Artificial Pleural Effusion for Microwave Ablation of Hepatic Dome Tumors: A Single-Center Experience

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Introduction

Clinical Challenge of Hepatic Dome Tumors:

- Liver tumors located in the hepatic dome (segments 7, 8, 7/8) present substantial technical challenges for percutaneous thermal ablation under ultrasound guidance. Intrapulmonary gas and rib interposition obscure real-time sonographic visualization.

The Role of Artificial Pleural Effusion (AP):

- Artificial pleural effusion displaces the lower margin of the lung, creating an acoustic "liquid window", enhancing real-time sonographic visibility of subdiaphragmatic lesions and enabling safer alternative needle trajectories that could circumvent main hepatic and portal vasculature.

Objectives

- To evaluate local experience with artificial pleural effusion (AP) for percutaneous ultrasound-guided microwave ablation (MWA) of hepatic dome tumors at a local tertiary center, focusing on technical feasibility, lesion visualization, local tumor control, and safety outcomes.

Materials and Methods

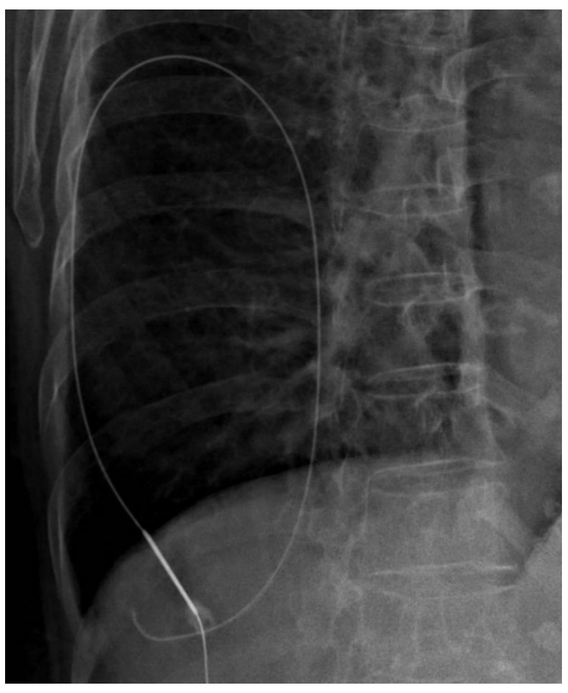
- Search of “artificial pleural effusion” in Radiology Information System (RIS) was performed from 1 July 2025 to 30 June 2026.
- Cases are retrospectively reviewed for technical success rate, and whether enhanced visibility and alternative safe percutaneous routes can be achieved with AP. Complications are graded according to the SIR Classification System. Follow-up period and local treatment outcome are also recorded.

Illustrated Steps

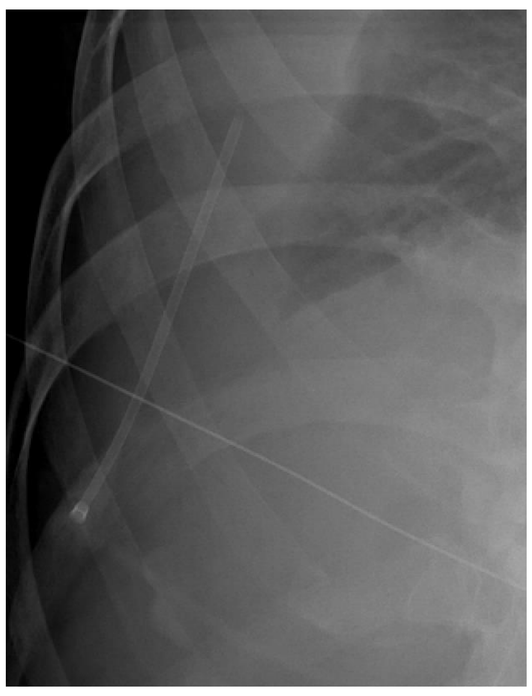
- Patient selection: Patients presenting with primary hepatocellular carcinoma (HCC) or hepatic metastases located in subdiaphragmatic segments (S7, S8, or S7/S8).
- Pre-Procedural Mapping: Prior CT or MRI studies were reviewed to evaluate lesion conspicuity, depth, and proximity to adjacent vascular structures (e.g. right portal vein branches).
- Conscious Sedation or Monitored Anesthesia Care (MAC): using IV Fentanyl (150–200 mcg) and IV Midazolam (3–5 mg), alongside local infiltration with 1% Lignocaine (10–20 mL).

Artificial Pleural Effusion (AP)

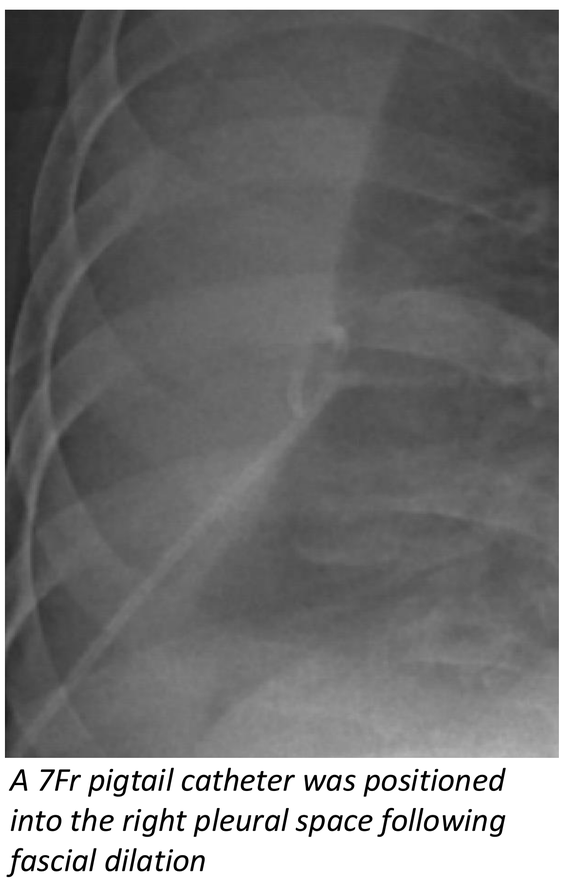
- Under real-time US (or fluoroscopic) guidance, the right pleural cavity was punctured using a 18G Tuohy needle. The curved tip of the Tuohy needle facilitates the access to pleural cavity and reduces the risk of lung injury.
- The Tuohy needle is connected to a three-way stoplock with another end linked to an IV drip stand. Confirmation of needle tip within the pleural cavity was made when there is dripping of fluid by pleural negative pressure.
- Over a 0.035" Terumo glidewire, a 5-7Fr vascular sheath or pigtail catheter was positioned into the pleural space following fascial dilation.
- Fluid Instillation: 5% Dextrose (D5W) solution (1000–1500 mL) was infused into the pleural space to create a clear acoustic window.



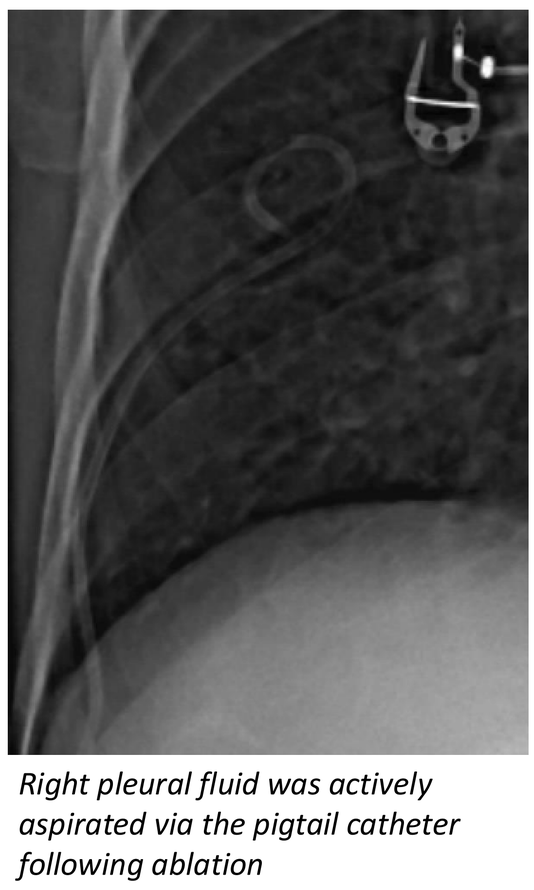
A 0.035" Terumo glidewire is threaded into the right pleural space via a 18G Tuohy needle



A 5-7Fr vascular sheath was positioned into the right pleural space



A 7Fr pigtail catheter was positioned into the right pleural space following fascial dilation

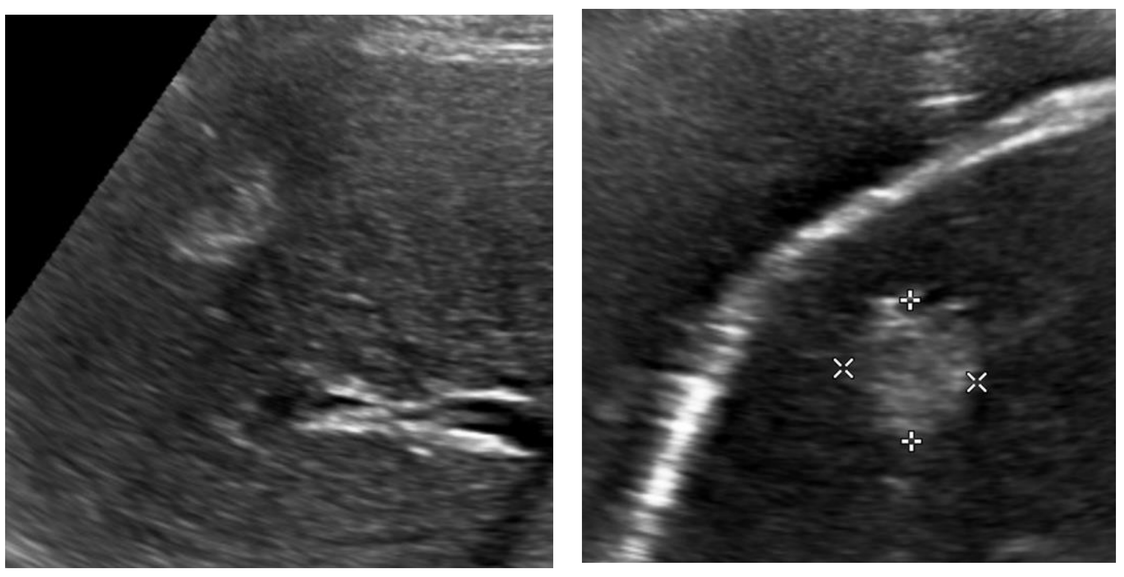


Right pleural fluid was actively aspirated via the pigtail catheter following ablation

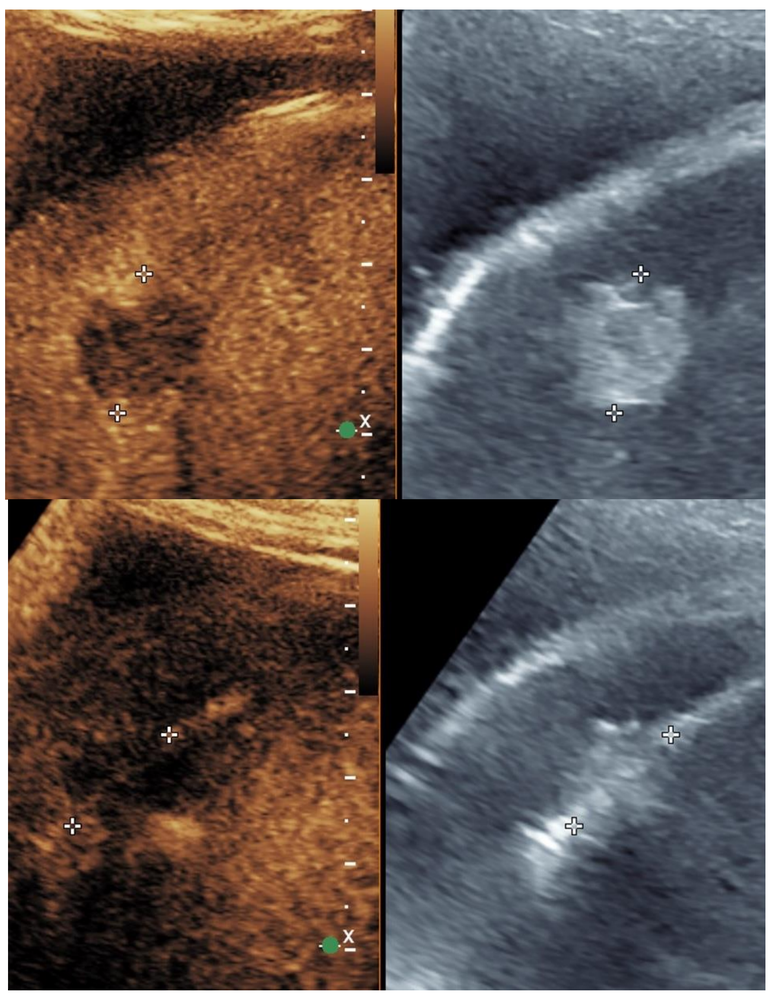
Results

- Six patients with primary hepatocellular carcinoma or liver metastases located in subdiaphragmatic segments (S7, S8, S7/S8) underwent AP-assisted MWA over a 12-month period.
- Creation of AP was achieved in all patients (6/6, with a technical success rate of 100%). Enhanced visualization of tumor is observed in 6/6 (100%) of patients. Alternative percutaneous access was feasible in 3/6 (50%) of patients, allowing paths without injuring main hepatic or portal vasculature.

Case 1:

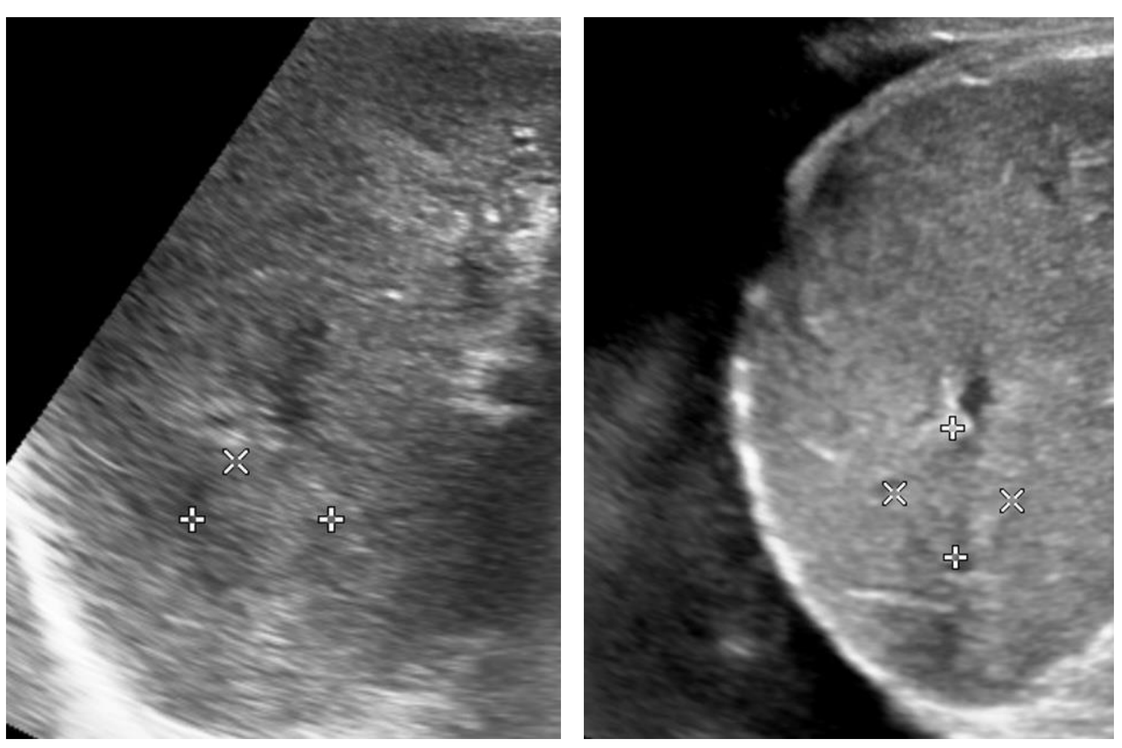


Enhanced visualization of segment 7 tumor is achieved with the acoustic window created by artificial pleural effusion.

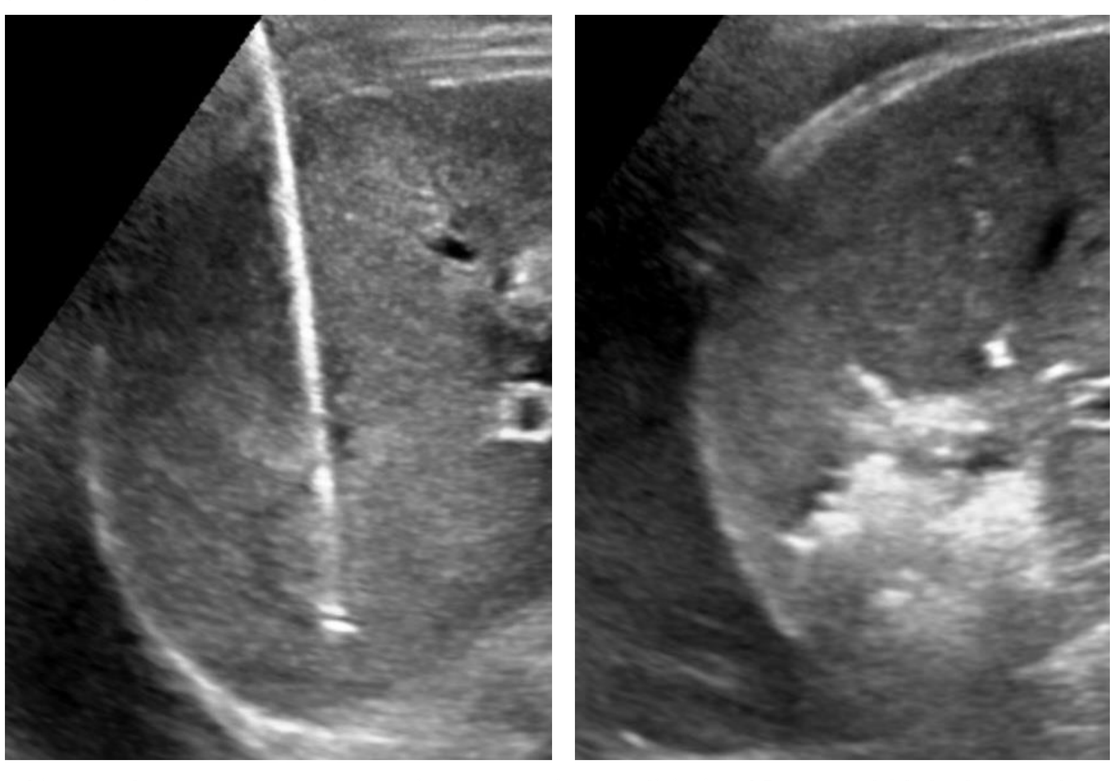


Subsequent microwave ablation of the S7 tumor was successfully performed with the assistance of contrast enhanced ultrasound.

Case 2:



Creation of AP again increases the acoustic window and alternative access pathways for this S7 hepatic tumor.



Alternative percutaneous path was made possible by AP to avoid injuring main hepatic and portal vessels. Subsequent ring-down artefact generated by microbubbles signifies successful microwave ablation.

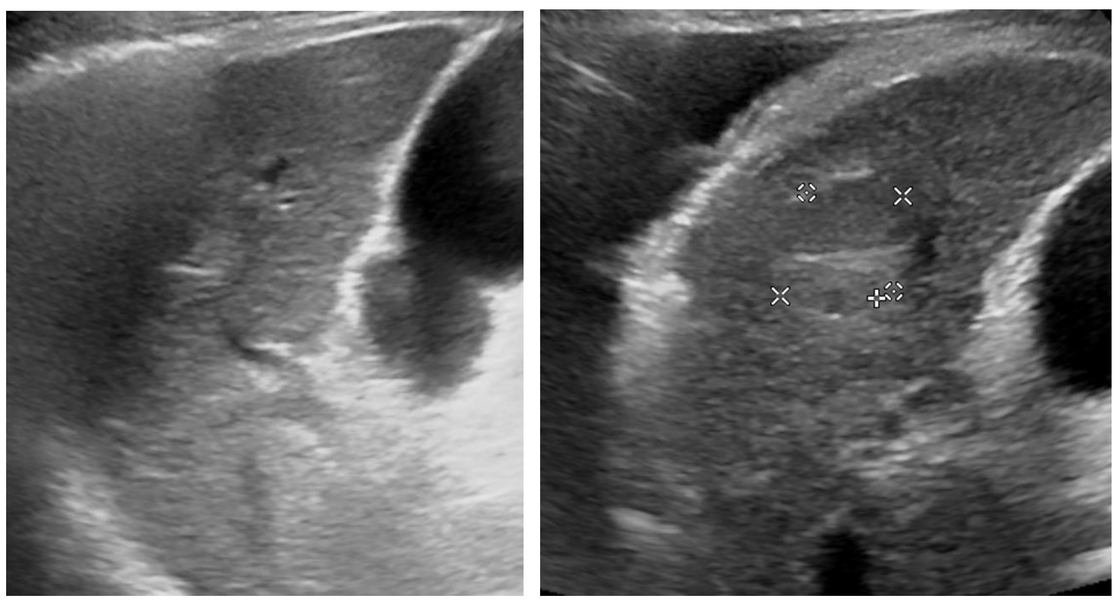
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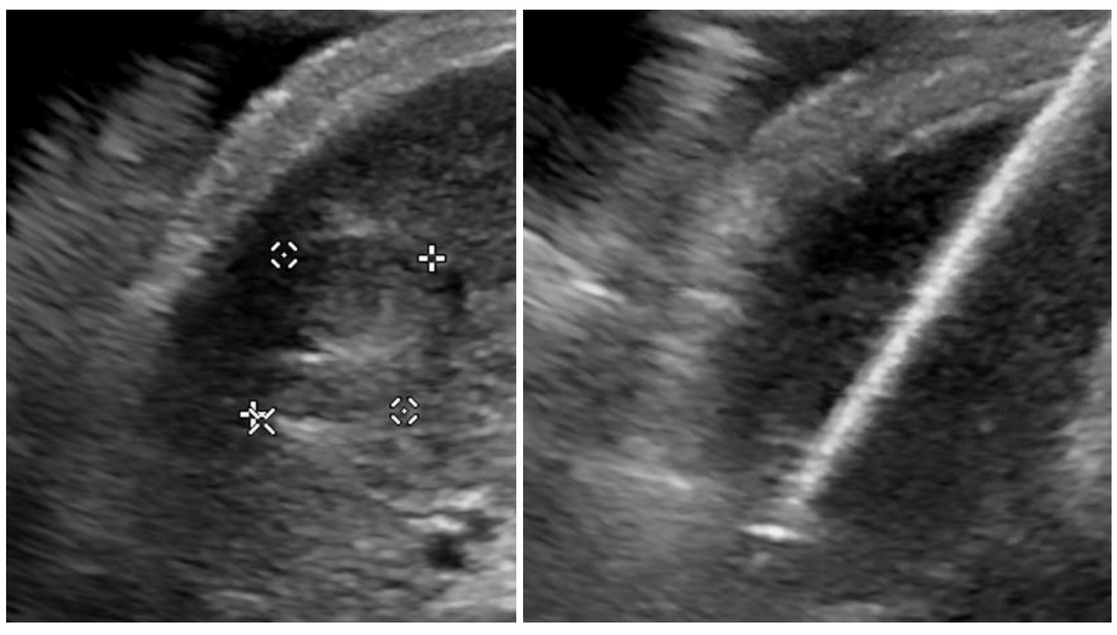
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Results (continued)

Case 3:



Artificial pleural effusion improves the visualization of this segment 8 tumor which was obscured by pulmonary gas in original ultrasound.



Successful navigation and ablation of the tumor with improved acoustic window.

- One minor complication occurred (1/6, 16%; SIR Grade B) due to delayed post-procedural pneumothorax, which was treated with percutaneous drainage and resolved within 1 day. No intra-operative desaturation or haemothorax. No major complication was observed.



Same-day pleural drainage was arranged for post-ablation right pneumothorax

- Median follow-up period with CT is 1 month (range: 1-2 months).
- All patients achieved complete response according to RECIST 1.1 criteria. No residual tumor is observed in the follow-up period.
- Pleural fluid spontaneously reabsorbed within 1 week in all patients.

Discussion

- Further large-scale study with longer follow-up period would be required to understand the safety and complication rate of artificial pleural effusion.
- Koda et al. reported that although 78.9% of patients exhibited a slight drop in oxygen saturation during AP creation, the mean reduction was minimal (2.3% ± 2.1%), with transient dyspnea developing in only one patient (4.3%) and resolving promptly with low-flow nasal oxygen.
- In our patient cohort, supplemental oxygen (2-4L/min via nasal cannula) was given routinely to patients to keep SaO2 >95%. Transient and mild drop in SaO2 to 90-95% range was occasionally observed, which quickly resolved after the procedure concluded. No dyspnea was recorded.
- While it is difficult to dissect whether the transient drop in oxygen saturation is a result of compromised lung expansion from AP or reduced ventilatory drive from conscious sedation, cardiopulmonary reserve remains a strict inclusion criterion in preoperative stratification, and routine supplemental oxygen could be helpful.

Conclusion

Artificial pleural effusion appears to be a safe and effective procedure to allow percutaneous MWA of right liver dome lesion. Further large-scale study could be considered with longer follow-up period.

Reference:

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