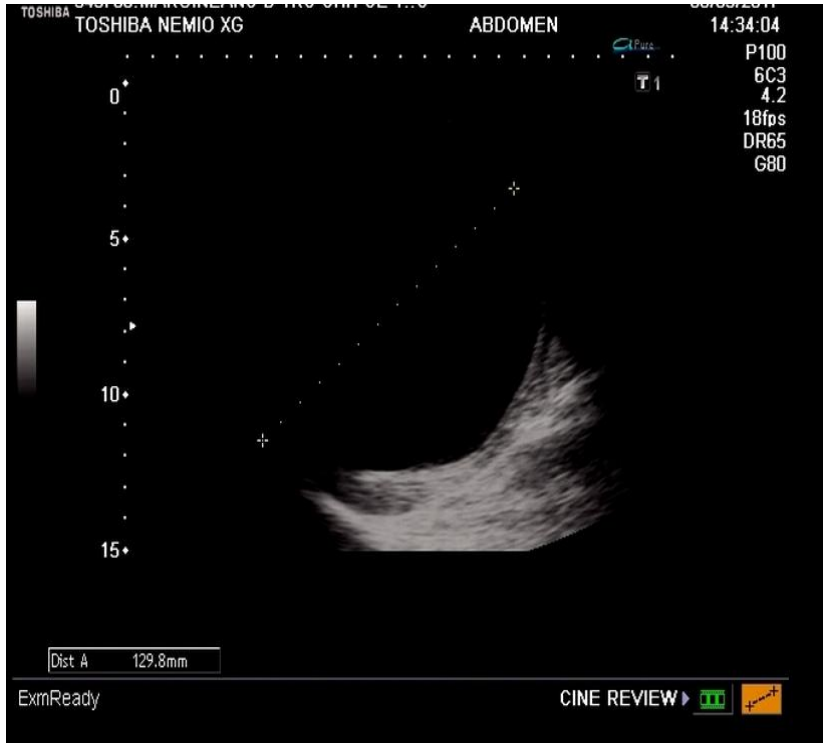
7 months after PAIR procedure – IRM image – detached membrana on the bottom of the cavity



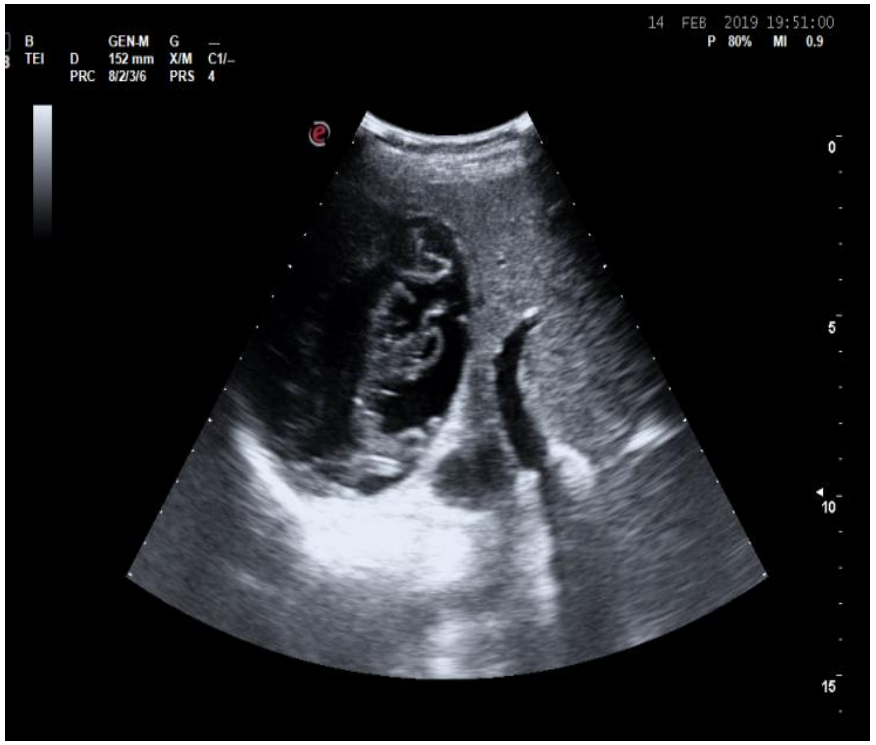
2 months after laparoscopic approach – cicatricial process is developing



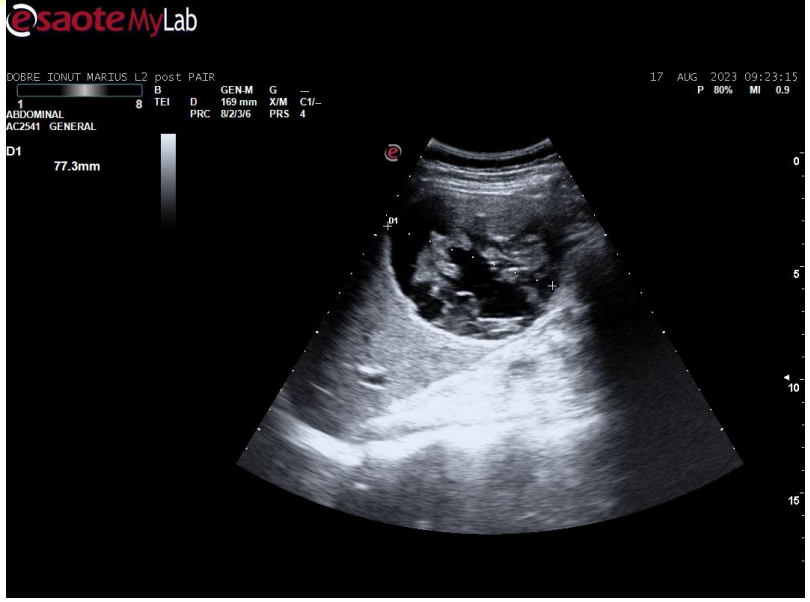
1 year after laparoscopic approach – cicatricial area



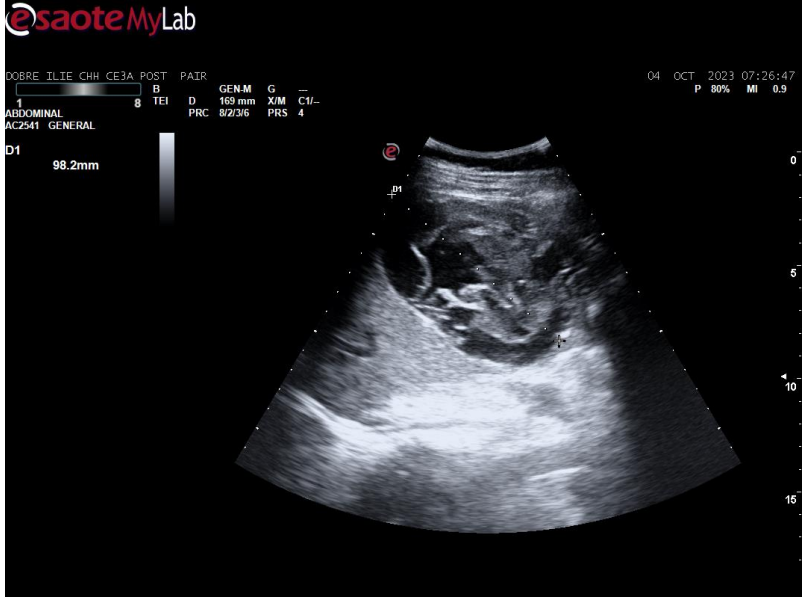
Initial CE1 hepatic cyst – PAIR was used first to inactivate the cyst



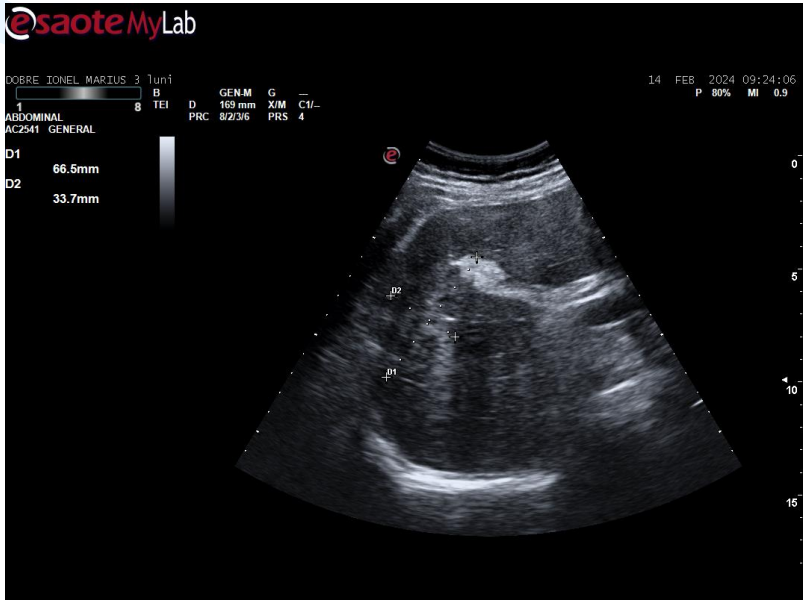
Initial CE1 hepatic cyst
2 months after PAIR procedure – typical aspect with liquid and detached floating membrana. Inactivation made by PAIR led to a thick, altered membrana



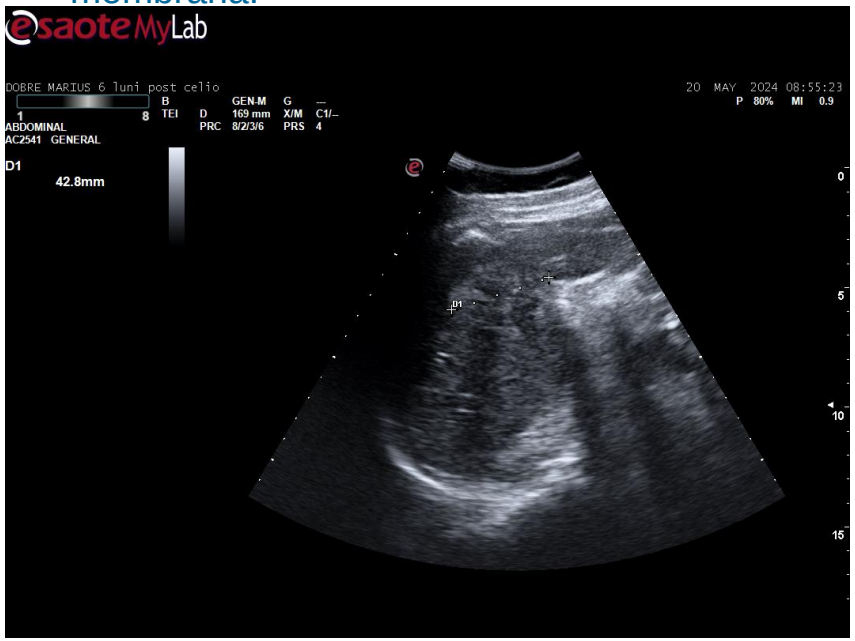
2 months after PAIR procedure – liquid and detached floating thick membrana.

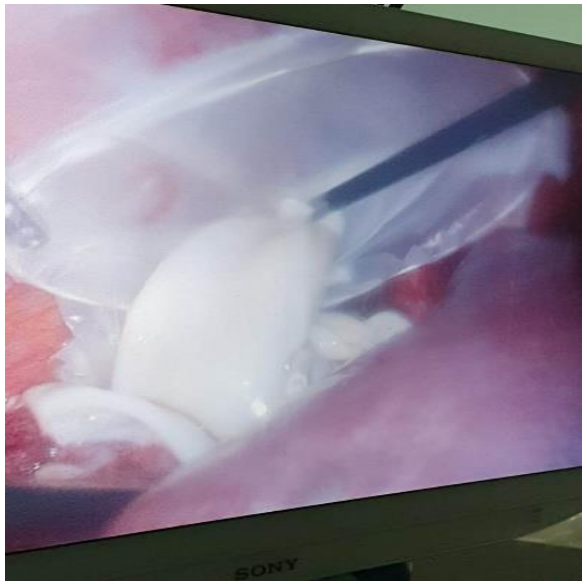


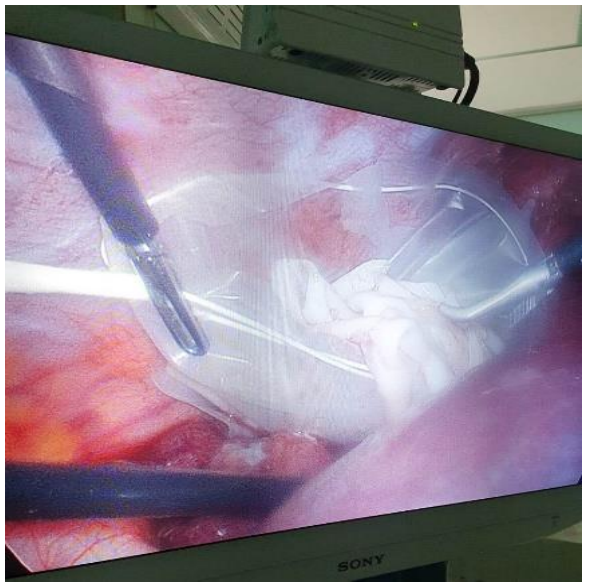
3 months after PAIR procedure – liquid and detached floating thick membrana.

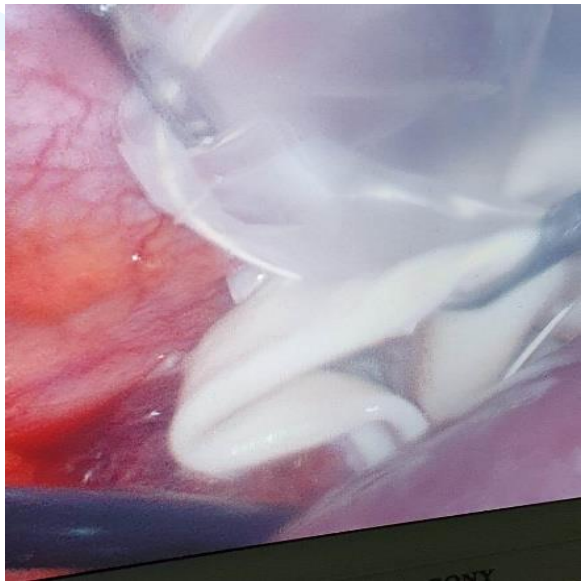


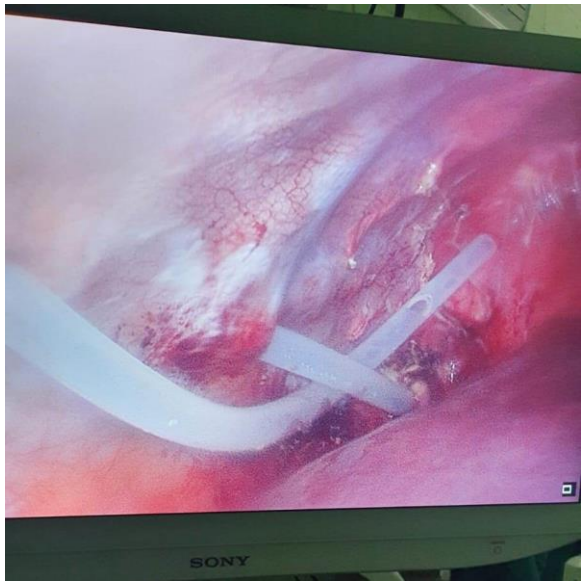
2 and 6 months after laparoscopic approach – cicatricial process is developing





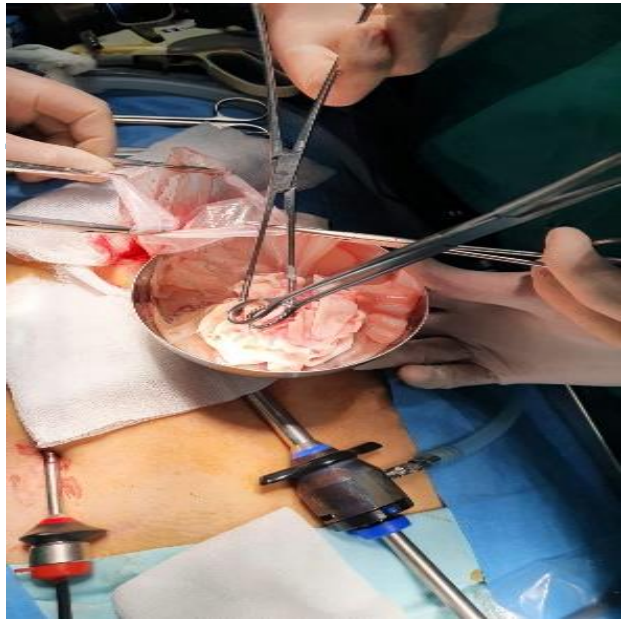






The laparoscopic approach was used to open the cyst – de-roofing and removing the hydatid membranae.

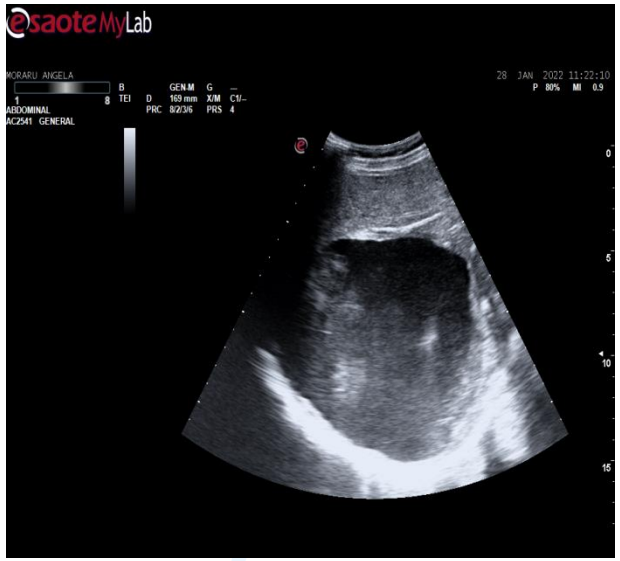
Drain tube was placed within the cavity.



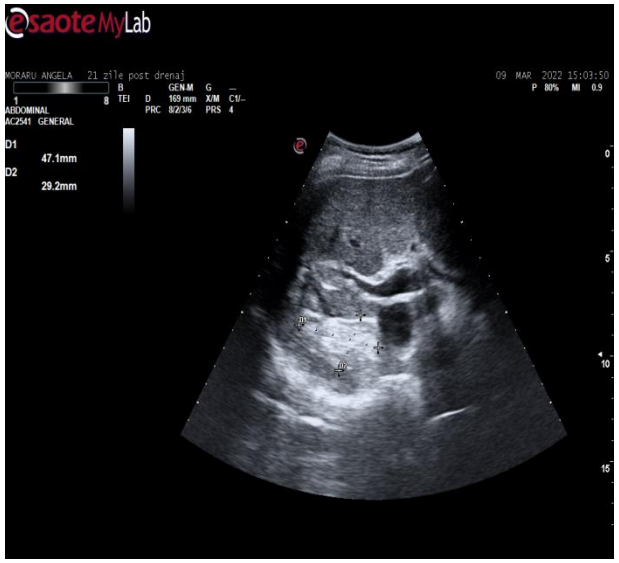
It is not uncommon that the cavity would fill again simply with liquid (lymph and some amount of bile) without any hydatic membrana.

This has usually no symptoms, being seen during the ultrasound surveillance exams.

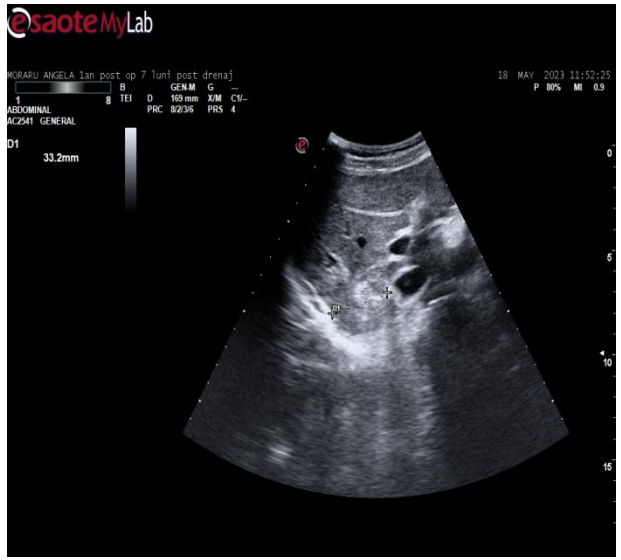
Percutaneous drainage is used to treat this complication



Former cavity of cyst is filled with liquid. No membrana is seen.



Appearance of scar obtained at 3 months after drainage.



Appearance of scar – 7 months after drainage.

Finally, we have adopted this 2 steps approach for other 4 cases in which cysts had 7 – 9 cm in diameter.

For those cases, the second procedure was percutaneous drainage (MoCAT)

Results were also optimal

During 01.2014 – 11. 2025:

The first period 2014-2017 was encompassed by the HERACLES Project (a FP7 European Project) which allowed us to gain know-how from our external partners in order to use minimally invasive techniques

- **Data from the General Surgery Clinic of the "Colentina" Clinic Hospital show:**

177 pacients with abdominal hydatid cysts – Cystic Echinococcosis or CL

111 pacients underwent minimally invasive procedures (62,71%)

55 cases were selected for percutaneous aspirative drainage MoCaT (CE2, CE3a and CE3a-like, CE3b and CE4 type) = 49,55% (31,07% from the total number)

56 cases were selected for Puncture Aspiration Injection Re-aspiration PAIR technique (CE1 and CE3a type 41 / 8) or CL: 7 cases = 50,45 % (31,64% from the total number)

The total number of cysts = 58 cysts for MoCaT, 59 cysts for PAIR (2 cases with multiple CE1 / CE3a cysts)

3 pacients have had hydatid cysts of both types, so they needed both types of techniques – they were counted as MoCaT group (more complex technique)

Table 11. PAIR Protocol (Western Countries)

1) Patient's informed consent
2) Serological (IHA, ELISA) tests; US, CT, ERCP controls. MR for research purposes only.
3) Treatment with albendazole (or albendazole + cimetidine) 4 hours before procedure and over the following first week or month (length of treatment depending on cyst size and US appearance, more or less solid).
4) Presence of an anesthesiologist - Patient has an intravenous line.
5) Puncture under US guidance with or without catheter
6) Aspiration of cystic fluid (10-15 cc) for parasitological examination and biochemical (Na, K, Cl, Ca, Glucose, Proteins) evaluation.
7) If protoscolices are present and are still viable ---> aspiration of as much hydatid fluid as possible
8) If protoscolices are absent: a) If clinical and epidemiological data, and biochemical fluid data are positive ------- > proceed to next steps. b) If clinical and epidemiological data, and biochemical fluid data are negative ---------> stop procedure (probably non-parasitic cyst). (Non-parasitic cysts are treated with alcohol injection only when symptomatic).
9) Intracystic injection of contrast medium and reaspiration
10) Injection of 95% Ethanol solution (1/3 of amount of aspirated fluid)
11) Reaspiration of alcohol solution after 15 minutes
12) New parasitological control (to check protoscolices viability)
13) Assessment of alcohol blood level (Gascromatography) (optional).
14) Parasitological, biochemical, serological (IHA, ELISA) and US monitoring every week over 1 month and every other month over 6 months, every year over 5 years
15) Chest X-Ray one year after and then every other year. CT (Total body) after 5 years

Our comments:

1) YES

2) We use colangio MRI if a biliary fistula is suspicioned, which leads to indication for SE +/- stenting

3) We use ABZ for 7-14 days before procedure; after 14 days, a CE1 cyst could detach his membrana, transforming itself into a CE3a type, more difficult to manage
4) YES
5) YES, but not agree with the catether = better a next procedure which removes all the content, including the detached membrana
6) YES

7) YES, but VERY SLOWLY, to avoid to detach the membrana

8) YES; even a non-hydatic cystic lesion has benefit after alcoolisation

9-10) Liquid is clear and has no colour (stone water) there is no fistula
Liquid is yellowish we control the inner bilirubin level
Liquid is bilious = we use NaCl 20% to inactivate the cyst, then next evacuatory procedure
11) YES, even 20 minutes
12) Optional
13) No
14) YES

15) YES

Conclusions I:

- The results may be as good as the open conservative surgery
- This means to obtain the imagistic appearance of scar / small calcified lesion.
- The hospitalisation could be shorter and the costs are low
- Those procedures is easily supported by pacients
- The difficulties during the evolution of the remaining cavities (lack of remission with re-filling, even abscesses), could be solved using the minimally invasive techniques.
- Re-filling of the cavity with bile and lymph is one way of evolution, not an error of those techniques

Conclusions II:

- **Using PAIR as first option in minimally invasive treatment of CE is correct but we have to choose accurately the type and size of CE asigned (CE1, CE3a,CL)**

- **Large cysts (>10 cm) would need a two-step procedure:**

  1. **inactivation using PAIR**

  2. **evacuation using laparoscopic approach / MoCaT technique (depending the membranae thickness)**

It is very important to mantain the drainage as long as it is necessary

The endoscopic sphyncterotomy is an useful tool to limit the biliary leakage; sometimes , a biliary stent is a good solution

Conclusions III:

- The cysts with diameter between 7/8 and 10 cm = they form “the grey zone”
  many of them will require a second procedure

- Knowing to apply a percutaneous drainage technique is indeed a useful method
  It helps in treating the hydatic hepatic cysts if a CE3a –like appearance with thin membranae is developing

  As at every invasive procedure addressed to CE, use of Albendazole prior and after the PAIR procedure is indicated

- The role of the major open surgery remains for those cases with severe complications.

We are expressing **our gratitude** to

Prof. Dr. Okan Akhan

(Hacettepe University - Ankara)

Former President of The European Society of Interventional Radiology

who taught us and supervised us to use all these percutaneous methods

THANK YOU FOR YOUR ATTENTION!