Radioactive Seed Localization for Non-Breast Tissue Excision

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Background

- Lymph nodes (LNs) are common basins for **cancer recurrence**; however, most patients are asymptomatic and difficult to diagnose clinically without imaging.
- Lymphatic tissue is often difficult to distinguish from surrounding tissue making **local excision challenging**, especially in non-palpable LNs.
- Novel breast surgery techniques have utilized **radioactive seed localization (RSL)** to preoperatively tag tissue so it can be identified intraoperatively with a gamma probe.
- RSL has not been well-investigated for use in **non-breast cancer patients**.
- The use of **RSL** in non-breast cancer patients both in lymphatic nodal basins and other tissue types is presented in this study.
- We hypothesize that the use of RSL can aid surgeons in more precise, less morbid excision of tissue concerning for malignancy.

Methods

- This is a retrospective case series of patients at our institution with past surgical history of RSL between 2014 and 2021.
- Each patient had concerning imaging findings without palpable masses.
- Patients undergoing RSL for initial breast cancer resection were excluded.
- **Forty-two patients** with various malignancies met inclusion criteria.
- Patients first received preoperative imaging, such as PET/CT, US, or mammography to identify the lesion of interest.
- Prior to surgery, patients received **US guided radioactive seed placement.**
- Patients then underwent an operation within five days for excision of the radioactive seed and tissue of concern.
- The surgeon utilized a gamma-probe to localize the seed and excise the mass.
- Tissue was then sent to pathology where a post-operative mammographic scan was conducted to confirm the presence of the radioactive seed.
- Three example cases are presented as follows:

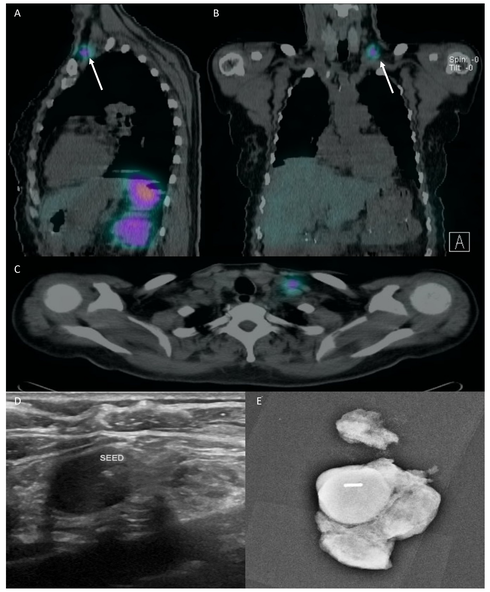

Figure 1. Neuroendocrine metastasis with cervical lymph node RSL. Surveillance nuclear somatostatin receptor study demonstrating increased radiotracer activity in the left neck suggesting metastatic disease (A-C). Ultrasound-guided radioactive seed placement (D). Post operative mammography of resected lymph node with radioactive seed (E).

Case 1: Neuroendocrine Metastasis (Figure 1)

- History: 52 yo female with uncontrolled HTN found to have elevated plasma metanephrines and peripancreatic masses on PET/CT
- Pathology: **well-differentiated neuroendocrine tumor**, G1
- Initial Surgery: Staging laparoscopy, robotic assisted classic pancreaticoduodenectomy, portal lymphadenectomy, retroperitoneal lymphadenectomy, falciform ligament flap creation, and cholecystectomy were performed
- Initial Follow-up: Routine octreotide scan **three months postoperatively** (Figure 1. A-C) revealed increased radiotracer activity in the left neck with associated enlarged **left supraclavicular node** concerning for metastatic disease
- RSL: **left deep jugular cervical lymph node**
- Node pathology confirmed metastasis
- Interval Follow-up: The patient's most recent PET/CT revealed improving signals in the left cervical region.
- After 16 cycles of lantreotide, the patient required ERCP with choledochojejunostomy dilation and stent placement for stenosis; otherwise, the patient continues to improve.

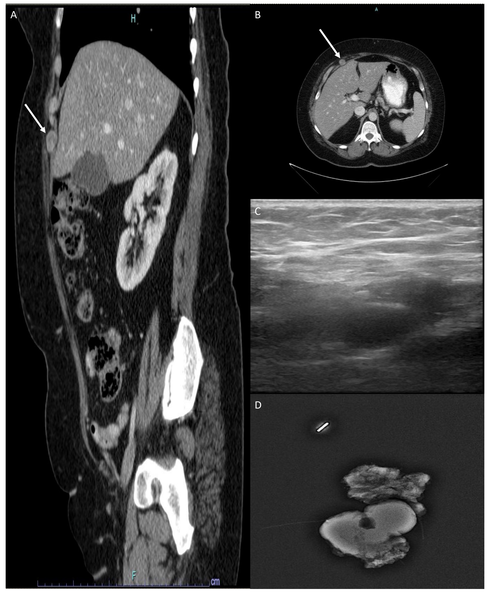

Figure 2. CT demonstrating RUQ abdominal wall mass (A and B). Ultrasound guided radioactive seed placement (C). Post operative mammography of resected tissue with radioactive seed (D).

Case 2: Abdominal Wall Sarcoma (Figure 2)

- History: 51 yo female with routine imaging for a hepatic adenoma was found to have an **enlarging RUQ abdominal wall mass** (Figure 2. A and B)
- Pathology: CT guided biopsy demonstrated **atypical spindle cells**
  - Final pathology indicated an **unclassified sarcoma**, as well as positive lateral, inferior, superior, and posterior margins
- RSL: **RSL** for both diagnostic and therapeutic purposes was performed
- Follow-up: **Re-excision was completed**, and pathology indicated that all margins were negative
- She is currently undergoing surveillance with CT CAP Q3 months with no evidence of recurrence to date.

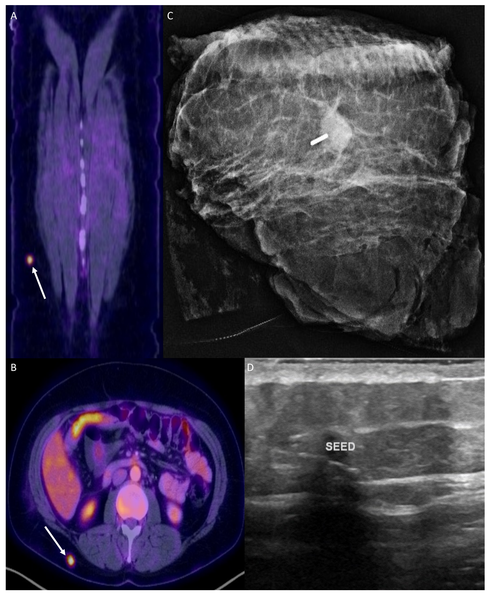

Figure 3. PET/CT demonstrating hypermetabolic mass in right lower back (A and B). Ultrasound-guided radioactive seed placement (C). Post operative mammography of resected tissue with radioactive seed (D).

Case 3: Melanoma Recurrence (Figure 3)

- History: 39 yo female with new **axillary** lymphadenopathy
  - History of melanoma excision from right lower back **20 years prior**
  - PET/CT demonstrated hypermetabolic activity in the right axilla as well as the **right lower back subcutaneous tissues** (Figure 3. A and B)
- Pathology: Node biopsy indicated **melanoma**
- RSL: Patient underwent right axillary complete (levels I, II, and III) lymphadenectomy and **seed localization wide local excision of the right lower back**
- She was diagnosed with stage IIIB melanoma
- Follow-up: Nearly 6 years after her initial operation, a growing left upper pulmonary nodule was noted on PET/CT
- Left upper lobe division segmentectomy and mediastinal lymph node dissection was performed
- Lung nodule was metastatic melanoma, but all mediastinal lymph nodes were negative
- To date, the patient is undergoing a revised treatment strategy.

Results

Table 1. Case Details

Time from imaging to surgery (days)		44	2-167
Median surgery time (mins)		53	(16-246)
Blood loss	Minimal	42	100.00%
Outpatient procedure?			
	Outpatient	33	78.57%
	Inpatient	9	21.43%

Table 2. Patient and Tissue Excision Characteristics

Sex		Number	Percentage (n=42)
	Male	8	19.05%
	Female	34	80.95%
Median Age (years)			
		53	31-86
Imaging modality			
	Mammography	10	23.81%
	PET/CT	15	35.71%
	MRI	1	2.38%
	US	7	16.67%
	XR	1	2.38%
	Palpated	1	2.38%
Pathology result			
	Benign LN	20	47.62%
	Toxoplasma	1	2.38%
	Non-necrotizing granulomatous	2	4.76%
	Malignant progression	19	45.24%
Benign LN with PMH of Cancer		11	26.19%
Mass location			
	Axillary	32	76.19%
	Cervical	4	9.52%
	Inguinal	2	4.76%
	RUQ	1	2.38%
	Supraclavicular	2	4.76%
	Trunk	1	2.38%

Conclusions

- These cases show the benefits of RSL in **tissue identification** and **isolation** intraoperatively.
- Our study showcases the opportunity to expand the use of RSL to **non-breast cancer** non-palpable masses and LNs.
- RSL can also be used concurrently with sentinel LN mapping due to gamma **probe I-125 and T99m settings.**
- The main pitfall of RSL is radioactivity. Even with its relatively safe levels of radiation, it still requires proper handling and disposal, increasing cost and oversight.
- New developments include radiofrequency identification (RFID) tags, magnetic seeds, and infrared reflectors that **do not produce radiation.**
- A potential alternative is intra-operative ultrasound.

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