Technical Note

One-Step Method in Creation of Artificial Ascites

CME Credits

Tienshin Chou, Cho-Li Yen*, Li-Wei Chen, Cheng-Hung Chien

Department of Hepatogastroenterology, Liver Research Unit, Keelung Chang-Gung Memorial Hospital, Keelung, Taiwan

Abstract

Background: The study aims to improve the success rate and the rapidity in creating artificial ascites before starting the treatment for subcapsular hepatocellular carcinomas. **Methods:** Two hundred and forty-six consecutive hepatocellular carcinoma patients who required the instillation of artificial ascites for better visualization or prevention from organ injury were recruited between November 2011 and September 2017. Initially, 95 patients were using the Seldinger technique, while the remaining 151 patients were using the one-step method. The proportions of patients who had undergone surgery, transarterial chemoembolization, or radiofrequency ablation therapy before performing artificial ascites infusion were 11.6% (11/95), 3% (3/95), and 37% (35/95) in the Seldinger group, and 15.9% (24/151), 15.2% (23/151), and 52.3% (79/151), respectively, in the one-step group. **Results:** The complete success rate, partial success rate, and failure rate in creating artificial ascites using the Seldinger technique and the one-step method were 76.8% (73/95), 11.6% (11/95), 11.6% (11/95) and 88.1% (133/151), 7.9% (12/151), 4% (6/151), respectively. The complete success rate was significantly higher in the one-step method group ($P < 0.05$) than that of the Seldinger group. The mean time required from starting the procedure to successful intraperitoneal instillation of glucose water was 145.79 ± 133.37 s in the one-step method, which was statistically shorter than that of 238.68 ± 95.58 s in the Seldinger group ($P < 0.05$). **Conclusion:** The one-step method has a higher success rate than the Seldinger method in creating artificial ascites and is faster, especially in treatment-experienced patients.

Keywords: Artificial ascites, hepatocellular carcinoma, one-step method, radiofrequency ablation

Introduction

Radiofrequency ablation (RFA) therapy has been widely accepted as an effective modality for the treatment of hepatocellular carcinomas, and the response rates were high with few complications.[1-4] Patients with hepatocellular carcinoma at the early stage can be treated with RFA, and the 5-year survival rates were between 50% and 70%.[2,5]

Percutaneous ultrasonography-guided RFA therapy is one of the most frequently used methods in treating hepatocellular carcinoma. There are a number of drawbacks, especially when the tumors are adjacent to the intestine, stomach, or abutting the dome. The reported complication rates of intestinal perforation varied from 0.5% to 0.7%.[6,7] Artificial effusion[8,9] or artificial ascites[10-12] was used to increase the visibility of the tumors near the dome as well as to avoid injury to the digestive tract. The success rates in the creation of artificial ascites were between 88% and 97%.[10-12] The Seldinger technique has been adopted for the placement of the angiosheath.[10] The patients who underwent artificial ascites infusion were requested to hold their breath, and the outer sheaths were placed in the peritoneal cavity when the patients exhaled. However, when the patients were under deep anesthesia, they were unable to cooperate. To overcome these shortcomings, we conducted this study using the one-step method to improve the effectiveness in creating artificial ascites.

Materials and Methods

The study was approved by the Institutional Review Board of Keelung Chang Gung Memorial Hospital (IRB No. 2107130069). Informed consents were obtained from all patients before starting treatment. The procedures for the induction of artificial ascites were performed by the same hepatologist who had experience in sonography-guided intervention for more than 20 years.

Received: 13-02-2022 **Revised:** 15-04-2022 **Accepted:** 19-05-2022 **Available Online:** 16-08-2022

Access this article online

Quick Response Code:

Website: www.jmuonline.org

DOI: 10.4103/jmu.jmu_17_22

Address for correspondence: Dr. Cho-Li Yen, Department of Hepatogastroenterology, Keelung Chang-Gung Memorial Hospital, No. 222, Mai-Chin Road, Keelung 204, Taiwan.
E-mail: a29157@ yahoo.com.tw, choliyen55@cgmh.org.tw

How to cite this article: Chou T, Yen CL, Chen LW, Chien CH. One-step method in creation of artificial ascites. J Med Ultrasound 2022;30:287-90.

The diagnosis of hepatocellular carcinoma, conformed to the AASLD criteria, was confirmed by percutaneous liver biopsy or based on at least one characteristic imaging finding with computed tomography or magnetic resonance imaging. All the patients were Child–Pugh class A or B liver cirrhotic patients with the values of prothrombin time <1.7 (international normalized ratio), and the platelet counts >60,000 cells/mm^3.

Between November 2011 and September 2017, a total of 246 patients who had undergone artificial ascites infusion before RFA therapy were enrolled. The Seldinger method was adopted in 95 patients and the one-step method was implemented in 151 patients.

Creating artificial ascites

All patients were sedated with 100 μg of fentanyl or 50 mg of Demerol in addition to 5 mg of midazolam intravenously before treatment. Local anesthesia using 2% lidocaine solutions of variable amounts, as required, was injected to the puncture sites under the guidance of sonography.

The procedure of the one-step method was implemented as described below. After taking out the inner stylet from an 18 gauge Chiba needle, a guide wire was threaded into the hollow needle. The threaded hollow needle was punctured through the skin. Upon reaching the capsule of liver, as can be seen on ultrasonography, the resistance from the parietal peritoneum could be felt. With a gentle push on the threaded needle, the resistance was released and the needle was placed just above the liver capsule. The guide wire was pushed beyond the tip of the threaded needle [Figure 1]. As the guide wire was placed correctly in the abdominal cavity, the resistance was minimal. The guide wire could be demonstrated on ultrasound and the liver capsule was usually pressed slightly downward [Figure 2]. The angiosheath was then passed over the guide wire into the skin and reached the intraperitoneal space. After withdrawal of the guide wire, D5/W was instilled through the angiosheath to create artificial ascites. If the guide wire was misplaced in the liver parenchyma, an echogenic linear structure could be seen on ultrasonography [Figure 3]. The tip of the threaded needle was pulled back a little bit to allow for the replacement of the guide wire into the intraperitoneal cavity.

A complete success was defined as the instillation of adequate water to separate the target tumor from the adjacent organ; a partial success was defined as the incomplete separation of the tumor from the adjacent organ despite sufficient amount of ascites instilled; and a failure was defined as the subcutaneous or intrapleural instillation of water without reaching the desired region.

Statistical analysis

The time required to complete the artificial ascites infusion, and the success rates were analyzed and compared between the one-step method group and the Seldinger group using Student's *t*-test and the χ^2 test or Fisher's exact test. $P < 0.05$ was considered statistically significant.

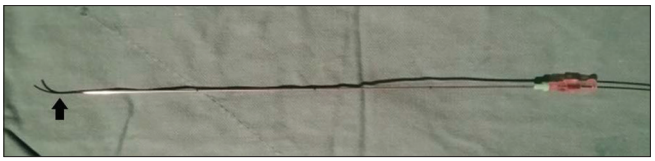

Figure 1: A guide wire is threaded into the hollow chamber of an 18 gauge Chiba needle with the wire (arrow) pushed beyond the tip of the needle

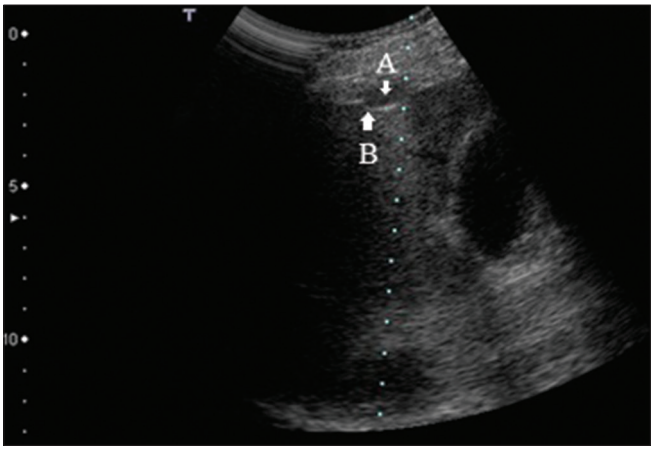

Figure 2: The guide wire was placed correctly in the peritoneal space (arrow A). The liver capsule was pressed down by the wire (arrow B)

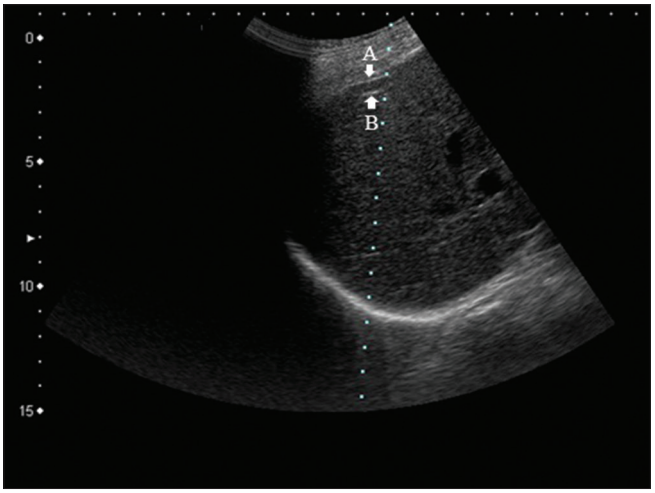

Figure 3: The guide wire is misplaced under the liver capsule (arrow A) in the liver parenchyma (arrow B)

Results

The proportions of patients who had undergone surgery, transarterial chemoembolization (TACE), or RFA therapy before the procedures were 11% (11/9), 3% (3/95), and 37% (35/95) in the Seldinger group, and 15.9% (24/151), 15.2% (23/151), and 52.3% (79/151) in the one-step method group, respectively. In total, 51.6% (49/95) in the Seldinger group and 83.4% (126/151) in the one-step group had undergone previous procedures. The patients using the one-step method had undergone more previous treatment than the Seldinger group had statistically undergone ($P < 0.05$).

For the one-step method, the time required from the beginning to the completion of the procedure ranged from 40.0 s to 920.0 s with a mean and standard deviation of 145.79 ± 133.37 s. In patients using the Seldinger method, the time required from the beginning to the completion of the procedure ranged from 150.0 s to 720.0 s with a mean and standard deviation of 238.68 ± 95.55 s. The time required for the one-step method was significantly shorter than that of the Seldinger method ($P < 0.05$).

The complete success rate, partial success rate, and the failure rate for the Seldinger technique and the one-step method were 76.8% (73/95), 11.6% (11/95), 11.6% (11/95) and 88.1% (133/151), 7.9% (12/151), 4.% (6/151), respectively. In total, the success rate (complete success plus partial success) of the one-step method was 96%, which is significantly better than that of the 88.4% in the Seldinger group ($P < 0.05$).

In subgroup analysis, the success rate of 95.25% (120/126) in treatment-experienced patients using the one-step method was statistically higher than that of 85.7% (54/63) in the Seldinger group ($P = 0.022$). For treatment naïve patients, the success rates of 100% (25/25) and 93.7% (30/32) for the one-step method and the Seldinger group, respectively, were not different statistically.

A total of 11 patients (7.3%) demonstrated ultrasonography detectable right pleural effusions after the one-step method and required a pigtail catheter placement to relieve symptoms.

Discussion

Before the introduction of artificial ascites, the frequency of diaphragm injury after percutaneous RFA for hepatic tumors adjacent to the diaphragm was reported to be 17%.[13] Artificial ascites infusion of saline or glucose water into a pocket created by the injection of lidocaine was first reported by Raman in the animal study.[14] The injury of the diaphragm was reduced to grade 0 in 65% of experimental animals. However, the creation of artificial ascites using lidocaine pocket has several drawbacks including the difficulty to maintain the injection needle in place and the risk of injury to the liver or the adjacent organs during RF deployment or treatment[15] and most importantly the collection of artificial ascites may not be present in the desired place. With either the one-step method or the Seldinger technique, a catheter instead of the injection needle can be placed intraperitoneally nearest to the tumor to be ablated and during treatment; the amounts of artificial ascites required can be easily adjusted.

The Seldinger technique has several technical limitations when creating artificial ascites. The method requires the patients to hold their breath during needle punctures and exhale when advancing the external sheath. However, this practice is difficult to put into place when the patients are under heavy sedation or general anesthesia. In the presence of peritoneal adhesion resulting from previous surgery, thermal ablation therapy or TACE, the placement of an external sheath with the Seldinger method[10,11] is more difficult than the advancement of a guide wire during the performance of the one-step method because the space between the parietal peritoneum and the liver capsule is narrow and the sheath is wider than the guide wire.

One more advantage of the one-step method is that the guide wire is more readily visible on sonography than the plastic sheath. However, severe adhesion is still a main obstacle in advancing the guide wire with the one-step method. The time required to achieve a successful artificial creation of ascites using the one-step method was 145.79 s in this study, which was significantly shorter than that of the Seldinger method because the one-step method omitted the step of placing the over-sheath. As a result, the one-step method shortened the time required to achieve a successful infusion of the artificial ascites.

The success rate was 96% with the one-step method in this study, which was compatible with the rates of 84.1%–100% in previous reports.[11,16,17]

The concern that the guide wire might penetrate the liver parenchyma was minimized by the clear demonstration of the guide-wire under ultrasonography and the risk of penetration of liver parenchyma was avoided by drawing back the threaded needle when the wire was present in the liver parenchyma.

In summary, the creation of artificial ascites with the Seldinger method requires the cooperation of conscious patients and has the disadvantage of poor visualization of the sheath during placement of the guide wire on sonography. The introduction of artificial ascites with the one-step method is safe and faster than the conventional Seldinger method. The guide wire can be seen more readily on sonography, but adhesion from previous procedures including surgery, RFA, or HACE still interferes with the success rate. The risk of introducing the guide wire into the liver can be minimized as the guide wire can be visualized clearly on ultrasonography while performing the one-step method.

Financial support and sponsorship

Nil.

Conflicts of interest

Prof. Cho-Li Yen, an editorial board member at *Journal of Medical Ultrasound*, had no role in the peer review process of or decision to publish this article. The other authors decalared no conflicts of interest in writing this paper.

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