

# Achieving Excellence Across Embolization Applications

Experience at a large, urban academic institution with a focus on comprehensive clinical practice, multidisciplinary collaboration, innovation, and training.

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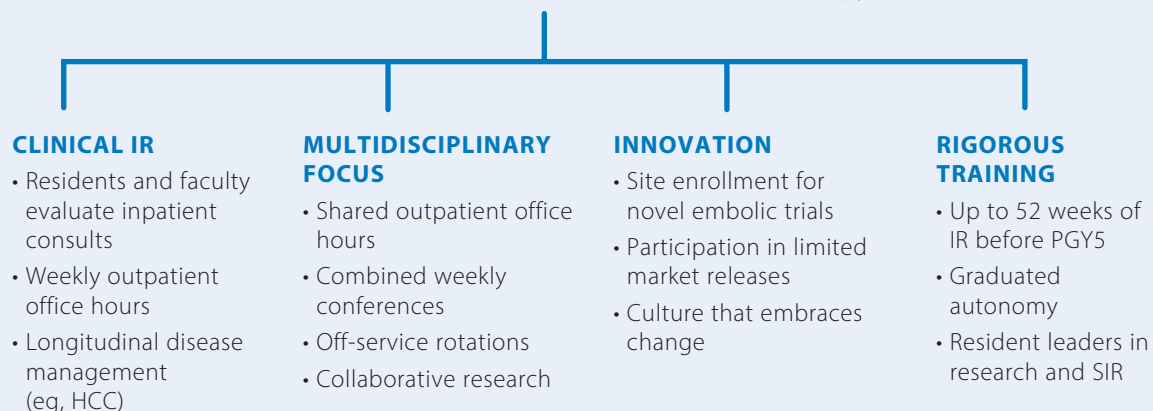
Excellence in embolization requires more than technical expertise. It depends on a comprehensive clinical practice, close collaboration with referring specialties, a culture that supports research and innovation, and a robust training model. At the Mount Sinai Hospital, a large academic medical center in New York City, embolization is practiced across a wide clinical spectrum, ranging from emergent hemorrhage control to complex elective interventions. These procedures are supported by a multidisciplinary framework that integrates procedural expertise with longitudinal patient care (Figure 1).

## SCOPE OF EMBOLIZATION PRACTICE

The interventional radiology (IR) embolization service at Mount Sinai reflects the demands of a large, urban health system. These demands include managing a range of case acuity, collaborating with multiple specialties, and delivering high-volume procedural care while maintaining rigorous clinical standards. Emergent procedures range from embolization for postpartum and gastrointestinal (GI) hemorrhage to bronchial artery embolization for massive hemoptysis, among others. Elective embolization represents an equally important component of the practice and includes prostate artery embolization (PAE),

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*Mount Sinai Interventional Radiology*



**Figure 1. Pillars of the IR division at Mount Sinai Hospital in New York, New York. The Mount Sinai IR team has made a commitment to clinical IR, multidisciplinary collaboration, innovation, and trainee education. These pillars form the foundation for achieving excellence across embolization applications. PGY5, postgraduate year 5; SIR, Society of Interventional Radiology.**

**TABLE 1. ENDOVASCULAR PROCEDURES OFFERED AT MOUNT SINAI, BY MEDICAL SPECIALTY**

Specialty	Endovascular Procedure
Hepatobiliary, transplant, and oncology	<ul style="list-style-type: none"> <li>• Yttrium-90 radioembolization</li> <li>• Transarterial chemoembolization</li> <li>• Bland embolization</li> <li>• Portal vein embolization</li> <li>• Splenic artery embolization for symptomatic hypersplenism</li> <li>• Adrenal adenoma and metastases embolization</li> <li>• Palliative embolization</li> </ul>
Endovascular	<ul style="list-style-type: none"> <li>• Endoleak embolization</li> <li>• Visceral aneurysm embolization</li> <li>• Embolization for vascular access complications</li> <li>• Embolization for peripheral vascular anomalies</li> </ul>
Urology	<ul style="list-style-type: none"> <li>• Prostate artery embolization</li> <li>• Renal angiomyolipoma embolization</li> <li>• Renal pseudoaneurysm and AVF embolization</li> <li>• Varicocele embolization</li> </ul>
Gastroenterology	<ul style="list-style-type: none"> <li>• Upper and lower gastrointestinal arterial bleeding embolization</li> <li>• Balloon-occluded antegrade/retrograde transvenous obliteration</li> <li>• Hemorrhoid embolization</li> <li>• Embolization for angiodysplasia</li> </ul>
Thoracic	<ul style="list-style-type: none"> <li>• Bronchial artery embolization</li> <li>• Pulmonary AVM embolization</li> <li>• Lymphatic embolization</li> </ul>
Obstetrics and gynecology	<ul style="list-style-type: none"> <li>• Uterine artery embolization for fibroids, uterine AVM, uterine AVF, postpartum hemorrhage, and preoperative prophylaxis</li> <li>• Embolization for pelvic venous disorders</li> </ul>
Orthopedics	<ul style="list-style-type: none"> <li>• Preoperative embolization for hypervascular bone tumors</li> <li>• Geniculate artery embolization</li> <li>• Shoulder embolization</li> <li>• Ankle embolization</li> </ul>
Neurointerventional	<ul style="list-style-type: none"> <li>• Embolization of head and neck AVM</li> <li>• Preoperative embolization for head and neck tumors</li> <li>• Sphenopalatine artery embolization</li> </ul>
Pediatrics	<ul style="list-style-type: none"> <li>• Embolization of congenital AVM</li> <li>• Varicocele embolization</li> <li>• Lymphatic malformation embolization</li> <li>• Embolization for peripheral vascular anomalies</li> </ul>
Trauma	<ul style="list-style-type: none"> <li>• Embolization for solid organ injury</li> <li>• Pelvic fracture hemorrhage embolization</li> </ul>
Abbreviations: AVF, arteriovenous fistula; AVM, arteriovenous malformation.	

uterine fibroid embolization, musculoskeletal embolization, oncologic embolization therapies, treatment of pelvic venous disorders, and management of vascular malformations (Table 1). The diversity of our caseload requires fluency across a spectrum of embolic agents, each selected for precise clinical indications and technical considerations (Table 2).

As one of the largest liver transplant centers in New York City, Mount Sinai maintains a high-volume interventional oncology practice. Radioembolization, chemoembolization, and portal vein embolization are routinely integrated into multidisciplinary cancer care.<sup>1</sup> This combination of procedural volume, clinical diversity, and academic engagement yields an environment of clinical excellence.

### MULTIDISCIPLINARY COLLABORATION

Strong collaboration with other specialties is central to the success of the embolization program. There are particularly close relationships with hepatobiliary/transplant surgery, liver medicine, medical oncology, vascular surgery, obstetrics and gynecology, urology, orthopedics, and pediatrics via institutional referral patterns and even structural office spaces. On the inpatient side, any clinical evidence of bleeding prompts a consultation to IR. On the outpatient side, our hepatobiliary office hours are shared with liver medicine and hepatobiliary/transplant surgery, allowing same-day multidisciplinary patient evaluations. Weekly tumor boards connect surgery, radiation oncology, medical oncology, and IR to ensure therapies are appropriately incorporated into cancer treatment plans after discussion of the highest-quality evidence available.

These collaborations extend to academics as well. The RASER study was a joint effort with hepatobiliary and transplant colleagues evaluating the safety and efficacy of radiation segmentectomy with yttrium-90 in patients with unresectable very early to early stage hepatocellular carcinoma (HCC) who were suboptimal ablation candidates. Radiation segmentectomy achieved robust sustained complete radiologic response rates and high rates of complete pathologic necrosis, highlighting the potential of this therapy for curative intent, and also supporting its role within standardized treatment algorithms for HCC.<sup>1</sup> Our team has also published with obstetrics and gynecology colleagues

TABLE 2. EMBOLIC CHARACTERISTICS AND TYPICAL USE

Embolitic Type	Distal Penetration	Precision	Flow Dependence	Permanence	Typical Use
Mechanical (coils/plugs)	Low	High	Low	Permanent	Aneurysms, hemorrhage
Particulate (PVA/microspheres)	Moderate-high	Low-moderate	High	Permanent	Tumors, fibroids
Liquid-nonadhesive (EVOH)	High	High	Moderate	Permanent	AVM, hemorrhage
Liquid-adhesive (NBCA)	High	Moderate	High	Permanent	AVM, hemorrhage
Conformable (Obsidio [Boston Scientific Corporation])	Moderate-high	High	Low	Permanent	Tumors, hemorrhage
Drug-eluting beads	Moderate	Moderate	High	Permanent	Liver oncology
Temporary (Gelfoam)	Moderate	Low	High	Temporary	Trauma
Sclerosants (ethanol, STS, bleomycin)	Moderate	Low-moderate	Moderate	Permanent	Varices

Abbreviations: AVM, arteriovenous malformation; EVOH, ethylene vinyl alcohol; NBCA, N-butyl cyanoacrylate; PVA, polyvinyl alcohol; STS, sodium tetradecyl sulfate.

on fertility outcomes after uterine artery embolization for postpartum hemorrhage, demonstrating a robust rate of spontaneous pregnancies with live births after embolization.<sup>2</sup>

Additionally, residents provide multidisciplinary patient care on off-service rotations. As early as intern year, trainees rotate on the vascular surgery service, and our team participates in weekly combined vascular surgery–IR conferences. Senior residents may also pursue elective rotations such as vascular lab, transplant surgery, and neurointerventional radiology.

### OVERCOMING HURDLES AND ESTABLISHING THE SERVICE

Efficiently coordinating patient care across a multitude of services is essential for a center of excellence in embolization. This system is especially important on the inpatient side for life-saving hemorrhage embolization, which often requires coordination between the emergency department, intensive care unit (ICU), and any relevant specialist teams such as the GI and surgical services in cases of GI arterial hemorrhage or the liver medicine and transplant surgery teams for variceal hemorrhage. Managing bleeding also requires 24/7 IR resident, faculty, technologist, and nursing staffing, as well as an on-call anesthesiologist, to enable rapid and safe access to the embolization suite.

Establishing a comprehensive embolization service requires navigating complex hospital dynamics and securing administrative buy-in. When introducing new procedures or expanding outpatient clinical pathways, early challenges often include securing capital for specialized equipment and establishing dedicated clinical

spaces. We overcame these hurdles by demonstrating the downstream value of minimally invasive therapies such as reduced length of stay and fewer ICU admissions.

### INNOVATION AND DATA-DRIVEN PRACTICE

Innovation is essential to sustaining excellence in embolization, and our team is on the cutting-edge of interventional therapies and research. The culture at Mount Sinai welcomes integration of new devices, imaging techniques, and procedural strategies into clinical practice. We routinely are a site of enrollment for major novel peripheral embolization trials and have also participated in the limited market release for multiple embolization products.

Retrospective data analysis helps evaluate the effectiveness and safety of interventions over time to drive practice patterns toward a more durable result. For example, we recently copublished that for patients who underwent PAE using N-butyl cyanoacrylate glue, improved distal glue penetration correlated with improved patient outcomes.<sup>3</sup> To further evaluate our PAE cohort, we maintain a > 500-patient database. This project requires standardizing follow-up protocols and establishing a strong referral network with our urology and primary care colleagues across the health system. Not only do these projects improve patient selection, but they also establish data necessary to support novel therapies and generate hypotheses for future prospective trials. In cases of nonresponse or retreatment, detailed analysis of embolization technique informs iterative improvement in treatment strategy.

The Mount Sinai IR team is at the forefront of innovation in medical education. Through the TREAT iR

LIVE platform (<https://treatsymposium.com>), we routinely live stream endovascular interventions, including a wide range of embolization procedures. These sessions foster real-time engagement between Mount Sinai faculty, residents, and expert panelists from peer institutions, enabling dynamic discussion of best practices, technical strategies, and procedural troubleshooting. By also making these cases accessible to patients, Mount Sinai IR promotes transparency, demystifies complex IR procedures, enhances patient understanding, and strengthens shared decision-making.

### TRAINING MODEL

Finally, sustaining excellence across embolization applications requires a robust training environment that prepares future interventionalists through early clinical exposure, graduated autonomy, and academic engagement.

The Mount Sinai IR residency program is among the largest in the country. Our integrated IR residents receive 4 months of IR training during each year of diagnostic radiology residency. There is an emphasis on graduated autonomy, empowering residents to take ownership of patient evaluations, procedural planning, and periprocedural management under tailored supervision.

Training extends beyond the angiography suites. Residents attend mandatory daily conferences, as well as spend multiple weeks on inpatient consult services and in outpatient office hours each year. Junior residents take six weekends of call alongside independent residents and senior integrated IR residents (fellows), covering the Mount Sinai Health System. Trainees also rotate at Elmhurst Hospital in Queens, a high-volume trauma center serving one of the most diverse patient populations in the United States.

Research participation is highly encouraged, and residents are paired with faculty mentors at the start of the program. Trainees are expected to present at national meetings and publish regularly. Mount Sinai residents remain active nationally within the specialty and cur-

rently serve as chair and vice-chair of the Society of Interventional Radiology Resident, Fellow, and Student Governing Council.

Beyond the physician and trainee roster, our center of excellence relies heavily on a dedicated support infrastructure. Advanced practice providers, specialized IR nurses, technologists, and clinical coordinators play integral roles in patient triage, periprocedural care, and longitudinal follow-up, ensuring high-volume throughput without compromising safety or the patient experience. Together, our team delivers thoughtful, technically precise embolization care across a wide range of clinical scenarios.

### CONCLUSION

Achieving excellence across embolization applications requires strong training in clinical IR, multidisciplinary collaboration, and continuous innovation. At the Mount Sinai Hospital, a high-volume and clinically diverse practice combined with a strong commitment to education and data-driven care supports excellence across emergent and elective settings. As embolization techniques and technologies continue to evolve, adaptability, collaboration, and rigorous training will remain essential to delivering effective, patient-centered care and advancing the field of minimally invasive endovascular therapies. ■

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