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Brief Report

Impact of an emergency medicine pharmacist on time to thrombolysis in acute ischemic stroke☆,☆☆,★

Kayla Montgomery [a,*], A. Brad Hall [a], Georgia Keriazes [b]

[a] Department of Emergency Medicine, Lakeland Regional Health, Lakeland, FL
[b] Department of Pharmacy, Lakeland Regional Health, Lakeland, FL

1. Introduction

The time to thrombolysis, commonly termed *door-to-needle* (DTN), is a measure of stroke center quality and effective patient care. The 2013 American Heart Association/American Stroke Association (AHA/ASA) "Guidelines for the Early Management of Patients with Acute Ischemic Stroke" recommend that hospitals administer thrombolytics to all eligible ischemic stroke patients in less than 60 minutes from arrival [1]. Time to initiation of thrombolytics in ischemic stroke patients has been associated with improved neurological outcomes, decreased adverse effects, and reduced mortality, with early thrombolysis associated with the best outcomes [2,3,5]. Secondary to this benefit, The Joint Commission has also adopted this DTN goal as a performance measurement for stroke center accreditation [4]. As many hospitals have been successful with a DTN goal of 60 minutes, the AHA/ASA is now launching a new initiative, Target: Stroke Phase II [6]. The new DTN goal for participating hospitals will be to administer thrombolytics to at least 50% of patients within 45 minutes.

The initiation of clinical pharmacy services in the emergency department (ED) and incorporation of ED pharmacists within ED clinical teams has been well documented in the literature [7-10]. Results from these studies conclude that the incorporation of a pharmacist may lead to more rapid treatment of trauma, stroke, and ST-elevation myocardial infarction patients. Our institution uses a stroke alert process which activates a team comprised of nurses, ED physician, ED pharmacist, laboratory technician, radiology technicians, and stroke neurologist. All stroke alert patients are evaluated by a stroke neurologist while in the ED. During daytime hours on weekdays, the stroke neurologists provide in-house coverage for all stroke alerts. During nighttime hours and on weekends, the stroke neurologists either provide in-house coverage or respond via telemedicine. Telemedicine allows the stroke neurologist to perform a full neurological examination and order thrombolytics without delay. The ED pharmacist responds to stroke alerts during his or her approximately 40 hours of coverage per week and is notified via pager along with other members of the team. During the stroke alert, the ED pharmacist assists in reviewing contraindications and coordinating administration of thrombolytics including dosing and reconstitution.

The purpose of this study was to evaluate the potential impact of an ED pharmacist on time to thrombolytic administration in acute ischemic stroke patients.

2. Methods

This was a single-center, institutional review board–approved, retrospective cohort study conducted in a 133-bed ED with more than 210 000 annual patient visits. Our institution is a community tertiary care 849-bed hospital in the southeast with a Level II Trauma Center and maintains Primary Stroke Center certification. Our stroke alert process is activated by emergency medical services before ED arrival. Upon arrival, the stroke alert team simultaneously initiates the first steps in the stroke alert process, including head computed tomography imaging without contrast, bedside international normalized ratio from laboratory staff, and a thorough clinical assessment. One full-time equivalent ED clinical pharmacist has been a member of the stroke alert team since 2009. In addition to the dedicated ED clinical pharmacist, 1 PGY2 Emergency Medicine pharmacy resident and multiple PGY1 pharmacy residents also rotate through the ED and may participate during the stroke alert process.

Study participants were selected by a retrospective medical record review of all patients who received intravenous thrombolytics and presented to the ED via activation of the stroke alert system between January 1, 2012, and September 30, 2014. The ED stroke alert log was reviewed to determine all patients who presented to the ED via activation of the stroke alert system. The electronic medical record (EMR) and medication cabinet dispensing reports were reviewed to determine which of these patients received thrombolytics. Two groups were created for comparison: one when the ED pharmacist was participating on the stroke alert team, referred to as the *PHARM group*, and one when the ED pharmacist was absent, referred to as the *NON-PHARM group*. ED pharmacist participation was determined by either thrombolytic order entry in the EMR or medication cabinet user dispensing reports.

The primary outcome of this study was the proportion of patients meeting the goal DTN time of less than 60 minutes. The secondary outcomes of this study were the mean DTN times as well as the proportion of patients meeting DTN time of less than 45 minutes. To evaluate the variable of telemedicine use on DTN, a subanalysis of telemedicine DTN times with and without a pharmacist was performed. Descriptive statistics were used to report baseline characteristics of all study participants. A χ^2 test was used to compare the proportion of patients within

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* Corresponding author at: Lakeland Regional Health, 1324 Lakeland Hills Blvd, Lakeland, FL 33805.
E-mail addresses: kayla.montgomery@myLRH.org (K. Montgomery), brad.hall@myLRH.org (A.B. Hall), georgia.keriazes@myLRH.org (G. Keriazes).

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Table 1
Baseline characteristics of the stroke population

Characteristic	PHARM n = 38	NON-PHARM n = 59	*P* value
Age (y), mean (range)	71 (28-96)	68 (29-87)	.17
Male sex, n (%)	18 (47)	33 (56)	.41
Arrival SBP, mean (range)	155 (93-227)	158 (98-224)	.69
Arrival NIHSS score, mean (range)	11 (0-31)	12 (0-30)	.48

NIHSS, National Institutes of Health Stroke Scale; SBP, systolic blood pressure.

the PHARM and NON-PHARM groups meeting goal DTN times of less than 45 and 60 minutes. An unpaired 2-tailed Student *t* test was used to evaluate the difference in mean DTN times between both groups. Confidence intervals were calculated for both primary and secondary outcomes. A 2-tailed *P* value less than .05 denoted statistical significance. An interrater, blinded to the study objectives, was assigned a 10% audit rate of the sample size to assess the reliability of DTN times. An interrater reliability goal of greater than or equal to 90% agreement was considered acceptable [11]. Data reviewed by the interrater included the ED arrival time and thrombolytic administration time points.

3. Results

A total of 658 patients presented to the ED as a stroke alert during the study time period. Of those, 97 patients met inclusion criteria by receiving intravenous thrombolytics, with 38 patients in the PHARM group and 59 patients in the NON-PHARM group. Patient characteristics at baseline were similar between both groups with no statistically significant difference in age, sex, arrival systolic blood pressure, or arrival National Institutes of Health Stroke Scale score (Table 1).

Patients in the PHARM group achieved a 32% increase (95% confidence interval [CI], 10%-50%) in the proportion receiving thrombolytics within 60 minutes when compared with the NON-PHARM group, at 71% vs 39%, respectively. Similarly, patients in the PHARM group achieved a 23% increase (95% CI, 5%-41%) in the proportion receiving thrombolytics within 45 minutes when compared with the NON-PHARM group, at 42% vs 19%, respectively.

Patients in the PHARM group were also associated with a mean 20-minute decrease (95% CI, 6.6-33.4) in DTN time, from 74 to 54 minutes, respectively (Table 2). In the subset of patients evaluated by the stroke neurologist using telemedicine, the DTN was 50 minutes in the PHARM group (n = 6) compared with 80 minutes in the NON-PHARM group (n = 28) (95% CI, −59.8 to 0.2). Interrater reliability testing resulted in an agreement level of 100%.

4. Discussion

Recently, the American College of Emergency Physicians formally recognized ED pharmacy services, supporting the incorporation of clinical pharmacists within the ED and emergency medicine pharmacy residency training [12]. Along with our study, similar positive outcomes with pharmacist participation on clinical interdisciplinary teams have been documented in the literature. In 2012, Acquisto et al [8] found a mean 11.5-minute decrease in door-to-balloon times with pharmacist involvement in the management of ST-elevation myocardial infarction patients presenting to the ED. Amini et al [9] and Montgomery et al [7] both found significant decreases in time to analgesia administration with pharmacist involvement during trauma resuscitation. A recent publication of a study performed by Gosser et al [10] found a 20-minute decrease in DTN times when a pharmacist was present; however, it did not find a significant difference in the proportion of patients meeting a goal DTN time of less than 60 minutes. The results of these studies, the recognition from the American College of Emergency Physicians, and the results of our own study may support the integration of pharmacists onto clinical interdisciplinary teams within the ED.

Table 2
Time to thrombolytic therapy

	PHARM n = 38	NON-PHARM n = 59	95% CI	*P* value
Thrombolysis in <60 min, n (%)	27 (71)	23 (39)	0.10-0.50	.002
Thrombolysis in <45 min, n (%)	16 (42)	11 (19)	0.05-0.41	.012
Mean DTN time, min (range)	54 (21-160)	74 (28-187)	6.6-33.4	.004

In our study, we determined that pharmacist participation on the stroke alert team was associated with an increased proportion of patients receiving thrombolytics within 45 and 60 minutes, as well as a decrease in mean DTN times. Although our subset evaluation was not powered to detect a difference, it is reassuring that regardless of the method of evaluation, either bedside or telemedicine, a pharmacist still appears to positively impact the DTN time. The ED pharmacist is well qualified in the preparation and dosing of thrombolytics. In addition, the ED pharmacist may also impact the choice of antihypertensive used in acute ischemic stroke patients, allowing for more efficacious treatment with appropriate agents, as recommended in the AHA/ASA guidelines. When the ED pharmacist is not participating on the stroke alert team, it is the responsibility of the ED nursing staff to retrieve thrombolytics from the medication dispensing cabinet and calculate doses, which may impact DTN times depending on the familiarity of the ED nursing staff with the administration of thrombolytics.

We recognize that our study does have several limitations. Because of the nature of a retrospective cohort study, our results rely on the validity of data entry into the EMR and ED stroke alert log. Our institution relies heavily on the data time points collected in this study for review and continued accreditation by The Joint Commission. Our study was also conducted at a single-site ED, which may limit generalizability of our results to other institutions with stroke alert processes dissimilar to our own. Furthermore, the stroke alert process is a complex process with many variables that could potentially impact DTN time such as laboratory delays, radiology delays, administration of antihypertensive medications before thrombolytic administration, as well as lengthy discussion with family members to receive consent. The stroke neurologist is ultimately responsible for the decision to administer thrombolytics, and DTN times may be affected by this process. Although our study was not designed to determine which particular pharmacist activities may contribute to the study results, we believe that it is likely due to the proactive nature of the ED pharmacist and their anticipation of thrombolytic administration.

5. Conclusion

The incorporation of a pharmacist within the stroke alert team was associated with significant improvements in both the proportion of patients receiving thrombolytics meeting the DTN goals and the overall mean time to thrombolytic administration. This study may support the integration of clinical pharmacists within stroke alert teams and adds to the literature supporting pharmacists on other clinical interdisciplinary teams within the ED. We believe that the results of our study may have a positive impact on measureable outcomes such as stroke center accreditation and hospital rankings as well as potential reimbursement from Centers for Medicare and Medicaid Services [13]. Further studies are needed to identify other interrelated factors that may influence time to thrombolysis.

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