A Retrospective Review of Balloon Dissection During Thermal Ablation in Renal and Liver Tumors

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Background

- **Percutaneous cryoablation** and **microwave ablation** are established therapies for renal and hepatic tumors, but proximity to bowel can result in serious gastrointestinal injury.
- **Hydrodissection** is widely used yet may fail in post-surgical or anatomically constrained spaces.
- **Balloon dissection** creates an air-filled thermal barrier that physically separates critical structures from the ablation zone.

Objectives

• To evaluate **technical success**, **organ protection**, and **complications** when balloon dissection is used during image-guided renal and liver tumor ablation.

Patient and Methods

- **Design:** single-center retrospective review, IRB approved.
- **Study window:** December 2020 → May 2025.
- **Population:** 12 adults who underwent CT-guided cryoablation or microwave ablation with balloon interposition; ≥1 follow-up scan required for inclusion.
- **Key variables:** age, sex, primary malignancy, lesion size and location, balloon type, number of probes, tumor-to-bowel distance before and after balloon inflation, hospital stay, complications (graded by CTCAE v5).
- **Procedural:** workflow Balloon dissection performed as shown in **Figure 1** (needle access → guidewire → vascular sheath → balloon placement and inflation → ablation probe insertion).
- **Primary end-points**

1). Feasibility: balloon successfully deployed and ablation margin >5 mm.

2). Safety: procedure-related adverse events (CTCAE v5).

Step-by-step Workflow

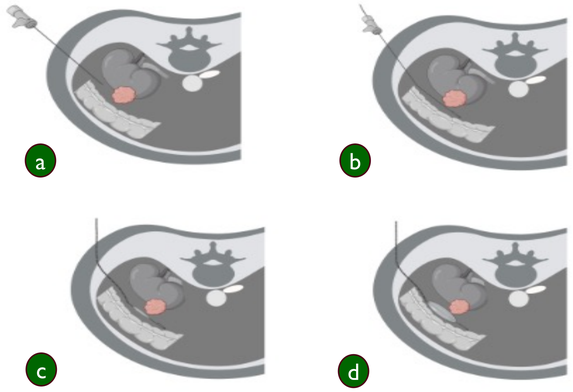

Figure 1: *(a) Yueh needle gains access to the plane between the tumor and adjacent bowel. (b) Bentson guidewire is advanced through the needle. (c) Needle is exchanged for a vascular sheath; balloon catheter is threaded over the wire under intermittent CT. (d) Balloon is positioned and insufflated with air, achieving safe separation of bowel from the target lesion before probe placement.*

Patient Characteristics

Patient characteristics (N=12)	Kidney Cryoablation (N=6)	Liver MWA (N=6)
Age in years (mean, SD)	75.2 (± 9.8)	68.5 (±9.9)
Sex		
Male	4 (66.7%)	2 (33.3%)
Female		3 (75%)
Primary Malignancy		
RCC	6 (100%)	2 (33.3%)
HCC		2 (33.3%)
CRC		2 (33.3%)
Tumor characteristics (N=12)	**Kidney Cryoablation (N=6)**	**Liver MWA (N=6)**
Side		
Right	2 (33.3%)	1 (16.7%)
Left	4 (66.7%)	5 (83.3%)
Tumor location		
Superior	1 (16.7%)	
Interpolar	4 (66.7%)	
Inferior	1 (16.7%)	
Segment 3		1 (16.7%)
Segment 5		3 (50.0%)
Segment 6		2 (33.3%)
Adjacent Bowel		
Colon	5 (83.3%)	4 (66.7%)
Small Bowel	1 (16.7%)	2 (33.3%)
Balloon		
Atlas	3 (50.0%)	3 (50.0%)
Conquest	3 (50.0%)	3 (50.0%)
Tumor to organ distance prior to balloon insufflation (mm) (median, range)	2.0 (0 - 6)	0.0 (0 - 5)
Tumor to organ distance post balloon inflation (mm) (median, range)	23.5 (19 – 30)	18.5 (17 – 22)
Largest tumor diameter (cm) (mean, SD)	3.7 (1.5)	3.0 (1.3)
No. of probes (median, range)	3.5 (2-5)	1 (1-2)
Length of hospital stay (median, range)	1.0 (1-16)	1 (1-5)

Balloon CT Series

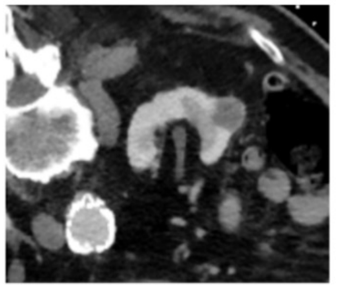

Figure 2: *CT scan prior to balloon dissection. Tumor-to-bowel distance is 6mm.*

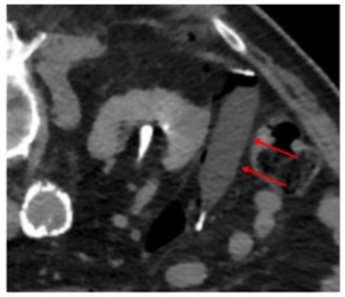

Figure 3: *CT demonstrates balloon placement with sufflation of an 18 mm x 40 mm Atlas balloon (arrows) between the kidney and a loop of bowel. The tumor-to-bowel distance is 24 mm after inflation of the balloon catheter.*

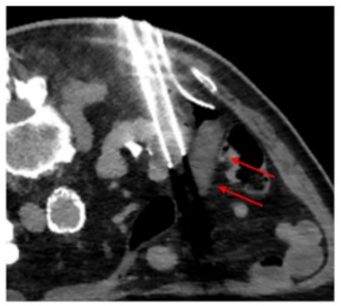

Figure 4: *Intraprocedural CT demonstrates two cryoprobes advanced into the target tumor with the balloon (arrows) displacing the adjacent bowel away from the ablation zone.*

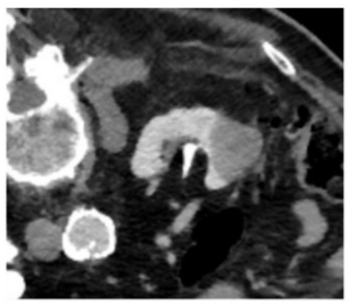

Figure 5: *CT scan post cryoablation of the kidney lesion without damage to adjacent structures and successful retraction of the balloon.*

Results

- **Procedures**: 12 ablations — 6 renal cryoablations; 6 liver microwave ablations (2 HCC, 2 CRLM, 2 RCC metastases).
- **Baseline tumor-to-bowel gap**: median 1.0 mm (0–6 mm).
- **Post-balloon gap**: median 20.0 mm (17–30 mm).
- **Technical success**: **100%** 12/12 lesions with margin > 5 mm.
- **Organ protection**: 0 thermal injuries to bowel or other structures.
- **Complications:** 1 grade I peri-renal hematoma; 2 grade II hepatic pseudoaneurysm — all unrelated to balloon dissection.
- **Length of stay:** median 1 day (1–16 days).

Discussion

- **Provides separation when hydrodissection falls short:** balloon created a consistent 17–30 mm gap where fluid tracking can be unpredictable.
- **Extends to liver MWA:** our series is among the first to pair balloon dissection with microwave ablation of hepatic tumors, expanding evidence beyond renal cryoablation.
- **Safety profile:** no balloon-related complications in our cohort, supporting low-risk adjunct use.
- **Limitations:** Retrospective, n = 12, operator selection bias, mixed organs/modalities, no hydrodissection comparator.
- **Next steps:** Prospective multicenter study benchmarking balloon versus hydrodissection in difficult-site ablations.

Conclusions

- Balloon dissection is a **feasible** and **safe** adjunct that reliably increases organ separation and enables effective ablation of renal and hepatic tumors that are positioned close to the bowel. Early experience suggests it should be considered, especially when hydrodissection is insufficient.

References