

# Efficacy of single-session 99.5% ethanol sclerotherapy for incidentally found simple renal cysts

Jin Hyeok Kim, MD, PhD<sup>a</sup>, Ung Bae Jeon, MD, PhD<sup>a,b,\*</sup> , Joo Yeon Jang, MD<sup>a</sup>, Tae Un Kim, MD<sup>a,b</sup>, Hwaseong Ryu, MD<sup>a</sup>, Jeong A Yeom, MD, PhD<sup>a</sup>, Jieun Roh, MD<sup>a</sup>

## Abstract

Simple renal cysts are the most common masses in the kidney. Most are asymptomatic and are incidentally detected on imaging examinations performed for other reasons. This study aimed to compare the results of 40 and 120 minutes ethanol sclerotherapies that were performed in a single session to treat incidentally found simple renal cysts. We retrospectively reviewed 63 renal cysts in 62 patients treated by single session percutaneous ethanol sclerotherapy. Thirty-one patients with 32 cysts underwent a 40 minutes sclerotherapy (group A), and 31 patients with 31 cysts underwent a 120 minutes retention technique (group B). Under ultrasonographic and fluoroscopic guidance, cystic fluid was completely aspirated, and 50% of the aspirated volume was replaced with 99.5% ethanol (a maximum of 100 mL). Imaging follow-up of the patients was performed 3 months after sclerotherapy. The technical success rates were 100% in both groups. Eighteen patients (29.0%) were symptomatic (flank pain or discomfort). Indications of the other patients were large cysts (>5 cm; 46%) and an increment in the diameter on serial studies (25.4%). A significant difference between the 2 groups in terms of age, cyst diameter, volume of aspirated fluid, volume of injected ethanol, and percentage of reduction in cyst diameter ( $P > .05$ ) was not found. After treatment, flank pain or discomfort resolved in 17 of 18 (94.4%) symptomatic patients. One patient complained of persistent flank pain; however, no significant abnormality was detected on post-procedural computed tomography images. There were no other complications after therapy in the 2 groups. Single session ethanol sclerotherapy with a 40 minutes retention technique is an effective, safe, and cost-effective method for the treatment of incidentally found simple renal cysts. Although the procedural time was reduced, there was no significant difference in therapeutic efficacy between the 40 and 120 minutes therapies.

**Abbreviations:** CT = computed tomography, US = ultrasonography.

**Keywords:** cystic, ethanol, kidney diseases, sclerotherapy

## 1. Introduction

Simple renal cysts are the most common masses in the kidney, accounting for approximately 70% of all renal masses, and they frequently occur in people older than 50 years.<sup>[1,2]</sup> Risk factors for the development of renal cysts are male gender, old age, smoking, renal dysfunction, and hypertension.<sup>[3]</sup> Based on the morphology and enhancement characteristics of renal cysts, Bosniak classified renal cysts into 4 categories (I, II, III, and IV) in 1986 and modified the classification by adding the category IIF. Most renal cysts are benign and correspond to Bosniak I and II with an insubstantial risk of malignancy.<sup>[3,4]</sup>

Most renal cysts are asymptomatic and are incidentally detected on ultrasonography (US), computed tomography (CT), and magnetic resonance images, performed for other reasons.<sup>[1,5]</sup> However, large cysts may cause pain, hematuria,

hypertension, or urinary tract obstruction associated with the cysts. Therefore, treatment is required for symptomatic patients.<sup>[6]</sup> Other indications for treatment that have not been strictly defined are the progression of the cysts (size and number), and large cyst size ( $\geq 4$  cm or  $> 5$  cm). Percutaneous sclerotherapy and surgical de-roofing are the primary methods to treat renal cysts. Although a higher symptomatic success rate and lower recurrence rate have been reported after laparoscopic treatment, sclerotherapy is also effective, and known as a minimally invasive procedure with few complications and high cost-effectiveness.<sup>[3,7]</sup>

Sclerotherapy of simple renal cysts is commonly performed to manage symptoms in symptomatic patients in single or multiple sessions of treatment with various sclerosants.<sup>[3,6,8]</sup> Favorable outcomes with various sclerosing techniques have been reported thus far. However, an optimal method is yet to be

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The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

<sup>a</sup> Department of Radiology, Pusan National University Yangsan Hospital, Yangsan, Korea, <sup>b</sup> Department of Radiology, School of Medicine, Pusan National University, Yangsan, Korea.

\* Correspondence: Ung Bae Jeon, Department of Radiology, Pusan National University Yangsan Hospital, 20 Geumo-ro, Mulgeum-eup, Yangsan, Gyeongnam 50612, Korea (e-mail: junwb73@pnuyh.co.kr).

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established, and different techniques are applied in each institution. Therefore, we compared the effectiveness of 40 and 120 minutes ethanol sclerotherapies performed in a single session to treat incidentally found simple renal cysts.

## 2. Methods

### 2.1. Patients

This retrospective study was approved by our institutional review board, and the requirement for informed consent was waived (05-2020-255). Renal cysts, contain homogeneous fluid, and have well-defined, thin, smooth walls without septa, calcification, or a solid component (corresponding to Bosniak I), were considered for sclerotherapy. The patient was excluded if echogenic cystic fluid or irregular wall thickening was detected on US during the procedure. Sixty-two patients (mean age, 62.35 years; range, 33–83 years) with 63 simple renal cysts underwent sclerotherapy using 99.5% ethanol between January 2014 and June 2017. Of the 62 patients, 31 patients with 32 cysts were treated with a 40 minutes retention technique (group A, from March 2016 to June 2017), and 31 patients with 31 simple renal cysts were treated with a 120 minutes retention technique (group B, from January 2014 to February 2016). One patient with bilateral renal cysts in group A was treated twice. The indications for sclerotherapy were flank pain or discomfort (18 patients, 28.6%), a large cyst >5 cm in diameter (29 patients, 46%), and an increment in the diameter on serial imaging studies (16 patients, 25.4%) (Table 1). The longest diameter of the targeted simple renal cysts was measured on the pre-procedural US and CT (Fig. 1A and B). Forty-three patients underwent both US and CT studies (23 patients in group A and 20 patients in group B), and the maximum diameter of the cysts on US and CT images was recorded. Patients were followed up using US or CT 3 months after sclerotherapy. Complete disappearance of the renal cyst was considered complete regression, while the decrement of the cyst diameter by > 50% was considered near-complete regression and the reduction of the cyst size by < 50% as partial regression. The persistence of symptoms or increased

size of the cyst on follow-up images was defined as a treatment failure.

### 2.2. Procedures

For all patients, the results of preliminary hematological investigations were checked before the sclerotherapy to exclude and correct coagulopathy. Prophylactic antibiotics were not administered. For pain control, 25 mg of pethidine hydrochloride was injected intravenously prior to the procedure. Patients were placed in the prone position and the puncture site was selected using US. Local anesthesia was achieved with 2% lidocaine hydrochloride. Under US guidance, the cyst was punctured with a 21-gauge Chiba needle (A&A MD, Seongnam, Korea). After checking the cyst with a small injection of contrast medium under fluoroscopy, a hairy wire (Cook Medical, Bloomington, IN), 5-Fr yellow sheath (A&A MD), and 0.035-inch hydrophilic guidewire (Terumo, Tokyo, Japan) were inserted sequentially. Subsequently, an 8.5-Fr drainage catheter (Cook Medical) was inserted after tract dilatation with an 8-Fr dilator. The cyst fluid was completely aspirated, and the same amount of contrast medium mixed with normal saline was filled in the cyst to check the communication between the cyst and pelvicalyceal system (Fig. 1C). The aspirated fluid was sent for cytologic evaluation. After removal of the contrast solution, half of the aspirated volume was replaced with 99.5% ethanol (a maximum of 100 mL). The patients were placed in supine, lateral decubitus, prone, and lateral decubitus positions at 10 minutes (group A) to 15 minutes (group B, 2 cycles) intervals to increase the exposure of all surfaces of the cyst to ethanol in the observation room while their vital signs were monitored. After 40 minutes (group A) and 120 minutes (group B) of retention, ethanol and the pigtail catheter were removed. Total procedure time was calculated based on the electronic medical record, which was defined as the time between initiation of drainage catheter insertion into the cyst and catheter removal. Fluoroscopic time and radiation dose during the sclerotherapy were also recorded. Imaging follow-up was performed at 3 months after treatment (Fig. 1D). Post-procedural

**Table 1**

**Characteristics of the patients and renal cysts.**

	Group A	Group B	P value
Patients	31	31	-
Age	62.22 ± 12.16	62.48 ± 10.89	.93
Sex			.51
Male	15	12	
Female	16	19	
Treated cysts	32*	31	
Indications for sclerotherapy			-
Flank pain or discomfort	10*	8	
Increment of cyst size	5	11	
Asymptomatic, large cyst (>5 cm)	17	12	
Diagnostic modality			-
CT and US	23*	20	
CT	9	10	
US	0	1	
Multiplicity of renal cysts			-
Single	8	11	
Bilateral multiple	19*	13	
Ipsilateral multiple	5	7	
Location of treated cysts			.91
Right	14*	14	
Left	18*	17	

CT = computed tomography, US = ultrasonography.

\* One patient with bilateral renal cysts was treated twice.

complications were classified using the Clavien-Dindo classification of surgical complications (Table 2).<sup>19]</sup>

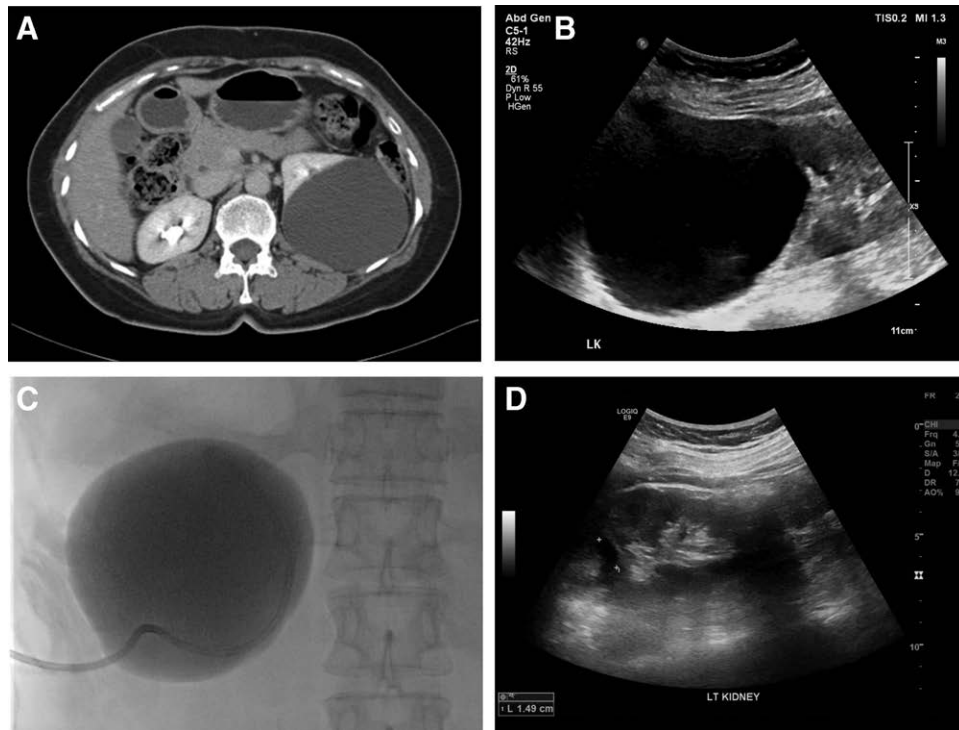
**2.3. Statistical analysis**

For analyzing patient data, commercially available statistical software, IBM SPSS Statistics for Windows, version 21 (IBM Corp., Armonk, N.Y.), was used. Data are presented as the mean ± standard deviation. Numeric variables were compared

between the 2 groups using an independent *t* test, and a Chi-square test was used for categorical variables. A *P* value < .05 was considered statistically significant.

**3. Results**

The overall technical success rate of sclerotherapy was 100% in both groups. Some patients complained of temporary pain during ethanol sclerotherapy. However, there were no reports



**Figure 1.** A 58-year-old woman with left flank pain. (A) A simple renal cyst is detected on an axial contrast-enhanced computed tomography image (maximum diameter: 8.8 cm). (B) The left simple renal cyst is measured as 9.6 cm on ultrasonography (US). (C) A fluoroscopic image during the sclerotherapy. Cystic fluid was completely aspirated (330 mL), and contrast medium mixed with normal saline was filled in the renal cyst to check for communication between the cyst and pelvicalyceal system. Subsequently, 100 mL of 99.5% ethanol was replaced in the cyst. The ethanol and pigtail catheter were removed after a position change of 40 min. (D) A follow-up US image after 3 months of sclerotherapy shows decrease in cyst diameter from 8.8 cm to 1.5 cm. Her symptom was resolved after the treatment.

**Table 2**  
**The Clavien-Dindo classification of surgical complications.**

Grades	Definition
Grade I	Any deviation from the normal postoperative course without the need for pharmacological treatment or surgical, endoscopic, and radiological interventions. Acceptable therapeutic regimens are drugs as antiemetics, antipyretics, analgesics, diuretics and electrolytes and physiotherapy. This grade also includes wound infections opened at the bedside.
Grade II	Requiring pharmacological treatment with drugs other than such allowed for grade I complications. Blood transfusions and total parenteral nutrition are also included.
Grade III	Requiring surgical, endoscopic, or radiological intervention.
Grade III-a	Intervention not under general anesthesia.
Grade III-b	Intervention under general anesthesia.
Grade IV	Life-threatening complication (including CNS complications) requiring IC/ICU-management.
Grade IV-a	Single organ dysfunction (including dialysis).
Grade IV-b	Multi organ dysfunction.
Grade V	Death of the patient.

CNS = central nervous system, IC/ICU = intensive care/intensive care unit.

of complications requiring treatment such as blood transfusion or additional procedures, and all the patients were classified as grade I according to the Clavien-Dindo Classification. In this study, the mean volume of all 63 cysts before sclerotherapy was  $243.02 \pm 221.88$  mL and the mean cyst size was  $8.29 \pm 1.93$  cm. On average, cyst diameter decreased by  $56.17\% \pm 18.48\%$  (range, 14.49%–100%) after treatment; the mean follow-up period was  $87.76 \pm 75.21$  days. In the follow-up study, 4 cysts completely disappeared and were categorized as complete regression (2 in group A and 2 in group B). Twenty-two cysts in group A and 16 cysts in group B were considered near-complete regressions, and the other 21 cysts were classified as partial regressions (8 in group A and 13 in group B). In the cytologic evaluation of the aspirated fluid, malignant cells were not detected in either group. The difference between the 2 groups in terms of age, sex, location of the cyst, cyst diameter, volume of aspirated fluid, volume of injected ethanol, percentage of decrement in cyst diameter, and follow-up period was not significant. Moreover, the mean radiation dose during sclerotherapy was not significantly different in both groups ( $15.24 \pm 11.58$  mGy, 31 patients in group A;  $15.48 \pm 13.02$  mGy, 28 patients in group B; the dose report was missing in 4 patients). However, the mean procedure time was significantly shorter in group A than group B ( $59.53 \pm 7.66$  vs  $142.74 \pm 8.56$  minutes;  $P < .001$ ) (Table 3). Clinically, flank pain or discomfort resolved in 17 out of 18 (94.4%) symptomatic patients. One patient complained of persistent flank pain; however, on post-procedural CT images taken 1 month after treatment, no significant abnormality was found. Moreover, the longest diameter of the treated cyst decreased from 9.4 to 5.8 cm. The patient's symptoms disappeared on the following visit to the urology clinic 1 week after checking the follow-up CT.

#### 4. Discussion

Simple renal cysts are more common in older people, and approximately half of people older than 50 years have simple renal cysts.<sup>[2,10]</sup> Most simple renal cysts are asymptomatic; however, treatment is sometimes required for the symptomatic cysts that cause flank pain, hydronephrosis, hematuria, or hypertension. Percutaneous sclerotherapy is a safe, minimally invasive procedure that is commonly performed for the treatment of simple renal cysts.

In the previous studies that evaluated the efficacy of laparoscopic decortication, surgical treatment was suggested as

the first choice of treatment for large cysts  $\geq 6$  cm or  $\geq 10$  cm. However, the laparoscopic approach was recommended as suitable for younger patients and in cases of failed sclerotherapy.<sup>[3]</sup> In the present study, the patients were elder (group A,  $62.22 \pm 12.16$  years; group B,  $62.48 \pm 10.89$  years), and the mean diameter of treated cysts was approximately 8 cm (group A,  $8.43 \pm 1.9$  cm; group B,  $8.14 \pm 1.97$  cm). In this study population, percutaneous sclerotherapy, rather than laparoscopy, is a safe and simple method to prevent complications after treatment. There were no patients who needed medication (other than analgesics), blood transfusions, or additional procedures after the sclerotherapy. Furthermore, the total procedure time is relatively shorter in sclerotherapy (40 minutes retention group,  $59.53 \pm 7.66$  minutes) than in the laparoscopic approach described in previous studies ( $36.6$ – $233$  minutes).<sup>[3]</sup>

Treatment with various sclerosants, such as ethanol, acetic acid, ethanolamine oleate, *n*-butyl cyanoacrylate, 20% hypertonic saline, and bleomycin, with single or multiple session techniques has been reported with high success rates and favorable outcomes.<sup>[5,8,10–16]</sup> Cho et al<sup>[14]</sup> reported that sclerotherapy with acetic acid and ethanol treatment showed equivalent effects on simple renal cysts. Li et al<sup>[11]</sup> suggested that single session bleomycin sclerotherapy is a simple, effective, and safe treatment for the management of simple renal cysts. According to Chung et al,<sup>[6]</sup> multiple session sclerotherapy using 99% ethanol is better than a single session treatment for simple renal cysts. However, the optimal technique to treat simple renal cysts in regards to efficacy and cost-effectiveness has not yet been established.

Ethanol is an effective, safe, and inexpensive sclerosing agent and is most widely used for the treatment of renal cysts.<sup>[8]</sup> When ethanol is filled in the cysts, it rapidly destroys the epithelial cells of the cyst (within 1–3 minutes); however, it penetrates the fibrous capsule slowly (4–12 hours). Therefore, ethanol can be stored for a while during the treatment and removed before the renal parenchyma is affected.<sup>[17]</sup> To avoid alcohol toxicity caused by the systemic absorption of ethanol, the maximum volume of injected ethanol should not exceed 100 mL, and the patient needs to be monitored during and after the sclerotherapy. Based on this theory, the average volume of injected ethanol was  $74.21 \pm 26.81$  mL (range, 10–100 mL) in this study, and patients changed their position every 10–15 minutes to maximize the contact of the alcohol with all areas of the cyst wall.

According to previous studies, the long-term ethanol retention technique with multiple sessions of treatment resulted in

**Table 3**  
Results of 40 min (group A) and 120 min (group B) ethanol retention techniques.

	Group A	Group B	P value
Longest diameter of cysts (cm)	$8.43 \pm 1.9$	$8.14 \pm 1.97$	.55
Volume of cysts (mL)	$236.09 \pm 198.49$	$250.16 \pm 246.83$	.80
Volume of injected ethanol (mL)	$77.81 \pm 22.82$	$70.48 \pm 30.31$	.28
Total procedure time (min)	$59.53 \pm 7.66$	$142.74 \pm 8.56$	<.001
Follow-up period (days)	$74.0 \pm 73.26$	$101.97 \pm 75.72$	.14
Size reduction rate (%)	$58.6 \pm 18.06$	$53.67 \pm 18.87$	.29
Radiation dose (mGy)	$15.24 \pm 11.58^*$	$15.48 \pm 13.02^\dagger$	.94
Treatment response	n = 32	n = 31	
Complete regression	2 (6.2%)	2 (6.5%)	-
Near-complete regression	22 (68.8%)	16 (51.6%)	-
Partial regression	8 (25%)	13 (41.9%)	-
Complications‡			
Grade I	32	31	
Others	0	0	

\* Mean radiation dose in 31 of 32 procedures in group A.

† Mean radiation dose in 28 of 31 procedures in group B.

‡ The Clavien-Dindo classification of surgical complications.

a favorable therapeutic effect.<sup>[10,18]</sup> However, the process of performing multiple sessions of sclerotherapy is time-consuming, as well as increasing patient inconvenience and discomfort and the possibility of ethanol leakage. In our study, the implementation of a single session, 40 minutes ethanol retention technique reduced procedure time and hospital stay compared to our 120 minutes method and other multiple session treatments. However, the therapeutic efficacy of the 40 minutes retention technique was not significantly different compared to that of the 120 minutes treatment. Although a higher percentage of volume reduction (up to 98%) was reported in other series using various sclerosing agents with single or multiple session treatment,<sup>[14,15]</sup> the aim of sclerotherapy for renal cysts is not complete regression of the cyst itself, but to decrease its size and resolve symptoms. Thus, even though the size decrement rate after treatment was lower in the present study ( $56.17 \pm 18.48\%$ ), 17 of 18 (94.4%) symptomatic patients were resolved after single session sclerotherapy, with the absence of recurrence in both groups.

Radiation exposure during sclerotherapy under fluoroscopic guidance is another concern. The mean radiation dose was  $15.35 \pm 12.17$  mGy in 59 patients (the dose report was missing in 4 patients) of our series, a similar dose to that of chest or abdomen CT exams.<sup>[19]</sup> Radiation exposure needs to be increased in multiple session treatments unless a repeated procedure is performed without fluoroscopic guidance.

This study has some limitations. First, the follow-up period after sclerotherapy was relatively short ( $87.76 \pm 75.21$  days). According to the study by Li et al,<sup>[11]</sup> results of a year follow-up using the single session method with bleomycin showed that proportions of complete regression and near-complete regression increased as the follow-up periods extended. The size increment of the treated cyst or recurrence of symptoms was not reported in the present study in the 3 month follow-up. We expect the treatment effect to be continued in long-term follow-ups. Second, the longest diameter of the renal cyst was measured to evaluate the size before and after sclerotherapy. As the renal cyst is not perfectly spherical, the exact volume of the cyst cannot be calculated on US or CT images. We measured the maximum diameter of the cyst and calculated the percentage of size decrement in a simple way. Therefore, differences may arise between our results and those of other studies that measured the volume of the cyst. However, if the volume is calculated assuming that the cyst is an exact sphere in this study, the difference might not be significant.

In conclusion, single session ethanol sclerotherapy with a 40 minutes retention technique is an effective, safe, and cost-effective method for the treatment of simple renal cysts. It can shorten the procedural time and the length of the hospital stay. However, there was no significant difference in therapeutic efficacy between the 40 and 120 minutes therapies.

## Author contributions

**Conceptualization:** Ung Bae Jeon.

**Data curation:** Jin Hyeok Kim, Joo Yeon Jang, Tae Un Kim, Hasson Ryu, Jeong A Yeom, Jieun Roh.

**Formal analysis:** Jeong A Yeom, Jieun Roh.

**Investigation:** Jin Hyeok Kim, Ung Bae Jeon, Joo Yeon Jang, Tae Un Kim, Hwaseong Ryu, Jeong A Yeom, Jieun Roh.

**Methodology:** Jin Hyeok Kim, Joo Yeon Jang, Tae Un Kim, Hwaseong Ryu.

**Project administration:** Jin Hyeok Kim, Ung Bae Jeon, Joo Yeon Jang.

**Supervision:** Ung Bae Jeon.

**Visualization:** Jin Hyeok Kim.

**Writing – original draft:** Jin Hyeok Kim, Ung Bae Jeon.

**Writing – review & editing:** Jin Hyeok Kim, Ung Bae Jeon.

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