Fluoroscopic and Endoscopic Gastrostomy Tube Placement: Regional Variation and Their Prevalence

Syed I. Khalid[1] Rita Wu[2] Ayoolamide Gazal[3] Jordan C. Tasse[1] David M. Tabriz[1] Sreekumar Madassery[1] Ulku C. Turba[1] Bulent Arslan[1]

[1]Division of Vascular and Interventional Radiology, Rush University Medical Center, Chicago, Illinois, United States
[2]Chicago Medical School, North Chicago, Illinois, United States
[3]Rush University School of Medicine, Chicago, Illinois, United States

Address for correspondence Syed I. Khalid, MD, Division of Interventional Radiology, Rush University Medical Center, Professional Building, 1725 W. Harrison St., Suite 450, Chicago, IL 60612, United States (e-mail: syed.khalid@me.com).

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Abstract

Objective This study aims to assess the regional variation and overall longitudinal prevalence of approaches to gastrostomy tube placement in patients covered by Medicare or Medicaid.

Background Gastrostomy tubes are most commonly inserted endoscopically given the approaches' demonstrated safety, success, and patient outcomes as compared with laparoscopic approaches. Recently, the growth of interventional radiology services has provided patients with an alternative percutaneous approach. The safety and efficacy of this approach as opposed to endoscopic approaches has yet to be determined.

Methods From 2005 to 2014, Medicare Standard Analytic Files derived from Medicare parts A and B, which contain 100% of inpatient and outpatient facility records billed to Medicare, were retrospectively analyzed. Age, sex, year of placement, region, comparative quarterly ratio, regional cost variation, and overall financial cost were compared between both cohorts.

Results Our population included a total of 336,021 patients; of those, 30,327 patients underwent fluoroscopic guided procedures, and 305,694 patients underwent endoscopic procedures. Age ($p < 0.001$), region ($p = 0.043$), and year of placement ($p < 0.001$) varied significantly between these populations. Fluoroscopic-guided procedures were found to have a statistically significantly lower average cost of treatment compared with endoscopic gastrostomies ($2,018.62 vs. $2,471.33, respectively, $p = 0.03$).

Conclusion This study demonstrates an increasing prevalence of fluoroscopically placed gastrostomy tubes as compared with those placed endoscopically.

Keywords
- gastrostomy
- G-tube
- percutaneous endoscopic gastrostomy
- endoscopic
- fluoroscopic

Introduction

Gastrostomy tubes are commonly used to provide nutrition, hydration, and medication to patients with oral intake difficulties or patients with complex medical conditions who have functional gastrointestinal systems.[1] Although gastrostomy tubes have traditionally been placed using open surgical technique, since their introduction in the 1980s minimally invasive techniques including percutaneous endoscopic insertion and fluoroscopic guidance insertion have become adequate alternatives.[2–5] Early studies of these minimally invasive techniques have reported high rates of success (99.2% for fluoroscopic, 95.7% for endoscopic) with significantly less major complications compared with open surgery (5.9% for fluoroscopic vs. 9.4% for endoscopic and 19.9% for open surgery).[6] Common complications noted in the literature include wound infections, hemorrhage, gastroesophageal reflux, aspiration pneumonia, and/or mechanical failure.[7–10] Much of the existing literature on comparisons of endoscopic versus fluoroscopic gastrostomies is from outside of the United States or limited to single-institution or single-region analysis.[11] This study aims to summarize the cost

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Table 1 Descriptive characteristics of patients undergoing gastrostomy procedures

Parameters	Total (n = 336,021)		Fluoroscopic (n = 30,327)		Endoscopic (n = 305,694)		p Value
Age, n (%)							< 0.001*
< 64	60,045	(17.9)	6,224	(20.5)	53,821	(17.6)	
65–69	42,704	(12.7)	5,142	(17.0)	37,562	(12.3)	
70–74	45,197	(13.5)	4,782	(15.8)	40,415	(13.2)	
75–79	50,839	(15.1)	4,345	(14.3)	46,494	(15.2)	
80–84	54,666	(16.3)	4,278	(14.1)	50,388	(16.5)	
> 85	79,275	(23.6)	5,282	(17.4)	73,993	(24.2)	
Unknown	3,295	(1.0)	274	(0.9)	3,021	(1.0)	
Sex, n (%)							0.14
Male	158,401	(47.1)	16,272	(53.7)	142,129	(46.5)	
Female	174,324	(51.9)	13,780	(45.4)	160,544	(52.5)	
Unknown	3,296	(1.0)	275	(0.9)	3,021	(1.0)	
Region, n (%)							0.043*
Northeast	52,628	(15.7)	5,014	(16.5)	47,614	(15.6)	
Midwest	74,115	(22.1)	6,042	(19.9)	68,073	(22.3)	
South	152,972	(45.5)	12,146	(40.1)	140,826	(46.1)	
West	56,227	(16.7)	7,124	(23.5)	49,103	(16.1)	
Unknown	78	(0.0)	0	(0.0)	78	(0.0)	
Year, n (%)							<0.001*
2005	3,021	(0.9)	0	(0.0)	3,021	(1.0)	
2006	31,756	(9.5)	0	(0.0)	31,756	(10.4)	
2007	31,331	(9.3)	0	(0.0)	31,331	(10.2)	
2008	34,751	(10.3)	3,842	(12.7)	30,909	(10.1)	
2009	35,779	(10.6)	3,976	(13.1)	31,803	(10.4)	
2010	35,227	(10.5)	4,084	(13.5)	31,143	(10.2)	
2011	35,701	(10.6)	4,187	(13.8)	31,514	(10.3)	
2012	35,461	(10.6)	4,701	(15.5)	30,760	(10.1)	
2013	34,456	(10.3)	4,660	(15.4)	29,796	(9.7)	
2014	34,115	(10.2)	4,877	(16.1)	29,238	(9.6)	
Average billed/ patient ($)	2,244.98		2,018.62		2,471.33		0.03*

*Significant variables (p < 0.05).

and regional trends between endoscopic versus fluoroscopic gastrostomies nationally in patients covered by Medicare in the United States.

Patients and Methods

Medicare Standard Analytic Files derived from Medicare parts A and B, which contain 100% of inpatient and outpatient facility records billed to Medicare from 2005 to 2014, were retrospectively analyzed. Patients undergoing gastrostomy tube placement were identified based on Current Procedural Terminology (CPT) codes. Total 336,021 patients were identified; of those, 30,327 patients underwent gastrostomy tube insertion under fluoroscopic guidance (defined by CPT-49440), and 305,694 patients underwent gastrostomy tube insertion under endoscopic guidance (CPT-43246).

Patients were stratified by age, sex, year of placement, region, and cost. Comparative quarterly ratio and regional cost variations within the United States were compared between both cohorts. Cost was defined as total billed by a given provider for the procedure performed. Statistical analysis was performed using R-Studio (Version 1.0.136). Student's t-test was used for categorical variables, with significance level of p < 0.05.

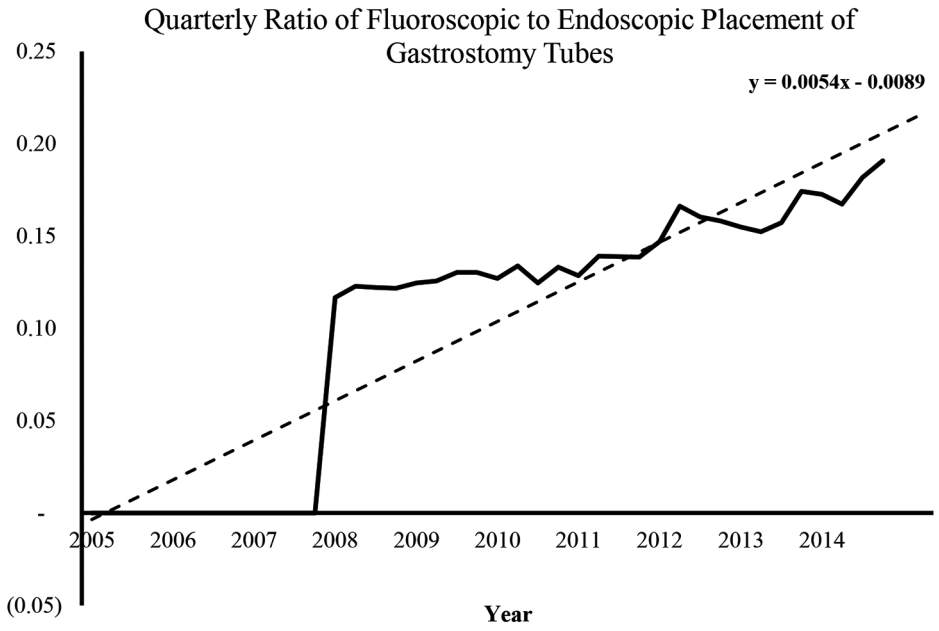

Fig. 1 Quarterly ratio of fluoroscopic to endoscopic placement of gastrostomy tubes.

Table 2 Average charges associated with gastrostomy procedures by region

	Average charge/patient ($) ± SD	
Region	Fluoroscopic gastrostomy	Endoscopic gastrostomy
Midwest	1,932.61 ± 1,500.89	2,190.54 ± 1,285.74
North-east	2,042.19 ± 1,347.89	2,389.05 ± 1,782.84
South	1,747.06 ± 1,427.05	2,425.80 ± 1,635.40
West	2,525.01 ± 2,229.45	3,082.10 ± 1,998.37
Unknown	–	1,166.62 ± 565.24

Abbreviation: SD, standard deviation.

Results

From 2005 to 2014, 336,021 patients underwent gastrostomy tube placement, with 30,327 under fluoroscopic guidance and 305,694 under endoscopic guidance. Age breakdown differed significantly between the fluoroscopic and endoscopic cohorts (►**Table 1**). There was a significantly higher prevalence of fluoroscopic procedures in patients age < 64 (20.5 vs. 17.6%), 65 to 69 (17.0 vs. 12.3%), and 70 to 74 years (15.8 vs. 13.2%). Conversely, there was a higher prevalence of endoscopic procedures in patients age 75 to 79 (14.3 vs. 15.2%), 80 to 84 (14.1 vs. 16.5%), and > 85 (17.4 vs. 24.2%). Males accounted for 53.7% (n = 16,272) of patients undergoing the fluoroscopic approach and 46% (n = 142,129) of patients undergoing the endoscopic approach. Regional variations were significant among both cohorts with 40.1% of fluoroscopic gastrostomy placements occurring in the south, 23.5% in the west, 19.9% in the mid-west, and 16.5% in the northeast compared with 46.1% in the south, 22.3% in the mid-west, 16.1% in the west, and 15.6% in the northeast for endoscopic gastrostomy procedures (p = 0.043). The quarterly ratio of fluoroscopic to endoscopic gastrostomies gradually increased between 2008 and 2014 (►**Fig. 1**).

Fluoroscopic-guided gastrostomies were found to have a significantly lower average cost of treatment compared with endoscopic gastrostomies ($2018.62 vs. $2,471.33 respectively, p = 0.03). This was true for every region of the United States (►**Table 2**).

Discussion

Our analysis of the 336,021 gastrostomy procedures from 2005 to 2014 indicates the growing prevalence of fluoroscopic guidance in gastrostomy placements compared with the traditional endoscopic approach. Fluoroscopic gastrostomy compared with endoscopic gastrostomy had a higher prevalence in southern and mid-western regions (45.5 vs. 40.1%, 22.1 vs. 19.9%, respectively). Previous literature has suggested the safety and efficacy of fluoroscopic gastrostomies with comparable complication and failures rates to endoscopic surgery.[7,9,10,12–17] An early randomized control trial by Hoffer et al evaluating 135 gastrostomy patients (66 fluoroscopic, 69 endoscopic) showed higher success rates and fewer incidences of postoperative complications (mainly in incidence of pneumonia) in the fluoroscopic cohort.[7] A more recent, retrospective, single-institution study by Allen et al evaluating the two gastrostomy approaches in patients with amyotrophic lateral sclerosis (ALS) showed significantly lower incidences of tube failure and postoperative aspiration in the fluoroscopic group compared with endoscopic group (1.9 vs. 15.7% failure; 0 vs. 10.5% postoperative aspiration).[17]

Our evaluation of cost differences between fluoroscopic and endoscopic gastrostomies showed significantly lower

average cost for patients undergoing fluoroscopic procedures ($2018.62 vs. $2,471.33, respectively, $p = 0.03$). An early study by Barkmeier et al of 121 gastrostomy patients found costs of successful fluoroscopic gastrostomy averaging $1,985 ± $418 compared with $1,862 ± $670 for percutaneous endoscopic tube placement.[18] Average cost was calculated as a sum of preprocedural, procedural, and postprocedural costs that included costs associated with imaging, intravenous sedation, and costs associated with follow-up management of the tubes. The higher cost associated with fluoroscopic gastrostomy was suggested to be due to the cost of imaging to document the tube position associated with the procedural cost. There was a 100% success rate for first-time tube placement for fluoroscopically placed tubes but only an 84% success rate for endoscopically placed tubes. All failed tubes subsequently underwent successful fluoroscopic placement. Cost of replacement was not included in their analysis. Furthermore, cost analysis by Hoffer et al also showed a 2.3 times higher average procedural cost for fluoroscopic surgery compared with endoscopic surgery (with average 57% greater Medicare reimbursement), which reflects the absence of room charge and shorter staff time requirements associated with endoscopic surgery.[7] Higher cost associated with fluoroscopic surgery was also attributed to a higher premium charge for fluoroscopic guidance. Interestingly, this cost difference was noted to be offset by cost of complications (endoscopic surgery was found to have higher complication costs associated largely due to additional length of stay). The comparable cost and safety of fluoroscopically guided gastrostomies suggest indications for the growing prevalence of these procedures in the interventional radiology suite.

Limitations

Administrative data allow for access to a large number of medical data files with long-term tracking of certain identifiers within the coding system. However, these data are usually meant for financial and administrative purposes rather than for research. The accuracy and detail of this data may be less reliable as it necessitates using diagnostic coding that relies on subjective interpretation of physician records by a medical reviewer.

Conclusion

This study demonstrates an increasing prevalence of fluoroscopically guided gastrostomies as compare endoscopic gastrostomies, with a greater prevalence of fluoroscopic procedures in the south and mid-western regions.

Conflict of Interest

None.

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