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Original Article

Effectiveness of Stroke Training Provided to Istanbul Medical Staff

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ABSTRACT

Objective: Stroke is one of the most common causes of morbidity and mortality in the world and therapy is time-sensitive. The biggest obstacles to optimal treatment are pre-hospital transport delays and hesitation to administer intravenous tissue plasminogen activator (iv-tPA) and perform a mechanical thrombectomy (MT). A number of educational sessions were held in Istanbul to address these problems. This study examined the effects of this training.

Methods: This retrospective study was designed to analyze the effectiveness of stroke treatment training programs provided to 2645 medical personnel in Istanbul, Turkey. The transport time, accuracy rate of stroke diagnosis, and treatment parameters of a 1-month period in 2017 and the same month in 2018 after the training were evaluated.

Results: In all, 1628 suspected stroke patients who were transported to a hospital by ambulance in October 2017 (n=796) and October 2018 (n=832) were included. There was a minimal but meaningful decrease in pre-hospital transportation time ($p<0.05$). In 2017, 27% of the patients who were transported to the hospital with the suspicion of stroke were ultimately diagnosed with acute stroke, while 36% were diagnosed with acute stroke in 2018 ($p<0.05$). Applications of iv-tPA and MT to acute stroke patients also significantly increased in 2018 (tPA: 14% vs 26%, p=0.003; MT: 6% vs 13%, p=0.034).

Conclusion: The analysis indicated that the educational programs targets were successful based on an increase in the diagnosis of stroke and use of iv-tPA and MT.

INTRODUCTION

Stroke is the second leading cause of death worldwide after cardiovascular disease.[1,2] Ischemic stroke accounts for about 87% of these events.[3] Intravenous tissue plasminogen activator (iv-TPA) and mechanical thrombectomy (MT) are the 2 principal treatment modalities for patients suffering acute ischemic stroke.[4,5] Since the first 4.5 hours are vital for the potency for iv-tPA and the first 6 to 24 hours for MT, earlier transport has been recognized as important in acute ischemic stroke patients.[6,7]

Certified Primary Stroke Centers (PSC) and Comprehensive Stroke Centers (CSC) offer dedicated, high-quality ischemic stroke treatment. Iv-tPA can be provided by both PSCs and CSCs, while MT is only available at CSCs.[8,9] Awareness of the differences in treatment options and knowledge of which is most appropriate is critical. There are 2 strategic approaches for transporting patients: the drip-and-ship and the mothership models. All suspected stroke patients are transported to the closest PSC for evaluation and iv-tPA treatment before transfer to a CSC as appropriate in the drip-and-ship model. If a patient is diagnosed with stroke and large vessel occlusion (LVO), they are transferred to a CSC for MT. In the mothership model, emergency medical service (EMS) personnel transport the patient directly to the nearest CSC for iv-tPA and MT, as needed.[8,10]

EMS is often the first medical contact for patients. The ability to form a correct immediate diagnosis and direct the transfer to the appropriate center for needed treatment can play an important role in mortality and morbidity.[11,12] Misdiagnosis can cause significant and costly delay in treatment.

Despite its proven efficacy in the treatment of acute ischemic stroke and a quarter century of use, iv-tPA treatment is often still not administered at the desired level.[13] Reasons it is not more widespread include the difficulty of the initial indicative evaluation, the limited therapeutic range (4.5 hours), and the complexity of the clinical, imaging, and laboratory exclusion criteria and assessment.[14]

Sixteen educational events were held in Istanbul in 2018 to address these reasons and other obstacles to stroke treatment. The training sessions reviewed the correct diagnosis of stroke, the need for transportation to the appropriate center as soon as possible, and optimal treatment. This study was designed to assess the impact of the training by comparing the transportation procedures, diagnostic accuracy, and treatment processes of patients who were diagnosed with a stroke during the month of October in 2017 and 2018.

MATERIALS AND METHODS

Written, informed consent was obtained from all of the health personnel and the study was conducted according to the principles of the Helsinki Declaration (2013). The Bakirkoy Dr. Sadi Konuk Training and Research Hospital Research Ethics Committee granted approval of the study (date: 05.11.2018, no: 2018/20).

Training programs

In early 2018 various education events supervised by the provincial health directorate were held in Istanbul to increase stroke awareness and to create a standard for treatment. The training programs were primarily aimed at improving diagnosis capability, transportation to the right center, and providing appropriate treatment as soon as possible.

The programs were divided into pre-hospital and hospital intervention components. A total of 1868 EMS staff (1587 paramedics and 281 general practitioners) were offered to take a 15-minute e-learning education session in the pre-hospital intervention component. All of the participants were examined for baseline stroke knowledge before and after the program. The training sessions covered stroke etiology and symptoms, use of prehospital stroke assessment tools, diagnosis, management, and transportation. To standardize the prehospital assessment of stroke, they were instructed in the use of the FAST test (facial drooping, arm weakness, speech difficulties, and time to call emergency services), which is a modification of Cincinnati Prehospital Stroke Scale (CPSS).[15,16] The protocol and rationale for the drip-and-ship and mothership approaches were explained.[17,18]

In the hospital intervention component of the training, a stroke nursing symposium (500 participants), 6 acute ischemia treatment-management meetings (107 physician participants) and 5 case-study meetings (170 physician participants) were held. A total of 777 participants from hospital emergency and neurology departments identified as primary or comprehensive stroke centers attended these events and were given information about tPA application methods, absolute and relative contraindications, possible side effects, and benefits of tPA treatment.[19–21]

Study population

Patients who were transported to hospitals with a preliminary diagnosis of stroke during the month of October 2017 and October 2018 were included in the study and compared.

The inclusion criteria were:

a) Patients over the age of 18, and

b) Patients who were transferred to hospital by provincial health directorate emergency ambulance with the diagnosis of stroke (ICD code 164).

The exclusion criteria were:

a) Patients who were transported to the emergency department with the diagnosis of disease other than stroke, but were diagnosed with acute stroke in the hospital,

b) Patients who were diagnosed with stroke in the hospital and referred for transfer to another hospital by ambulance, and

c) Patients who provided their own transportation to the hospital who were diagnosed with stroke.

Data collection method

After obtaining permission based on the purpose of scientific research, emergency medical services data were collected from the automated system of the Istanbul Provincial Directorate of Health. The hospital data were

Table 1. Definition of time intervals

Time interval	Definition
Activation interval	Period between receipt of emergency call and ambulance departure
Time from departure to scene	Period between ambulance departure and arrival at the scene
Response time	Period between emergency call and arrival to scene
Time at the scene	Period between ambulance arrival and departure from scene
Time from scene to hospital	Period between leaving the scene and arriving at the emergency department
Total run time	Period between emergency call and arriving at the emergency department

Table 2. Study group transportation time intervals

Time interval (minutes)	Group 1 (n=796)	Group 2 (n=832)	p
Activation interval	2.25±1.28	2.37±1.56	0.107
Time from departure to scene	6.98±6.34	5.75±3.87	<0.001
Response time	9.23±6.55	8.12±4.25	<0.001
Time at the scene	12.03±5.44	12.68±5.75	0.022
Time from scene to hospital	9.92±6.51	11.73±7.46	<0.001
Total run time	31.21±11.09	32.55±10.99	0.015

obtained with an official letter from the provincial health directorate. Details of age, sex, primary diagnosis, treatment modalities applied, activation interval, departure to scene time, response time, time at scene, transport time, and total run time according to the definitions provided in Table 1 were evaluated.

Statistical analysis

All of the analyses were performed using IBM SPSS Statistics for Windows, Version 22.0 (IBM Corp., Armonk, NY, USA). Continuous variables were presented as the mean (SD) or median (interquartile range), and categorical and qualitative variables were described as numbers (percentages). The 1 sample Kolmogorov-Smirnov test was used to assess the distribution of the data. Numerical variables were compared using either a t-test or the Mann-Whitney U test. Categorical variables were analyzed with a chi-squared test. Probability values were 2 tailed, and a p value of <0.05 was considered significant.

RESULTS

The study included 1628 suspected stroke patients who were transported to hospital by ambulance between October 1–31, 2017 (n=796) and October 1–31, 2018 (n=832). The mean age of the 1628 patients was 69.08±16.61 years. It was noted that the mean age of acute ischemic patients (n=514) was significantly higher than those without ischemia (71.06±14.66 years vs 68.17±17.44 years; p<0.001) following a definitive diagnosis in the hospital.

The patients from 2017 were identified as Group 1 and the patients from 2018 were categorized as Group 2. There was no significant difference in the age of acute ischemic patients between Group 1 and Group 2 (70.91±13.53 years vs 71.27±15.68 years; p=0.782). There was also no significant difference in the distribution of gender between the groups, as there were 127 (58%) women and 90 (42%) men in Group 1 compared with 149 (50.2%) women and 148 (49.8%) men in Group 2 (p>0.05). The combined distribution of gender in acute ischemic patients was 275 women (53%) and 239 men (47%).

There were minimal differences in the transportation intervals in the 2 groups. While the EMS managed to reach the scene earlier in 2018 than in 2017, they spent more time at the scene and the time from scene to hospital arrival was longer (p<0.05), leading to a longer total run time in 2018 (Table 2).

Table 3. Treatment modalities of the acute ischemic stroke patients

	Group 1 (n=168)	Group 2 (n=238)	p
Thrombolytic treatment	23	61	<0.05[a]
Mechanical thrombectomy	11	31	<0.05[b]

[a]χ^2 (1, n=406) = 8.556; p=0.003, odds ratio: 2.173.
[b]χ^2 (1, n=406) = 4.455; p=0.035, odds ratio: 2.137.

Based on the laboratory and radiological examinations performed in the hospital, 217 (n=796, 27%) of the patients in Group 1 and 297 (n=832, 36%) of the patients in Group 2 were diagnosed with acute stroke. The accuracy of diagnosis significantly increased in 2018 (χ^2 (1, n=1628) = 13.400; p=0.0003). In all, 168 (n=217, 77%) in Group 1 and 238 (n=297, 80%) in Group 2 were diagnosed with acute ischemic stroke, with no significant difference between groups (p>0.05).

Table 3 illustrates the details of the treatment modalities used for the acute ischemic stroke patients. Among acute ischemic stroke patients, 14% (23/168) of the patients in Group 1 and 26% (61/238) of the patients in Group 2 were treated with tPA (χ^2 (1, n=406) = 8.556; p=0.003). There was also a significant increase in MT: 6% (11/168) of the patients in Group 1 and 13% (31/238) of the patients in Group 2 (χ^2 (1, n=406) = 4.545; p=0.034). In Group 1, 2% (3/168) who were treated with MT were also administered tPA, while it was 6% (16/238) in Group 2 (χ^2 (1, n=406) = 5.381; p=0.02).

DISCUSSION

The objective of this study was to examine the effect of stroke training on the treatment process for acute ischemic stroke in Istanbul province. As has been widely reported, the main treatment modalities for stroke are thrombolytic and MT therapies, which are time-dependent.[7,22]

Among patients transferred by EMS, acute ischemic stroke was slightly more prevalent in women than men. The mean age of ischemic stroke patients (71.06±14.66 years) was higher than those not diagnosed with ischemic stroke.

These findings were consistent with the literature.[12,23] Bahrampouri et al.[12] observed that this may be a result of a greater likelihood among women to be willing to call EMS. Lee et al.[24] noted that women have a longer life expectancy and that stroke is more prominent in men when the data are age-adjusted.

Analysis of the pre-hospital transport data revealed that the response time was meaningfully shorter in 2018 than 2017 (8.12±4.25 min vs 9.23±6.55 min, respectively). The change in response time, which includes the activation time and time from departure to arrival at the scene, was due to a reduction in the departure to scene time (2017: 6.98±6.34 min vs 2018: 5.75±3.87 min). According to the literature, 8 minutes is frequently considered the response time goal.[25,26] Our data were consistent with this standard.

In our study, although EMS responders spent a little more time at the scene in 2018 than in 2017 (2017: 12.03±5.44 min vs 2018: 12.68±5.75 min), it appears to be a reasonable length of time, according to the literature. One study from the USA reported an on-scene time of 14.1 minutes, and another study that examined modeling assumptions for on-scene time determined a local response time of 13.5 minutes.[27,28] Differences in the length of on-scene time may be due in part to the application of assessment tools and a more thorough evaluation to identify stroke patients in the field. The mean time from scene to hospital in 2018 was 11.73 minutes with a total run time of 32.55 minutes. The scene-to-hospital time was longer than that recorded in 2017 (9.92±6.51 min vs 11.73±7.46 min, respectively). The time difference for transfer may be due to transfer to stroke centers rather than the nearest hospital. Bahrampouri et al.[12] reported a transfer time and total run time of 9.1 and 35.3 minutes. Kleindorfer et al.[29] also determined a transfer time of 13.1 minutes.

Of the patients transported to the hospital with the suspicion of stroke, it was observed that 27% of the patients in 2017 and 35% of the patients in 2018 were diagnosed with acute stroke. Among these, 77% in 2017 and 80% in 2018 were diagnosed as acute ischemic stroke. A 30% diagnostic increase was achieved following the EMS training sessions. There are many stroke assessment tools with different sensitivity and specificity. The CPSS and FAST scales have a sensitivity of 83% and 85% and a specificity of 69% and 68% respectively. The more complex Los Angeles Prehospital Stroke Screen (LAPSS), Melbourne Ambulance Stroke Screen (MASS), and Medic Prehospital Assessment for Code Stroke (Med PACS) have a high specificity (92% to 98%) but low sensitivity (44% to 71%).[28,29] Studies have reported an accurate diagnosis of stroke by pre-hospital emergency paramedics using the FAST test of 40% to 78%.[30,31] The education programs for EMS staff used in this study particularly mentioned the CPSS and FAST scales, and as a result, 30% progress in diagnosis was observed in a 1-year period. Additional, advanced training programs may result in even greater accuracy.

After the diagnosis of acute ischemic stroke, intravenous tPA and MT are the 2 primary treatment modalities.[6,32] In our study, there were significant increases in the use of both iv-tPA therapy and MT in 2018 compared with the previous year (tPA: 14% vs 26% and MT: 6% vs 13%). Although tPA treatment can be life-saving, it is time-sensitive and dependent on relative or absolute contraindications.[21] In a study conducted in England, 12% of all stroke cases were treated with tPA, though 15% of the patients were eligible.[33] Messe et al.[33] found that between 2003 and 2011, 25% of 61698 patients who were eligible for treatment with an admission within 2 hours were untreated. The previous 2 studies mentioned noted that the main reasons for avoiding tPA were the absence of centers available 24/7, access to brain computed tomography, differences in clinical decision-making, chronic diseases of the patient, and educational deficiencies.[13,33] MT is indicated for patients with acute ischemic stroke due to a LVO in the anterior circulation who can be treated within 24 hours.[34,35] A meta-analysis has demonstrated that although new MT devices have improved patient functional independence, careful planning and hospital capacity for rapid assessment of eligible patients is necessary.[36]

Our analysis showed that the educational programs successfully achieved the goals, as seen in the evident increase in the diagnosis of stroke and the use of tPA and MT. We believe that if public education campaigns are added to the current training program, we can reduce the time to presentation at the hospital and improve outcomes by providing personnel with the knowledge and skills needed to initiate optimal treatment earlier.

Ethics Committee Approval

Approved by the Bakirkoy Dr. Sadi Konuk Training and Research Hospital Ethics Committee (date: 05.11.2018, decision no: 2018/20).

Peer-review

Internally peer-reviewed.

Authorship Contributions

Concept: Y.S., S.K.; Design: Y.S., S.K., S.D.; Supervision: K.A.T., Y.S.; Materials: E.A., S.K.; Data: E.A., S.D. Y.S., S.K., K.A.T.; Analysis: Y.S.; Literature search: Y.S., K.A.T., S.K.; Writing: Y.S., S.K.; Critical revision: Y.S., S.K.

Conflict of Interest

None declared.

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İstanbul Genelinde Sağlık Personeline Verilen İnme Eğitimlerinin Etkinliği

Amaç: İnme, zamana bağlı tedavisi ile morbidite ve mortalitenin en sık nedenlerinden biridir. Tedavinin önündeki en büyük engel, hastane öncesi ulaşım gecikmeleri, doku plazminojen aktivatörü (IV-tPA) ve mekanik trombektomi (MT) ile tedavide tereddüt etmektir. İstanbul'da bu sorunları ve inme tedavisinin önündeki engelleri ortadan kaldırmak için farklı eğitim faaliyetleri gerçekleştirilmiştir. Çalışmamızda bu aktivitelerin tedavi sürecine yansımalarını göstermeyi amaçladık.

Gereç ve Yöntem: Bu çalışma, İstanbul'daki 2645 sağlık personeline inme tedavisi organize etmek amacıyla verilen eğitim programlarının etkinliğini görmek için geriye dönük olarak tasarlanmıştır. Çalışmamızda, eğitimlerin sonunda 2017–2018 yılları içindeki bir aylık periyotta nakil süreleri, inme tanısı için doğruluk oranları ve tedavi parametreleri arasındaki değişikliği inceledik.

Bulgular: Bu çalışmada, 1–31 Ekim 2017 (n=796) ve 1–31 Ekim 2018 (n=832) tarihleri arasında inmeden şüphelenilen ve ambulansla hastaneye nakledilen 1628 hastayı değerlendirdik. Hastane öncesi ulaşım sürelerinde minimal fakat anlamlı düşüşler vardı ($p<0.05$). İnme şüphesi ile hastaneye sevk edilen hastaların 2017 yılında %27'sinde akut inme tanısı konmasına rağmen, 2018'de bu rakam %36 idi ($p<0.05$). Akut inme hastalarına iv-tPA ve MT uygulamaları da 2018'de 2017'ye göre önemli ölçüde artmıştır (IV-tPA için %14'e karşı %26 p=0.003 ve MT için %6'ya karşı %13, p=0.034).

Sonuç: Analizlerimiz, inme tanısı konmasında, tPA kullanımında ve mekanik trombektomideki belirgin artışlar ile eğitim programlarının hedeflerine başarıyla ulaştıklarını göstermiştir.

Anahtar Sözcükler: Doku plazminojen aktivatör; hastane öncesi transpot; inme; inme tedavisi; mekanik trombektomi.