Analysis of the Completeness and Clarity of Free-Form Radiology Dictations for the Reporting of Pulmonary Embolism

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DESCRIPTION OF THE PROBLEM

Most clinical radiology reports are constructed using a free-form dictation method and include information such as the type of study, the date and time of the examination, a brief clinical history and/or the indication for the study, findings, and a brief impression [1]. The findings section typically consists of unstructured paragraphs that are dictated and edited by individual radiologists [2,3]. Prior work has suggested that reports organized in this fashion are incomplete, inconsistent, and/or unclear and can potentially result in miscommunication of significant findings and suboptimal outcomes [2-4]. Structured reporting, in which radiologists use closely defined templates, has the potential to improve clinical reports, ensure appropriate communication of findings, and optimize patient outcomes. Several professional organizations, such as the RSNA, have created reporting templates for various subspecialties, imaging modalities, and disease processes, including a CT pulmonary embolism (CT-PE) template [5].

CT-PE has become the imaging modality of choice for evaluation of suspected pulmonary embolism (PE) in recent years. Heath care providers rely on CT-PE to diagnose PE and depend on specific information from the clinical report, such as the presence or absence of right heart strain, to appropriately manage patients. It is unknown how frequently these elements of CT-PE studies are included by radiologists using free-form reporting. The objective of this study was to retrospectively analyze the completeness and clarity of free-form radiology reports generated for the reporting of CT-PE studies with positive results.

WHAT WE DID

The institutional review board of our institution approved this retrospective analysis, and the requirement for written informed consent was waived. The reports for 206 consecutive CT-PE studies with positive results performed between October 2014 and September 2015 were identified by MONTAGE Search and Analytics (Montage Healthcare Solutions, Philadelphia, Pennsylvania), a radiology data mining and analytics tool. As the RSNA template was created in April 2011, evaluation of studies during this time period would have allowed radiologists 4 years to become familiar with this standard. The clinical radiology reports were analyzed by a board-certified, thoracic fellowship–trained radiologist (B.W.C., with 6 years of experience) for content and compared with the recommended elements in the RSNA CT-PE template.

The first parameter assessed was whether the study was deemed adequate in terms of pulmonary artery opacification with intravenous contrast. Next, the presence or absence of PE and potential complications such as right heart strain and pulmonary infarction was assessed. Other information, such as the presence or absence of pleural effusion and lymphadenopathy, and discussion of the lung parenchyma, central airways, heart and great vessels, upper abdomen, and bones was assessed. The frequency distributions of reporting elements was tabulated by the original reporting radiologist's subspecialty and years of experience. P values $< .05$ were considered to indicate statistical significance.

Because of the potential clinical significance of findings such as PE, right heart strain, and pulmonary infarction, the images for all CT-PE examinations were retrospectively evaluated to determine the actual presence or absence of these items. To determine the presence of right heart strain, qualitative and quantitative

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assessments were performed. The qualitative assessment included evaluation of findings known to be associated with right heart strain such as flattening of the interventricular septum, bowing of the interventricular septum toward the left ventricle, and right ventricular enlargement [6-8]. Quantitative assessment included calculation of the right ventricular–to–left ventricular diameter ratios measured on the axial images [9,10]. Pulmonary infarction was judged to be present if airspace opacities and/or consolidations, especially if subpleural in location, were present in the region of the lung affected by PE.

OUTCOMES

Overall Data Analysis

Of the 206 CT-PE examinations, 66% (136 of 206), 26.2% (54 of 206), and 7.8% (16 of 206) were interpreted by thoracic, abdominal, and musculoskeletal subspecialty radiologists, respectively (Table 1). Overall, only 15.5% of the reports (32 of 206) included all of the elements in the RSNA reporting template. The diagnostic quality, whether adequate, suboptimal, or nondiagnostic, was mentioned in 15.5% of total cases (32 of 206). Thoracic radiologists were more likely to report the diagnostic quality of the study, at 19.1% (26 of 136), compared with 11.1% (6 of 54) for abdominal radiologists and 0% (0 of 16) for musculoskeletal radiologists. The presence of PE and laterality were reported in 100% of cases. The specific level (such as the main, lobar, segmental, and subsegmental) of pulmonary artery involvement was mentioned in 80% (164 of 206), and was higher for thoracic radiologists, at 86.8% (118 of 136), compared with abdominal and musculoskeletal radiologists, at 72.2% (39 of 54) and 44% (7 of 16), respectively. This difference was statistically significant ($P < .001$).

Table 1. Summary of the variability of reporting practice by subspecialty section

Specific Content Mentioned	Section			Total	*P*
	Thoracic	Abdominal	Musculoskeletal		
Diagnostic quality					.079
No	110 (80.9)	48 (88.9)	16 (100)	174 (85)	
Yes	26 (19.1)	6 (11.1)	0 (0)	32 (15)	
Pulmonary embolism					
No	0 (0)	0 (0)	0 (0)	0 (0)	
Yes	136 (100)	54 (100)	16 (100)	206 (100)	
Laterality					
No	0 (0)	0 (0)	0 (0)	0 (0)	
Yes	136 (100)	54 (100)	16 (100)	206 (100)	
Level					<.001
No	18 (13.2)	15 (27.8)	9 (56)	42 (20)	
Yes	118 (86.8)	39 (72.2)	7 (44)	164 (80)	
Right heart strain					.037
No	86 (63.2)	42 (77.8)	14 (88)	142 (69)	
Yes	50 (36.8)	12 (22.2)	2 (13)	64 (31)	
Pulmonary infarction					.13
No	103 (75.7)	48 (88.9)	13 (81)	164 (80)	
Yes	33 (24.3)	6 (11.1)	3 (19)	42 (20)	
PA caliber					<.001
No	98 (72.1)	50 (92.6)	16 (100)	164 (80)	
Yes	38 (27.9)	4 (7.4)	0 (0)	42 (20)	
Pleural effusion					.014
No	18 (13.2)	16 (29.6)	5 (31)	39 (19)	
Yes	118 (86.8)	38 (70.4)	11 (69)	167 (81)	
Total	136 (100)	54 (100)	16 (100)	206 (100)	

Note: Data are expressed as number (percentage). PA = pulmonary artery.

The presence or absence of right heart strain and pulmonary infarction was reported infrequently. Right heart strain was mentioned in 31% of cases (64 of 206) and was more likely to be reported by thoracic radiologists, at 36.8% (50 of 136), compared with abdominal and musculoskeletal radiologists, at 22.2% (12 of 54) and 13% (2 of 16), respectively ($P = .037$). Pulmonary infarction was reported in 20% of cases (42 of 206) and was more likely to be reported by thoracic radiologists, at 24.3% (33 of 136), compared with abdominal and musculoskeletal radiologists, at 11.1% (6 of 54) and 19% (3 of 26), respectively. Description of pulmonary artery caliber ($P < .001$) and presence or absence of pleural effusion ($P = .014$) were also more likely to be reported by thoracic radiologists. Other parameters, such as evaluation of the lung parenchyma, central airways, heart and great vessels, upper abdomen, and bones, were included in 100% of reports.

Most of the CT-PE studies were interpreted by radiologists with 5 to 10 years of experience (83 of 206), followed by those with fewer than 5 years (46 of 206), 10 to 20 years (41 of 206), and >20 years (36 of 206) (Table 2). Diagnostic quality was most likely to be reported by radiologists with 5 to 10 years of experience (21.7% [18 of 83]), 10 to 20 years (12.2% [5 of 41]), and >20 years (11.1% [4 of 36]). The specific level of PE was most likely