



## ARAŞTIRMA / RESEARCH

# Comparison of the modified Seldinger and trocar techniques in the percutaneous treatment of CE1 and CE3a hepatic hydatid cysts

CE1 ve CE3a karaciğer kist hidatik perkütan tedavisinde modifiye Seldinger ve trokar yöntemlerinin karşılaştırılması

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### Abstract

**Purpose:** The aim of this study was to compare the long-term results of the trocar and modified Seldinger techniques used in the percutaneous treatment of type CE1 and CE3a hepatic hydatid cysts.

**Materials and Methods:** The data of the patients with CE1 and CE3a hydatid cysts, treated by the catheterization technique between January 2015 and June 2019 were reviewed retrospectively. Cyst type, cyst size and localization, treatment method applied, duration of catheterization and length of hospital stay were recorded. Follow-up period, cyst size at the last follow-up, and inactivation time were listed using the follow-up ultrasound reports. All of these variables were listed separately in the modified Seldinger and trocar techniques and compared statistically.

**Results:** The data of 126 CE1 and CE3a patients were included in the study. The modified Seldinger technique was used in 36 patients, and the trocar technique was used in 90 patients. The mean follow-up period was 1185.36 ± 426.02 days. The efficacy of the treatment was at the rate of 97.2% in the modified Seldinger technique and 97.7% in the trocar technique. In total, recurrence was seen in 2.3% of the patients. The duration of catheterization and length of hospital stay were found to be significantly lower in the trocar technique compared to the modified Seldinger technique. The inactivation process was faster in the modified Seldinger technique.

**Conclusion:** Both the modified Seldinger and trocar techniques are effective treatment modalities that can be used safely in the treatment of CE1 and CE3a hepatic hydatid cysts.

**Keywords:** Hydatid cysts, CE1 and CE3a hepatic hydatid cysts, echinococcus granulosus, trocar technique, modified Seldinger technique

### Öz

**Amaç:** Bu çalışmanın amacı, CE1 ve CE3a tipleri karaciğer kist hidatiklerinin perkütan tedavisinde kullanılan trokar ve modifiye Seldinger yöntemlerinin uzun dönem sonuçlarının karşılaştırılması oldu.

**Gereç ve Yöntem:** Ocak 2015 ve Haziran 2019 tarihleri arasında kateterizasyon yöntemi ile tedavi edilmiş olan, CE1 ve CE3a kist hidatik hastalarının verileri geriye dönük olarak tarandı. Kist tipi, kist boyutu, lokalizasyonu, uygulanan tedavi yöntemi, kateterizasyon süresi, hastanede yatış süresi verileri kayıt edildi. Takip ultrasonografi raporları değerlendirilerek takip süresi, kistin son kontroldeki boyutu, inaktivasyon süresi listelendi. Bu değişkenlerin tamamı modifiye Seldinger ve trokar yöntemlerinde ayrı ayrı listelendi ve istatistiksel olarak karşılaştırıldı.

**Bulgular:** Toplamda 126 CE1 ve CE3a hastanın verileri çalışmaya dahil edildi. Tedavide 36 hastada modifiye Seldinger yöntemi, 90 hastada trokar yöntemi uygulandı. Ortalama takip süresi 1185.36 ± 426.02 gün oldu. Tedavi etkinliği modifiye Seldinger yönteminde %97.2, trokar yönteminde %97.7 oldu. Toplamda hastaların %2.3'ünde nüks görüldü. Modifiye Seldinger yöntemine kıyasla trokar yönteminde kateterizasyon ve hastanede yatış süresi anlamlı olarak düşük bulundu. Modifiye Seldinger yönteminde inaktivasyon süreci daha hızlı olmuştur.

**Sonuç:** Modifiye Seldinger ve trokar yöntemlerinin her ikisinde CE1 ve CE3a karaciğer kist hidatik tedavisinde güvenle kullanılabilir etkin tedavi yöntemleridir.

**Anahtar kelimeler:** Kist hidatik, CE1 ve CE3a hepatic kist hidatik, ekinokokus granulosus, trokar tekniği, modifiye Seldinger tekniği

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## INTRODUCTION

Hepatic hydatid cysts are caused by *Echinococcus Granulosus* and are an important public health concern for the general population<sup>1,2</sup>. The disease occurs worldwide but is endemic in some Mediterranean, Asian, South American, North African countries and Australia<sup>3</sup>. The liver is the most commonly affected and diseased organ by the parasite<sup>4,5</sup>. Cystic echinococcosis (CE) cysts are staged in active (CE1, CE2), transitional (CE3a and CE3b) and inactive (CE4, CE5) forms according to the World Health Organization Informal Working Group on Echinococcosis (WHO-IWGE) ultrasound (US) classification of cystic echinococcosis<sup>6</sup>. CE1, CE2 and CE3 hepatic hydatid cysts are recommended to be treated<sup>7</sup>.

There are three therapeutic modalities for the treatment of hepatic CE: chemotherapy, surgery and percutaneous drainage. Percutaneous techniques have become more popular as they are minimally invasive with high technical success rate<sup>8,9</sup>. These techniques have also been used successfully in the treatment of CE1 and CE3 hepatic hydatid cysts<sup>10</sup>. The possibility of complications such as cysto-biliary fistula and cavity infection is high in large cysts<sup>11,12</sup>. Therefore, the catheterization technique, which also includes sclerosing injection (PAIDS), is required in the percutaneous treatment of these cysts<sup>13</sup>.

The trocar (single puncture catheterization), Seldinger and modified Seldinger techniques are available as the catheterization techniques. There is no consensus on which of these techniques should be used<sup>14-17</sup>. In this study, we aimed to compare the trocar and modified Seldinger techniques used in the percutaneous treatment of CE1 and CE3a hepatic hydatid cysts in terms of treatment success, complications, recurrence, length of hospital stay, duration of catheterization and inactivation time.

## MATERIALS AND METHODS

This retrospectively designed study was conducted at the Interventional Radiology Clinic of University of Health Sciences Konya Training and Research Hospital. The records of the patients undergoing percutaneous treatment due to hepatic hydatid cysts between January 2015 and June 2019 were reviewed. The US reports of these percutaneously treated patients, which were performed at 1, 3, 6, 9, 12, 24,

36, 48, 60 months during the follow-ups before and after treatment were evaluated.

Age and gender were recorded. Cyst type, cyst size and localization were listed by an interventional radiologist after scanning pre-treatment ultrasound reports. The recorded percutaneous treatment information and reports were evaluated, and the type of treatment applied, complications, duration of catheterization and length of hospital stay were listed. Cysto-biliary fistula, cavity infection and anaphylactic shock were listed as major complications. Fever, angioneurotic edema and temporary bleeding were listed as minor complications. Complications after treatment with both techniques were recorded.

Decreased cyst size along with the absence of daughter vesicles or pure cystic appearance were defined as desirable criteria for cyst inactivation. In addition, complete obliteration of cyst cavity and complete solid cyst content with no fluid component were separately defined as inactivation criteria. Shrinkage, collapse, solidification of the inner membrane with decreased cyst size and more than 50% solidification of this cyst content were accepted as inactive form.

Inactivation time was defined as the period from the time of percutaneous treatment to the first follow-up time when the cyst was converted to inactive form. Follow-up period, cyst size at the last follow-up and inactivation time were recorded using the follow-up ultrasound reports.

Patients with CE2 and CE3b hepatic cysts were excluded from the study regardless of the type of percutaneous treatment applied. Patients who underwent percutaneous treatment with PAIR (puncture, aspiration, injection, re-aspiration) or modified catheterization were excluded from the study regardless of the cyst type. In total, the data of 209 patients were evaluated. As a result of this evaluation, the data of 83 patients were excluded from the study. Regardless of the type of hepatic cyst, the data of 59 patients who were treated with PAIR were excluded from the study. Recorded ultrasound reports obtained before percutaneous treatment were examined. As a result of the examination of these US reports, the data of 16 patients with CE2 cysts and MoCAT treatment were excluded from the study. In addition, eight patients with catheterization treatment and CE3b liver cysts were excluded from the study. The data of 126 CE1 and CE3a hepatic hydatid cyst

patients undergoing catheterization treatment were included in the study.

All procedures performed in the studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee, its later amendments or comparable ethical standards. All procedures performed in the studies comply with the 1975 Helsinki Declaration revised in 2000. This study was approved by the Ethics Committee of Necmettin Erbakan University Faculty of Medicine (Decision no.: 2020/2271). The requirement to obtain informed consent was waived due to the retrospective nature of this study.

## Procedure

### Evaluation before percutaneous treatment

Before treatment, laboratory tests were obtained from the patients and US was performed by the interventional radiologist who would apply the treatment. Complete blood count, prothrombin and partial thromboplastin times, international normalized ratio (INR) and platelet count were determined. Those with INR < 1.5 and platelet count > 100,000 / ml were considered suitable for percutaneous treatment. 10 mg/kg/day of Albendazole was administered orally for prophylaxis to reduce the risk of secondary dissemination 10 days before percutaneous treatment.

### Percutaneous treatment and follow-up procedures

All percutaneous treatment procedures were performed by the interventional radiologist with 3 years of experience. Treatment procedures were carried out under ultrasound or fluoroscopic guidance and fully sterilized conditions. Diphenhydramine HCl (20 mg) and Methylprednisolone (1 mg / kg) were administered to all patients intravenously by the anesthesiologist immediately before the procedure to prevent allergic reactions and reduce the risk of anaphylaxis. All patients were checked for anaphylaxis by an anesthesiologist in the interventional radiology unit during percutaneous treatment, and conscious sedation was performed.

Catheterization treatment was applied for CE1 and CE3a cysts over 8 cm in size. In addition, catheterization treatment was continued if the aspirate coming from the cavity was infected or

biliary yellow regardless of its size.

In the modified Seldinger technique, 18 G 15 cm needles were inserted into the cyst with a US-guided transhepatic approach first. Approximately 50% of the cyst content was evacuated visually with the needles to reduce the internal pressure of the cyst. ½ nonionic contrast material and ½ 0.9% NaCl were administered into the cyst under fluoroscopic guidance until the cyst contours became prominent for the evaluation of cyst integrity and relations with adjacent structures. The amount of contrast material and salt solution administered here was about half of the aspirated cyst fluid content. The cystography confirmed that there was no communication between the bile ducts and hepatic hydatid cyst cavity. Re-aspiration was performed until the content of the cyst cavity reached half of the cyst volume. Subsequently, an absolute scolicidal or sclerosing agent (20% hypertonic saline and 98% ethyl alcohol) was administered into the cyst in a volume equal to two thirds of the aspirate volume. The injected fluid was re-aspirated after waiting 10 minutes to observe the rupture of the endocyst layer from the pericyst. After these steps, ½ nonionic contrast material and ½ 0.9% NaCl mixture was re-administered into the cyst until the cyst cavity recovered approximately 50% of its volume. 0.035-in, 75-cm stiff guide wire was inserted into the cyst in an 18 G needle. An 8-F catheter (Bioteq, Taipei, Taiwan) was inserted into the cyst over the wire after appropriate tract dilatation. A collection bag was then attached to the tip of the catheter.

In the trocar technique, an 8-F trocar-type multi-purpose drainage catheter (Bioteq, Taipei, Taiwan) was advanced directly into the cyst with a US-guided transhepatic approach. All cyst contents were aspirated. The cyst was filled with ½ nonionic contrast material and ½ 0.9% NaCl equal to the aspirated amount. The cystography confirmed that there was no communication between the bile ducts and hepatic hydatid cyst cavity. The content of the cyst cavity was re-aspirated after cystograms, followed by injection of an absolute scolicidal or sclerosing agent (20% hypertonic saline and 98% ethyl alcohol) in a volume equal to two thirds of the aspirate volume. It was aspirated after waiting 10 minutes. A collection bag was then attached to the tip of the catheter.

After treatment, the patients were taken to the observation units. The catheter was kept in the cavity for at least 24 hours. After 24 hours, the catheter was

removed when the output was observed to be below 10 cc. All patients received oral Albendazole at a dose of 10 mg / kg / day for 2 weeks after percutaneous treatment.

### Statistical analysis

The data from the study was uploaded to the computer and evaluated by using “SPSS (Statistical Package for Social Sciences) for Windows 22.0 (SPSS Inc, Chicago, IL).” Descriptive statistics were presented as median (25%-75%), frequency

distributions, and percentages. Visual (histogram and probability graphs) and analytical (Kolmogorov-Smirnov Test) methods were used to assess the conformity of quantitative data to the normal distribution.

Pearson’s chi-square test was used in the evaluations of categorical data. Statistical significance between two independent groups of variables not showing a normal distribution was assessed using the Mann–Whitney *U* test. A *p* value of <0.05 was considered statistically significant.

**Table 1. Distribution and demographic data of variables compared in the modified Seldinger and trocar techniques**

Variables		Modified Seldinger Technique	Trocar Technique	P value
Gender n(%)	Male	16 (44.4)	21 (23.3)	0.019a
	Female	20 (55.6)	69 (76.7)	
Age mean(±SD)		41.83 (20.64)	39.62 (21.68)	0.601b
Localization n(%)	Left	6 (16.7)	26 (28.9)	0.154a
	Right	30 (83.3)	64 (71.1)	
Pretreatment Cyst Size (cm) mean(±SD)		10.59 (3.50)	9.34 (2.83)	0.702b
Cyst Type n(%)	CE1	29 (80.6)	78 (86.7)	0.386a
	CE3a	7 (19.4)	12 (13.3)	
Duration of Catheterization (day) mean(±SD)		10.61 (22.05)	2.67 (4.97)	0.002b
Duration of Hospitalization (day) mean(±SD)		2.61(1.57)	1.62 (2.11)	0.012b
Major Complication n(%)	None	28 (77.8)	78 (86.7)	0.226a
	CBF	3 (8.3)	6 (6.7)	
	Cavity Infection	5 (13.9)	4 (4.4)	
	Anaphylactic shock	0 (0.0)	2 (2.2)	
Minor Complication n(%)	None	30 (83.3)	64 (71.1)	0.324a
	Fever	4 (11.1)	10 (11.1)	
	Angioneurotic Edema	1 (2.8)	4 (4.4)	
	Temporary Bleeding	1 (2.8)	12 (13.3)	
Recurrence n(%)	None	35 (97.2)	88 (97.8)	0.853a
	Yes	1 (2.8)	2 (2.2)	
Final Cyst Size (cm) mean(±SD)		6.73 (2.65)	5.49 (1.80)	0.007b
Follow-up Time (day) mean(±SD)		768.44 (420.13)	1384.52 (249.10)	0.001b
Cyst Inactivation Time (day) mean(±SD)		394.29 (129.33)	500.77 (196.87)	0.023b

CE: Cystic echinococcus; Trocar: single puncture catheterization; CBF: cysto-biliary fistula; a: Pearson’s Chi-Square Test; b: Mann–Whitney *U* test

**Table 2. Comparison of complication rates between treatment modalities.**

		Modified Seldinger Technique		Trocar Technique		p
		n	%	n	%	
Major	None	28	77.8	78	86.7	0.217a
	Yes	8	22.2	12	13.3	
Minor	None	30	83.3	64	71.1	0.154a
	Yes	6	16.7	26	28.9	

Trocar: single puncture catheterization; a: Pearson’s Chi-Square Test

## RESULTS

A total of 126 patient data were included in the study. The number of CE1 cysts was 107, and the number of CE3a cysts was 19. The mean age of the patients was  $40.25 \pm 21.33$  years. 36 patients were treated with the modified Seldinger technique, while 90 patients were treated with the trocar technique. The trocar technique was preferred more in the selection of catheterization treatment. Our lost to follow-up rate was 21.4% (27 patients). The follow-up period of all patients after treatment in the interventional radiology unit was  $1185.36 \pm 426.02$  days. A total of 20 major complications and 32 minor complications developed. Demographic data of the patients treated with the modified Seldinger and trocar techniques, and detailed data on the variables of the treatment and follow-ups are presented in Table 1. The long-term treatment success rate was 97.2% in the modified Seldinger technique and 97.7% in the trocar technique. Recurrence was seen in only three (2.3%) patients. There was no significant difference between the two techniques in terms of long-term treatment success and recurrence rates ( $p = 0.853$ ).

The duration of catheterization was  $10,61 \pm 2,05$  days in the modified Seldinger technique and  $2,67 \pm 4,97$  days in the trocar technique. The length of hospital stay was  $2.61 \pm 1.57$  days in the modified Seldinger technique and  $1.62 \pm 2.11$  days in the trocar technique. The duration of catheterization and length of hospital stay were found to be significantly lower in the trocar technique compared to the modified Seldinger technique ( $p = 0.002$ ,  $p = 0.012$ , respectively).

The inactivation time was  $394,29 \pm 129,33$  days in the modified Seldinger technique and  $500,77 \pm 196,87$  days in the trocar technique. The inactivation process was faster in the modified Seldinger technique ( $p = 0.023$ ). The size of the cysts at the last follow-up, which were converted to inactive form, was  $6.73 \pm 2.65$  cm in the modified Seldinger technique and  $5.49 \pm 1.80$  cm in the trocar technique. In both techniques, the size of the cysts converted to inactive form decreased significantly in the follow-ups compared to pre-treatment size ( $p = 0.001$ ).

When the complications were grouped and evaluated statistically, there was no significant difference between the two techniques in terms of minor and major complication rates (Table 2). Three patients (2.3%) with recurrence underwent percutaneous

treatment again. Endoscopic treatment was performed by a gastroenterologist in the patients who developed cysto-biliary fistula.

## DISCUSSION

This study sought to answer the question: Which of the modified Seldinger and trocar techniques should be preferred in the treatment of CE1 and CE3a hepatic hydatid cysts? The inactivation process was faster in the modified Seldinger technique. The duration of catheterization and length of hospital stay were significantly lower in the trocar technique compared to the modified Seldinger technique. No significant difference was found between these two techniques in terms of efficacy, complication and recurrence rates.

Complications such as cysto-biliary fistula formation due to cavity infection or cyst decompression may also be observed after percutaneous treatment<sup>18-21</sup>. Turan et al. conducted a study comparing two percutaneous techniques and found a complication rate of 6.1% in the trocar technique and 17.9% in the Seldinger technique. There was no significant difference between the two techniques in terms of complications and recurrence<sup>22</sup>. We found it more accurate to compare the two techniques by including all complications during and after percutaneous treatment and in the long term. Unlike other studies, minor and major complications were compared between the techniques in this study. When the complications were grouped and evaluated statistically, there was no significant difference between the modified Seldinger and trocar techniques in terms of minor and major complication rates. Complications did not provide any predictions for technique selection.

Kahriman et al. suggested that the PAIDS technique can be used safely and with high success in the treatment of CE1 and CE3a hepatic hydatid cysts over 5 cm in size in their study in which they published their results of percutaneous treatment<sup>23</sup>. They did not apply the trocar technique to the patients in their study including all CE1, CE2, CE3 groups. This led to the suggestion of a single technique. Göktaş et al. continued with the Seldinger technique and inserted catheters after completing the stages of PAIR which was the same as our technique. In this study, they suggested this technique since it is unilaterally safe and effective<sup>24</sup>. Likewise, the modified Seldinger technique is suggested in the

percutaneous treatment of CE1 and CE3a cysts in another study using a single technique<sup>25</sup>. Contrary to these, there are also views arguing that one-stage low-profile trocar technique is safer<sup>26</sup>. One technique was evaluated as the percutaneous treatment modality, and the authors repeated each other in all of these studies. They did not compare the techniques in their studies. There was no significant difference between the two techniques in terms of treatment efficacy and recurrence rates in our long-term results. As is known, the success of treatment is high and recurrence rate is low in all percutaneous techniques. Each technique is safely applicable. It is difficult to choose a technique, considering these conditions. However, the evaluation of variables other than technical success may create differences between the techniques. This was taken into consideration in this study. Subsequently, variables that could affect the patient and treatment such as cyst inactivation time, duration of catheterization, length of hospital stay, decreased size at follow-ups were also evaluated. To the best of our knowledge, no evaluation was made regarding the duration of catheterization and length of hospital stay in the studies published to date. When the length of hospital stay is extended, it imposes additional costs to the insurance system and burden on the patient. Avoiding unnecessary health expenditures is thought to be as important as providing quality health care in today's medicine. In this study, it was proved that the duration of catheterization and length of hospital stay were significantly lower in the trocar technique compared to the modified Seldinger technique. This supported the interpretation that the trocar technique could be preferred primarily. However, the modified Seldinger technique had shorter cyst inactivation time. This was a superiority of the modified Seldinger technique. Faster inactivation process may be associated with longer catheterization time. Because the fluid content of cysts and more removal of their membranes can contribute to the inactivation in a shorter time.

There are some limitations of the study. Firstly, the diagnosis and follow-up of the patients were performed using ultrasound. US is a method applied simultaneously. It is not an imaging tool suitable for data recording and storage. We could not re-evaluate pre-treatment US images retrospectively. However, it is known that ultrasound is reliable in detecting hydatid pathognomonic symptoms of the cyst<sup>27</sup>. Our pre-treatment and post-treatment US assessment standard complies with the WHO-IWGE diagnostic and follow-up standards. Therefore, we

think that the study was not adversely affected in terms of the determination of the cyst type. Secondly, our lost to follow-up rate was high. In this regard, the number of the patients excluded from this study was higher than expected. However, the remaining patient group was sufficient for the significance of statistical analyses. Thirdly, our major and minor complication rates may be found high by the reader compared to the literature. Because we included complications during the entire follow-up period in addition to the complications during the periprocedural period and hospital stay. Our aim was to compare the short- and long-term results of the two techniques. We think that this condition did not adversely affect the study, since the data collection was carried out under the same conditions for both techniques, in line with our aim. In addition, our study group consisted of type CE1 and CE3a hepatic hydatid cysts that required catheter insertion. If the catheter is required in these cysts, it is large in size and the possibility of complications is high. This specific condition may have contributed to the increase in complication rates.

In conclusion, shorter cyst inactivation time was proved to be an advantage of the modified Seldinger technique, and shorter duration of catheterization and length of hospital stay were proved to be an advantage of the trocar technique in this study. Since there is no significant difference in terms of efficacy, complication and recurrence rates, both the modified Seldinger and trocar techniques are effective techniques that can be preferred safely in the treatment of CE1 and CE3a hepatic hydatid cysts.

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