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Procedural Impact of a Dedicated Interventional Oncology Service Line in a National Cancer Institute Comprehensive Cancer Center

Mary Ellen Koran, PhD^a, Andrew J. Lipnik, MD^b, Jennifer C. Baker, MSN, APRN^b, Filip Banovac, MD^b, Reed A. Omary, MD, MS^b, and Daniel B. Brown, MD^b

^aVanderbilt University School of Medicine, Nashville, Tennessee

^bDepartment of Radiology, Vanderbilt University Medical Center, Nashville, Tennessee

Abstract

Purpose—We tested the hypothesis that establishing a dedicated interventional oncology (IO) clinical service line would increase clinic visits and procedural volumes at a single quaternary care academic medical center.

Methods—Two time periods were defined: July 2012 to June 2013 (pre-IO clinic) and July 2013 to June 2014 (first year of dedicated IO service). Staff was recruited, and clinic space was provided in the institution's comprehensive cancer center. Clinic visits and procedure numbers were documented using the institution's electronic medical record and billing forms. IO procedures included were transarterial chemoembolization, Y-90 radioembolization, perfusion mapping for Y-90, portal vein embolization, and bland embolization. We compared changes in clinic visit and procedure numbers using paired *t* tests. Changes after IO initiation were compared to 1-year changes in the Medicare 5% Limited Data Set by cross-referencing Current Procedure Terminology and International Classification of Diseases codes in 2012 and 2013.

Results—Clinic visits increased from 9 to 204 ($P = .003$, $t = 8.89$, $df = 3$). Procedures increased from 60 to 239 ($P = .018$, $t = 3.85$, $df = 4$). Procedural volumes increased at least 150% for each subtype. The volumes in the 5% Limited Data Set did not change significantly over the 2-year period (443 to 385, $P > .05$).

Conclusions—The establishment of a dedicated IO service significantly increased clinic visits and procedural volumes. National trends were unchanged, suggesting that the impact of our program was not part of a sudden increase of IO procedures.

Keywords

Interventional radiology; practice development; chemoembolization; radioembolization; portal vein embolization

INTRODUCTION

Interventional radiologists have increasingly focused on oncologic procedures as a growth area over the last 15 years [1,2]. Spurred by randomized prospective trials demonstrating overall survival improvement with chemoembolization of hepatocellular carcinoma (HCC) [3,4], the expanded use of intra-arterial and ablative therapies has led to their inclusion within national guidelines for hepatobiliary malignancy, neuroendocrine tumors, and renal cell carcinoma [5–7]. Data acquisition leading to evidence-based recommendations for other tumors has been limited by challenges in patient recruitment. This difficulty is related to extensive variability between interventional oncology (IO) practices regarding disease types referred, a factor that limits the type of large-scale recruiting seen in medical oncology trials [8].

One potential reason for variable success in IO practice development could relate to lack of a defined process, including availability of ancillary staff. Practice building in IO is largely anecdotal, without objective data that quantifies growth when attempts are made to focus attention on this area of interest [9]. Our primary hypothesis in this report was that development of an IO-specific service line in a quaternary National Cancer Institute Comprehensive Cancer Center would significantly increase both clinic and procedure volumes. We also hypothesized that any increases resulting from development of the IO service line would exceed national trends.

METHODS

Institutional Analysis

Institutional Review Board approval was obtained to analyze procedure volume and clinic visit numbers from a single quaternary care university hospital. Two time periods were defined: the year before and the year after the implementation of an IO service line (7/2012–6/2013 and 7/2013–6/2014, respectively). Starting July 1, 2013, an IO director was recruited with support staff (full-time nurse and nurse practitioner), and clinic space was provided in the institution's National Cancer Institute Comprehensive Cancer Center. One half-day per week of clinic time and time to attend tumor boards was built into the clinicians' schedules. The cancer center supported the IO service line, recognizing the value in optimizing clinical and research collaboration. An interventional radiology (IR) suite was dedicated to scheduling IO procedures as a first priority. Before July 1, 2013, patients were seen in clinic before the procedure date only if the patients requested a separate consultation. After July 1, 2013, all new patient referrals were scheduled to be seen in the IO clinic. Follow-up patients were seen as well, with time to follow-up determined by pathologic entity. After a trial period of task redundancy, the nurse practitioner was tasked with running the IO clinic, managing inpatients, ordering imaging via service protocols, and triaging calls from patients. The IO nurse's responsibilities included scheduling procedures, imaging, and lab studies, as well as monitoring insurance precertification. These roles allowed maximal independence in assigned tasks for the staff.

Clinic visits and procedure numbers were documented using the institution's electronic medical record and billing forms, and were compiled across four quarters of each year. IO

procedures included in this analysis were vascular and included transarterial chemoembolization (TACE), yttrium-90 (Y-90) perfusion mapping (MAA) and radioembolization, portal vein embolization, and bland embolization of hepatic tumors (bland). The Shapiro-Wilk test was used to test the normality of difference between the data points of each year across quarters for the clinic visit data and across procedure type for the procedure data. After normality could be assumed, we compared changes between the two years in clinic visits and procedure numbers, using a paired t test in each instance, with $P < .05$ judged statistically significant.

Medicare Analysis

Based on changes in our outcomes, we elected to compare the findings to national trends. Review of our payer mix demonstrated that 51% of new patients had Medicare, 26% had Medicaid, and 23% had private insurance. Given this distribution, we obtained Institutional Review Board approval to analyze de-identified data via our institution's Health Services Research Core using the Medicare Limited Data Set (LDS). The LDS represents a random 5% survey of the Medicare population, and data from the years 2012 and 2013 were utilized. Patients treated with the procedures listed above (TACE, Y-90, MAA, and portal vein embolization) were included, with the exception of bland embolization, as we did not want to inadvertently include hepatic embolization for nononcologic indications, such as trauma. The Current Procedure Terminology (CPT) codes associated with the procedures were cross-referenced with the relevant International Classification of Diseases, ninth rev codes from the Denominator, Carrier, Inpatient, and Outpatient standard analytic files, as shown in Table 1. Total procedure numbers were tabulated with the goal of determining whether our growth reflected or exceeded national trends.

As above, the Shapiro-Wilk test was used to test the normality of difference between the data points across procedure type for the LDS data. After this, changes between the two years' procedure numbers were performed using paired t tests, with $P < .05$ judged statistically significant.

RESULTS

Institutional Data

Total clinic visits increased from 9 to 193 after implementation of the IO clinic (Table 2). Compared across fiscal quarters, assumptions of normality could be applied to the data ($W = 0.98$, $P > .05$) and a paired t test showcased a statistically significant difference between the two years ($P = .0008$, $t = 13.8$, $df = 3$). Eighty-eight percent of the clinic visits were new patients and the number of clinic visits increased each quarter of operation. During this time, physician participation in tumor board increased by over tenfold, from 6 to 70 hours.

Procedure volume increased between these two time periods, from 60 to 239 procedures, an increase of almost 300% (Table 3). Compared across procedure type, assumptions of normality could be applied to the data ($W = 0.87$, $P > .05$) and a paired t test showcased a statistically significant difference between these two years ($P = .018$, $t = 3.85$, $df = 4$).

Procedural volumes increased at least 150% for each subtype. TACE was the most common procedure in both years, increasing from 36 to 90 (an increase of 150%).

Distribution of procedure type also changed between the two years (Fig. 1). As reflected in Figure 1, a greater portion of the procedures performed in the post-IO period were Y-90 and MAA, whereas TACE was over 50% in the pre-IO period (Fig. 1A–B). The range of treated pathology also expanded (Fig. 2). While HCC remained the most common tumor in each year, the percentage of non-HCC cases rose from 27% to 40%, including growth beyond neuroendocrine and colorectal cancer.

Medicare Data

Compared across procedure type, assumptions of normality could be applied to the data ($W = 0.81$, $P > .05$). A paired t test showed no statistically significant difference between these two years across procedure type ($P = .45$, $t = 0.87$, $df = 3$).

Although there was no statistical difference between the two years, the total number of IO procedures between them decreased by 13.1%, from 443 procedures to 385 (Table 4). TACE was the predominant procedure in the 5% Medicare sample in both years, but also decreased from 383 to 312 cases.

DISCUSSION

The establishment of a dedicated IO service at a quaternary care academic medical center resulted in immediate and increasing utilization of clinic space. This increased both the volume and diversity of IO procedures. The IO service increased participation in tumor boards across the institution. Comparatively, volumes in the 5% Medicare LDS remained relatively flat in this 2-year interval, suggesting that our growth exceeded national trends in vascular IO procedures. Other reports have focused on the value of tumor boards or clinics for patient care, as well as utilization of physician extenders in practice [10–17]. We report integration of these components into a fully operational IO service that collaboratively discusses patient treatment options and manages care from initial consultation through follow-up.

Tumor boards are established as part of multidisciplinary cancer care, although most reports are from single centers, with radiology participation limited to review of diagnostic studies [11,17]. Multicenter, peer-reviewed data publications are limited [13]. One such review across the Veterans Administration system found that there was little association of multidisciplinary tumor boards with measures of use, quality, or survival. These findings suggest that tumor board outcomes are directly related to the individuals discussing case management in the local environment [13]. IO participation in tumor boards maintains familiarity of newer procedures, allows setting of expectations for referring services, and can preidentify potential complicating factors in arranging therapy, such as timing of periprocedural management of chemotherapy around portal vein embolization [18,19]. These preliminary discussions facilitate a smooth patient clinic experience.

Outpatient clinics have been part of IR practice for over a decade [16]. Lutjeboer et al evaluated the effects of clinic on a wide range of IR procedures and reported reductions in rescheduled procedures, as well as increased safety and patient satisfaction [14]. Patients value the opportunity to discuss complex procedures in the IR clinic [10]. Other focused radiology clinics have reported improved patient outcomes, such as a dedicated inferior vena cava filter clinic significantly increasing retrieval rates [20]. Cancer patients spend significantly more time in the hospital, emergency room, and clinic than patients with other diseases [21]. Our IO clinic is a patient-centered experience that streamlines scheduling and preprocedure workup while allowing detailed procedure and recovery descriptions, mitigating patient anxieties and avoiding delays. By managing needed labs and imaging in advance, delays on the day of treatment are limited. Other endovascular specialists have similarly described growth by assuming greater direct responsibility for patient care similar to our model [22,23].

Physician extenders can play a number of roles in an IO practice [12,24]. By triaging calls and managing clinics, our nurse practitioner and nurse facilitate the procedural practice to maximize physician focus on patient treatment, teaching, and collaboration with translational researchers. By the day of the procedure, patients are familiar with the treating physician and other IO staff. The continuity of care increases patient confidence and comfort, particularly in the quaternary care, teaching hospital setting [10,14]. Our fellows have dedicated time on the IO service to get an in-depth opportunity to participate in both clinic and tumor board. This exposure is modeled after trainee experiences in surgical, medical, and radiation oncology with the goal of duplication of this model in other centers.

To compare to national trends, we used a 5% Medicare LDS as a control group, which allowed us to study more procedures and diagnoses than a SEER Medicare search focused on a single disease entity would. Zafar et al used a similar methodology when they reviewed various endovascular therapies for peripheral arterial disease [25]. The LDS is a random sampling of patients and does not represent an average of the entire Medicare population. Our numbers are similar to other reports. Sanoff et al reported an average of 306 HCC patients treated per year with chemoembolization and 25 with Y-90 in a SEER/Medicare-linked study focused on HCC alone [26]. Parikh et al reported outcomes after 2,161 hepatectomies for metastatic colorectal carcinoma from 1991 to 2006 using SEER/Medicare data [27]. Fewer than 11 portal vein embolizations and chemoembolizations were identified in their group.

There are several important limitations to this study. First, the use of Medicare data [28] contains the potential for erroneous coding and entry. The Medicare patient group is older and not representative of the entire United States population. This group may be less likely to undergo large-volume hepatic resection than a younger cohort, limiting data on procedures such as portal vein embolization. Second, we did not specifically review financial impact of our clinic and procedural growth. This will be the topic of a future study. Finally, because the study was performed at a single quaternary academic institution, the results may not generalize to all types of clinical practices.

In summary, our structured IO service line improved procedure volume and diversity and increased the range of diseases treated at a rate much greater than predicted by national trends. Other groups can use this model to spur growth. Acquiring dedicated staff requires capital support. Given that most IRs report suboptimal support in the procedure suites, getting staffing comparable to surgical or medical oncology is a challenge [29]. We hope that other IO service lines and IR divisions can use these data to demonstrate value. Future research directions include determining downstream impact on follow-up imaging, as well as the effect on accrual rates for multicenter national cancer trials.

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TAKE-HOME POINTS

- Development of a focused interventional oncology service line led to increases in patient referrals, with clinic visits growing by over 2,000% in a single year.
- The interventional oncology service line resulted in a 298% increase in procedures in a single year.
- Presence in a multispecialty clinic and participation in tumor boards is a responsibility for the interventional oncology service line.
- Growth in our practice far exceeded national trends using a 5% Medicare Limited Data Set.

Fig 1.

Procedure type and percentage of each procedure by year: A: 2013; B: 2014. Bland = bland embolization of hepatic tumors; MAA = mapping angiography for Y-90 radioembolization; PVE = portal vein embolization; TACE = chemoembolization; Y-90 = yttrium-90.

Fig 2.

After development of the interventional oncology service line, a greater diversity of referred pathology was referred. CRC = colorectal carcinoma; HCC = hepatocellular carcinoma; NET = neuroendocrine tumor.

Table 1

Summary of International Classification of Diseases and Current Procedure Terminology codes used for the 5% Limited Data Set search

Procedure	ICD-9	Procedure ICD	CPT Codes	Notes
Chemoembolization	155.0, 197.7, 209.72	99.25	37204 plus one of 36247 or 75726	Inpatient and outpatient files. CPT and ICD-9 diagnosis or ICD-9 procedure and diagnosis codes on same date.
Radioembolization (mapping)	155.0, 197.7, 209.72		A9540 plus one of 78201 or 78205 or 78215	Outpatient hospital/carrier files only. CPT and ICD-9 codes on same date.
Radioembolization	155.0, 197.7, 209.72		One of 79445 or C2616 or S2095	Outpatient hospital/carrier files only. CPT and ICD-9 codes on same date.
Portal vein embolization	155.0, 197.7, 209.72	39.79	36481 and 37204	Inpatient and outpatient files. CPT and ICD-9 diagnosis or ICD-9 procedure and diagnosis codes on same day.

Note: CPT = Current Procedure Terminology; ICD-9 = International Classification of Diseases, rev 9.

Table 2

Changes in clinic visits for interventional oncology patients by quarter in financial year 2013 (7/1/12–6/30/13) and financial year 2014 (7/1/13–6/30/14)

Quarter	Financial Year 2013	Financial Year 2014	Percent Change
Q1	2	39	1,850%
Q2	0	43	-
Q3	3	50	1,567%
Q4	4	61	1,425%
Total	9	193	2,044%

Note: Q = quarter. Significant growth was noted: $P=.0008$, $t = 13.8$, $df = 3$.

Table 3

Changes in volume by procedure type in financial year 2013 (7/1/12–6/30/13) and financial year 2014 (7/1/13–6/30/14)

Procedure Type	Financial Year 2013	Financial Year 2014	Percent Change
Chemoembolization	36	90	150%
Mapping	12	56	367%
Y-90	9	73	711%
Bland embolization	1	11	1,000%
Portal vein embolization	2	9	350%
Total	60	239	298%

Note: Y-90 = yttrium-90. Significant growth in the number of procedures was identified: $P = .018$, $t = 3.85$, $df = 4$.

Table 4

Breakdown of procedures by year and Current Procedure Terminology codes for 2012 and 2013 using the 5% Medicare sample

Number Procedures	Procedure Type									
	TACE		MAA		Y-90		PVE		Total	
	2012	2013	2012	2013	2012	2013	2012	2013	2012	2013
	134	118	12	18	6	1	4	6	443	385
155.0	134	118	12	18	6	1	4	6	443	385
197.7	236	179	20	26	8	6	8	0	0	0
209.72	13	15	1	2	1	0	0	0	14	14

Note: MAA = mapping angiography; PVE = portal vein embolization; TACE = chemoembolization; Y-90 = yttrium-90.