Artificial Ascites During Microwave Ablation of Hepatocellular Carcinoma: A Practical Guide from a Tertiary Interventional Oncology Centre

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1. Learning Objectives

- To review the role of artificial ascites (AA) as a thermoprotective adjunct during microwave ablation (MWA) of hepatocellular carcinoma (HCC).
- To demonstrate a simplified direct ultrasound-guided technique for establishing AA.

2. Background

The Role of MWA in HCC Treatment

- HCC is the most common primary liver malignancy. Incidence is highest in Asia.[1]
- MWA is a CT- or ultrasound-guided localised thermal ablation technique for early-stage HCC:
  - Australian guidelines recommend MWA as a curative-intent treatment option for very early-stage or early-stage HCC who are not candidates for surgery (Barcelona Clinic Liver Cancer 0/A).[2]
  - Hong Kong guidelines recommend MWA as an alternative to resection in Child-Pugh A/B patients with HCC <3cm.[3]

AA is a Thermoprotective Adjunct to MWA

- AA involves percutaneous introduction of an isotonic fluid into the perihepatic peritoneal space before ablation.
- AA reduces the risk of collateral thermal injury when targeting 'high-risk' lesions in the periphery or adjacent to surrounding viscera by forming heat-dissipating buffer, and allows for adequate ablative margins.
- AA improves the sonographic window by displacing surrounding gas-containing viscera.

Table 1. Structures at risk of thermal injury

Adjacent structure	Potential thermal injury
Gastrointestinal tract (stomach, duodenum, colon)	Perforation, fistula, stricture
Gallbladder	Cholecystitis, perforation
Diaphragm	Perforation, phrenic nerve injury, pleuritis, pleural effusion
Pericardium	Pericarditis, pericardial effusion, arrhythmia
Kidney	Renal parenchymal injury
Abdominal wall	Thermal skin injury, abdominal wall laxity, intercostal nerve injury, pain

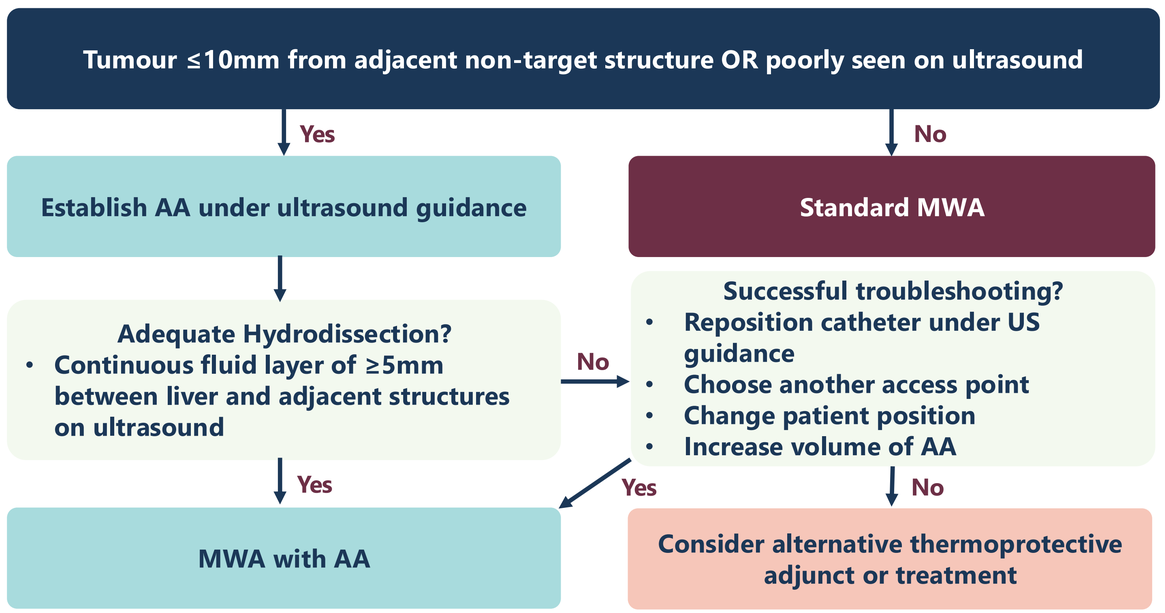


Figure 1. Decision tree for establishing AA for MWA

3. Patient Selection

Indications

- Lesions are considered high risk when ≤5-10mm from non-target structures.[4] Structures at risk, and consequences of thermal injury are listed in Table 1.
- Our practice considers AA when ≤10mm to facilitate an adequate ablative margin. The decision pathway for AA is summarised in Figure 1.
- Consider AA when the target lesion is poorly visualised on ultrasound when attempting ultrasound-guided MWA.

Contraindications

- Absolute: None specific to AA itself beyond those associated with MWA.
- Relative: Dense adhesions, severe cardiac and/or renal failure.

4. Procedure Details

Simplified Direct Technique for Establishing AA

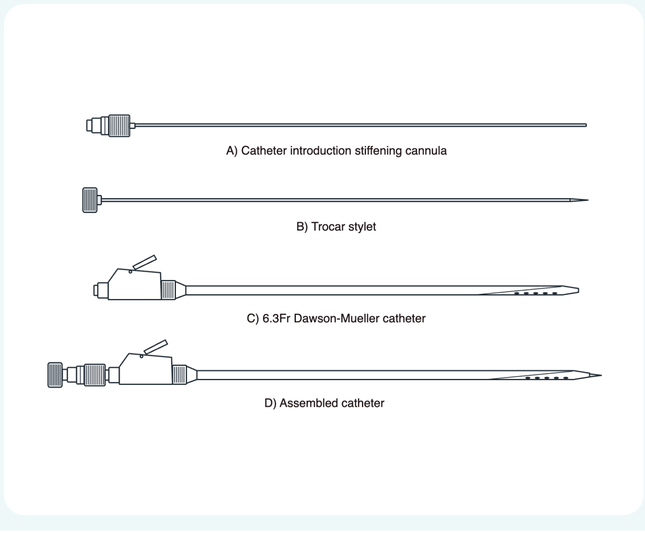
- Most published methods are multi-step and require a guidewire.
- Our approach involves direct placement of a 6.3Fr Dawson-Mueller catheter along the liver capsule. It reduces procedural complexity, with fewer steps and no guidewire exchange, and leaves a drainage-capable catheter. Procedural steps are described in Figure 2.

Equipment: Curvilinear ultrasound probe, 6.3Fr Dawson-Mueller catheter, pressure infusion bag, 0.9% Saline 1L bag(s).

Figure 2. Procedural steps for direct ultrasound-guided AA technique

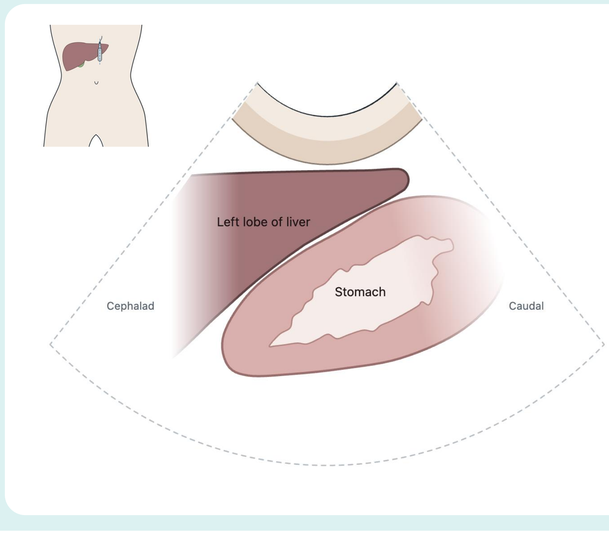
A. Setup

- Patient positioned supine, under general anaesthesia as per MWA protocol.
- 6.3Fr Dawson-Mueller catheter is assembled with stiffening cannula and then trocar.



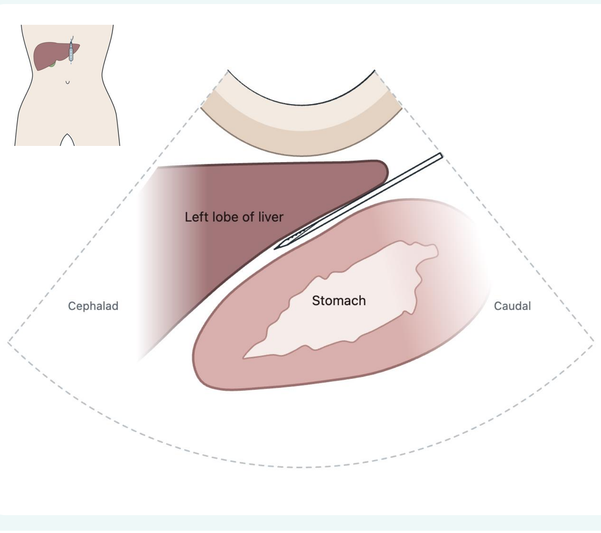
B. Access

- Left-lobe or gallbladder interface approach preferred: provides a broad peritoneal window and avoids interposed bowel.



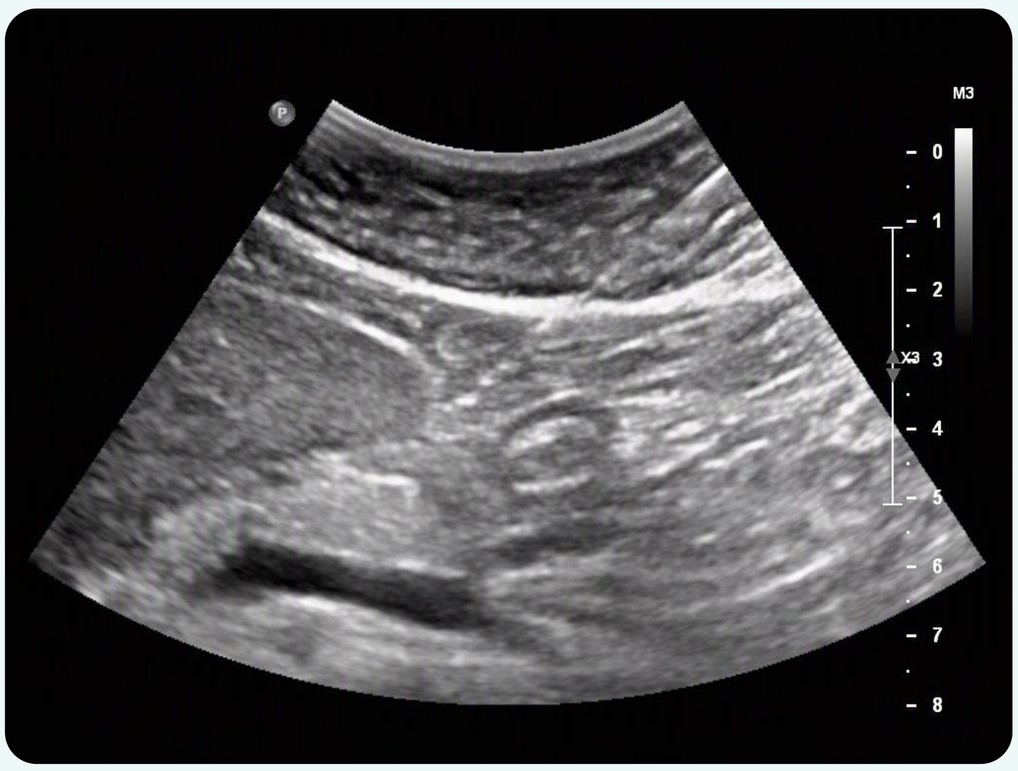
C. Placement

- Using the liver capsule and gastric wall as landmarks, advance the catheter tangentially along the hepatic surface.



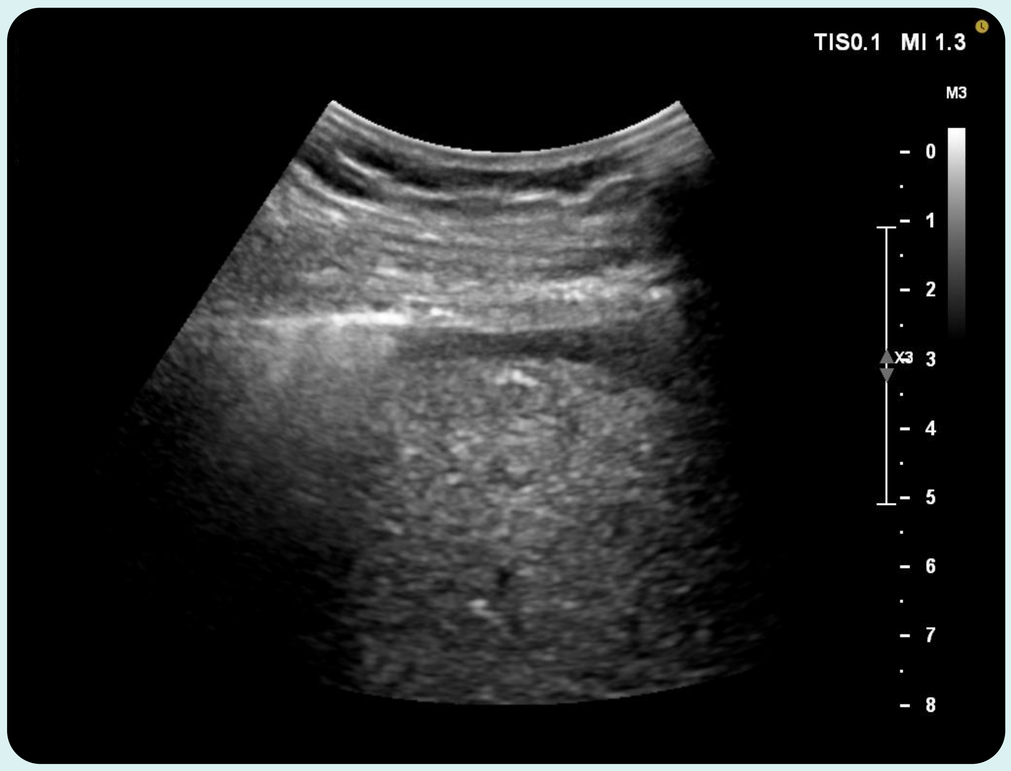
D. Placement (US)

- Confirm the catheter tracks along the liver capsule.
- Once satisfied with placement, retract the stiffening cannula & trocar.



E. Hydrodissection

- Infuse saline by pressure bag until a continuous layer ≥5mm is achieved between liver and adjacent structures (typically 500-1000mL).



5. Pitfalls and Troubleshooting

Perihepatic Adhesions

- Perihepatic adhesions are the dominant cause of failure to establish AA.
- Predictors of perihepatic adhesions include previous hepatic resection or other upper abdominal surgery, and previous ablation.[5,6] Previous transarterial chemoembolisation (TACE) is not an independent predictor.[5]
- Infused fluid pools or loculates without free spread around the liver (Figure 3).
- Troubleshoot by repositioning the catheter or choose another window. Multiple attempts may be required.

Anatomical Location

- Tumours adjacent to the bare area or gallbladder bed are challenging due to limited peritoneal space to infuse.
- Tumours in non-dependent locations may require additional volume of AA or change in body position to redirect fluid.

Incorrect Catheter Position

- Preperitoneal catheter placement results in fluid accumulating outside the peritoneal space. Advance the catheter and perform small-volume test infusion to confirm peritoneal placement.
- Subcapsular or intraparenchymal placement results in localised fluid collection. Retract the catheter and perform small-volume test infusion to confirm peritoneal placement.

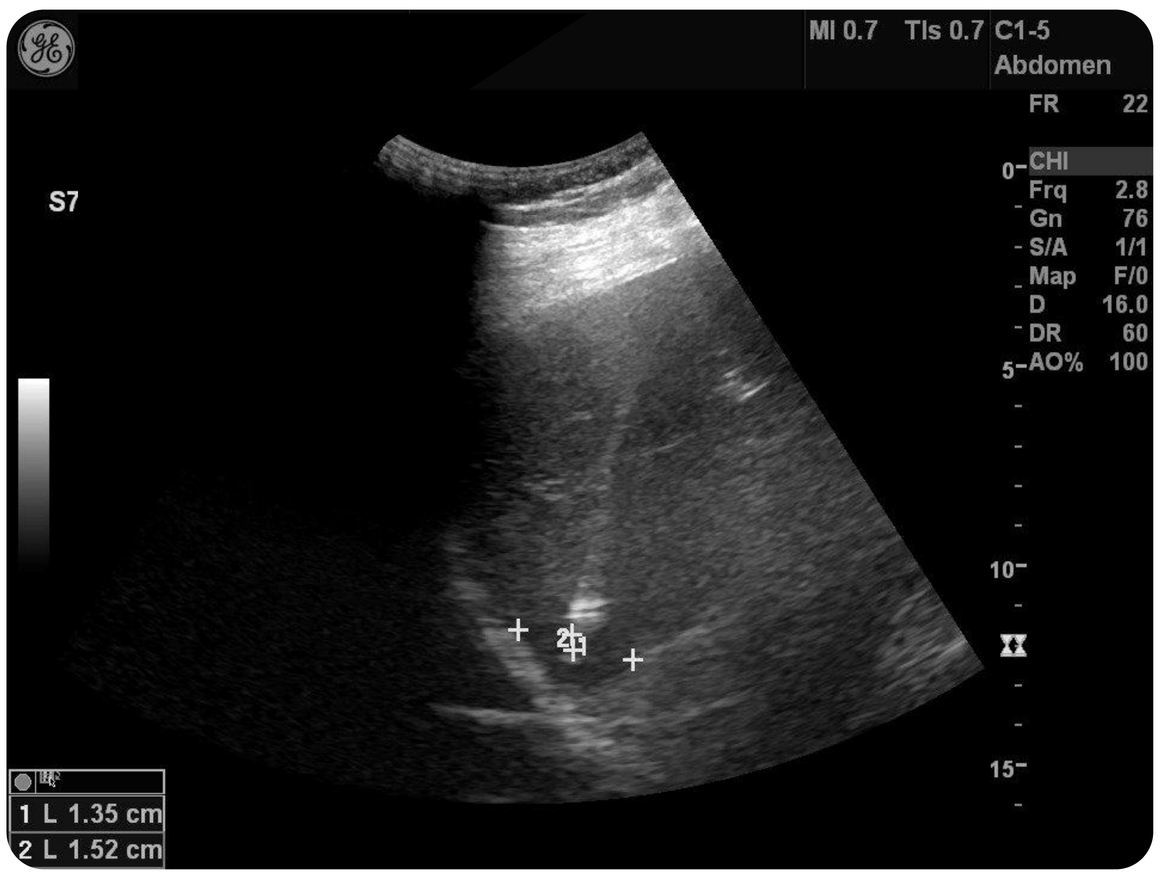


Figure 3. Unsuccessful AA. Fluid infusion was unable to establish any perihepatic separation.



Figure 4. MWA after successful AA.

6. Post-Procedural Considerations

Ablation

- Monitor fluid layer with ultrasound or CT during MWA (Figure 4).

Complications

- Although major complications such as bleeding and infection are uncommon, minor acute complications may include:
  - Pleural effusion, usually small and self-limiting. Chest imaging can be performed to monitor resolution.
  - Rebound pain at around 72-96 hours post-procedure due to fluid reabsorption.[7] Analgesia is recommended.
  - Electrolyte disturbance, routine monitoring post-procedure is recommended.

Drainage of AA

- AA is not routinely drained as fluid is absorbed over 3-7 days.
- The catheter allows drainage if needed, e.g. for symptomatic distension, breathing difficulty, or suspected haemoperitoneum.

7. Conclusion

AA is a safe and effective thermoprotective adjunct that enables MWA of anatomically high-risk HCCs. Direct ultrasound-guided placement of a 6.3Fr Dawson-Mueller catheter provides a simplified approach to establishing and maintaining hydrodissection while retaining the option for post-procedural drainage.

References

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1. McGlynn KA, Petrick JL, El-Serag HB. Epidemiology of hepatocellular carcinoma. Hepatology. 2021;73(Suppl 1):4–13.
2. Lubel JS, Roberts SK, Strasser SI, et al. Australian recommendations for the management of hepatocellular carcinoma: a consensus statement. Med J Aust. 2021;214(10):475–83.
3. Hui RW, Mak LY, Cheung TT, et al. Clinical practice guidelines and real-life practice on hepatocellular carcinoma: the Hong Kong perspective. Clin Mol Hepatol. 2023;29(2):217–29.
4. Wang Y, Zhang L, Li Y, et al. Computed tomography-guided percutaneous microwave ablation with artificial ascites for problematic hepatocellular tumors. Int J Hyperthermia. 2020;37(1):256–62.
5. Zhuang BW, Xie XH, Yang DP, et al. Percutaneous thermal ablation of hepatic tumors: local control efficacy and risk factors for artificial ascites failure. Int J Hyperthermia. 2021;38(1):461–70.
6. Delmas L, Koch G, Cazzato RL, et al. Artificial ascites using the guidewire technique during microwave ablation in the liver dome: technique and analysis of fluid repartition. Abdom Radiol. 2021;46:4452–9.
7. Hakime A, Tselikas L, Otmezguine Y, et al. Artificial ascites for pain relief during microwave ablation of subcapsular liver tumors. Cardiovasc Intervent Radiol. 2015;38:1557–62.