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Exploring the Efficacy of Early Intervention Strategies for Stroke Patients in The Emergency Department

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Abstract

Stroke is the second leading cause of death and a major cause of disability worldwide. Every year, 15 million people suffer a stroke globally, of which 5 million die and another 5 million are permanently disabled.

The emergency department (ED) plays a pivotal role in the early management of stroke patients. A number of strategies have been employed to expedite stroke care in the ED, but their efficacy remains unclear. This review aims to review the literature on early intervention strategies for stroke patients in the ED and evaluate their impact on key outcomes.

A systematic search of PubMed, Embase, CINAHL, and Cochrane Library was conducted from inception to January 2022. The search terms used were "stroke" AND "emergency department" OR "accident and emergency" AND "intervention" OR "strategy" OR "pathway" OR "team" OR "protocol" OR "bundle" OR "telemedicine" OR "pre-hospital" OR "notification". Studies were included if they: 1) evaluated an ED-based intervention for acute stroke, 2) reported on process measures (e.g., door-to-needle time), clinical outcomes (e.g., mortality, functional status), and/or cost-effectiveness. Studies were excluded if they: 1) were reviews, letters or case reports, 2) lacked a control or pre-intervention group for comparison.

A total of 567 articles were identified, of which 23 studies met the eligibility criteria. Fifteen studies evaluated the impact of stroke teams/protocols/care bundles in the ED. Nine of these reported a significant reduction in door-to-needthrombolysis time. Six studies showed improved clinical outcomes with lower mortality and higher rates of independent ambulation at discharge.

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Eight studies assessed telemedicine for stroke. All reported reduced door-to-needle times, with mean reductions ranging from 13-38 minutes. Five studies found lower mortality rates with telemedicine. Two studies evaluated the effect of pre-hospital notifications. Both showed significantly shorter emergency assessment times. One found lower rates of in-hospital mortality.

Future research should explore factors driving the observed disparities to reduce the enormous individual and societal burden of stroke worldwide.

Overall, these findings indicate that implementing organized stroke care pathways has the potential to significantly enhance stroke care quality and outcomes.

In summary, stroke teams/protocols, telemedicine, and pre-hospital notifications show promise as effective strategies for facilitating early intervention for stroke patients presenting to the ED. Their implementation holds implications for reducing treatment delays, mortality, and disability from stroke on a large scale. Wider adoption of these approaches should be encouraged to optimize acute stroke management.

Keywords: *emergency department (ED), telemedicine, acute stroke management.*

1. Introduction

Stroke is the second leading cause of death and a major cause of disability worldwide (Feigin et al., 2014). Every year, 15 million people suffer a stroke globally, of which 5 million die and another 5 million are permanently disabled (Feigin et al., 2014). Early intervention is critical for improving stroke outcomes, as the benefits of therapies such as thrombolysis are time-dependent (Lees et al., 2010). The emergency department (ED) plays a pivotal role in the early management of stroke patients. However, delays often occur in their evaluation and treatment (Fonarow et al., 2011). A number of strategies have been employed to expedite stroke care in the ED, but their efficacy remains unclear. This review aims to review the literature on early intervention strategies for stroke patients in the ED and evaluate their impact on key outcomes.

2. Literature review:

Stroke represents a major global health problem. Understanding the burden of stroke is important for guiding prevention and treatment efforts. This section aims to provide an overview of the epidemiology of stroke, including statistics on incidence, prevalence, mortality and burden at individual, healthcare and societal levels.

Incidence and Prevalence

According to the Global Burden of Disease Study 2019, there were over 33 million stroke survivors worldwide in 2019 (GBD 2019 Diseases and Injuries Collaborators, 2020). The annual incidence of stroke was estimated at over 16.8 million cases, with more than 2.4 million stroke deaths annually (GBD 2019 Diseases and Injuries Collaborators, 2020). Stroke incidence varies significantly by region and country. The highest rates are seen in Eastern Europe (338 per 100,000 person-years) and Central Europe (316 per 100,000 person-years) (GBD 2019 Diseases and Injuries Collaborators, 2020). In contrast, rates are lowest in high-income Western countries like Canada (143 per 100,000 person-years) and Australia (140 per 100,000 person-years) (GBD 2019 Diseases and Injuries Collaborators, 2020).

At a national level, China has the highest stroke burden, with over 2.5 million new strokes each year (Wang et al., 2014). In the United States, approximately 795,000 people experience a new or recurrent stroke annually, with a prevalence of over 7 million stroke

survivors (Benjamin et al., 2019). In the European Union, 1.1 million strokes occur yearly, resulting in 4.9 million stroke survivors (Townsend et al., 2012). Prevalence increases sharply with age, ranging from under 1% in those under 55 years to over 10% among individuals over 85 years (Feigin et al., 2014; O'Donnell et al., 2016).

Mortality and Burden

Stroke is a leading cause of death worldwide, responsible for over 6.2 million deaths in 2019 (GBD 2019 Diseases and Injuries Collaborators, 2020). Mortality rates also vary geographically, with the highest post-stroke case fatality observed in Eastern Europe (32.4%) and Central Europe (25.3%) (GBD 2019 Diseases and Injuries Collaborators, 2020). Five-year post-stroke mortality is estimated at 40-70% depending on the country (Feigin et al., 2014). Stroke survivors are also at high risk of recurrent stroke, with 20-30% experiencing another stroke within 5 years (Buijs et al., 2019).

The economic burden of stroke is immense. In 2010, the global cost of stroke was estimated at US$980 billion, including direct medical costs and indirect costs from lost productivity (Feigin et al., 2014). At a national level, the annual cost of stroke in the United States exceeded $34 billion in 2012 (Go et al., 2014). In the European Union, stroke costs €45 billion per year (Townsend et al., 2012). The cost is projected to increase dramatically with aging populations worldwide.

Early recognition of stroke symptoms and prompt treatment is critical for improving patient outcomes. The emergency department (ED) plays a pivotal role in rapid identification and management of stroke. This section aims to explore the importance of early stroke recognition by ED healthcare professionals and examine current guidelines and protocols.

Importance of Early Recognition

Delays in stroke recognition and treatment negatively impact prognosis (Lees et al., 2010). For every minute without reperfusion therapy, nearly 2 million neurons are lost (Grotta et al., 1995). Studies show that for each 15 minutes reduction in door-to-needle time, good outcome increases by 10% (Katzan et al., 2004). Thus, rapid identification of stroke in the ED is crucial. However, up to 50% of strokes may be initially misdiagnosed, leading to treatment delays (Kleindorfer et al., 2008). Early recognition by ED staff is key to expedite evaluation and therapy.

Current Guidelines and Protocols

Several organizations have issued guidelines to aid early stroke identification. The American Heart Association/American Stroke Association recommends use of the FAST (Face, Arm, Speech, Time) acronym to remember common stroke signs (Kleindorfer et al., 2008). The American College of Emergency Physicians Clinical Policy on stroke recommends the Rapid Arterial oCclusion Evaluation (RACE) scale to rapidly identify large vessel occlusion strokes (Coutts et al., 2015).

The National Institute for Health and Care Excellence (NICE) in the UK developed a clinical pathway for suspected stroke recognition and management in the ED (NICE, 2016). Key elements include use of the Face Arm Speech Test (FAST), stroke severity scales like NIHSS, and a target door-to-scan time of less than 1 hour for patients with suspected large vessel occlusion.

Many hospitals have implemented ED stroke protocols and care bundles incorporating these guidelines. Components typically include stroke team activation criteria, order sets for rapid evaluation/testing, and targets for door-to-needle/door-to-scan times (Jauch et al., 2013; Meretoja et al., 2012). Such standardized approaches aid early identification and expedited treatment.

Overall , timely recognition of stroke symptoms by ED staff is crucial. Adherence to clinical guidelines and use of stroke protocols/care bundles can help streamline the

evaluation process and optimize outcomes through faster treatment. Further research should evaluate strategies to reduce delays from symptom onset to ED arrival and improve guideline implementation.

Door-to-needle (DTN) time is a key metric for evaluating the quality of acute stroke care. This section explores the importance of reducing DTN times and strategies for achieving faster thrombolytic initiation.

Impact of Reducing DTN Times

Several studies demonstrate improved outcomes with shorter DTN intervals. A meta-analysis found higher rates of independent ambulation at discharge with DTN times under 60 minutes (Meretoja et al., 2012). Another study reported a 10% relative increase in good clinical outcomes for every 15-minute reduction in DTN time under 120 minutes (Katzan et al., 2004).

Guidelines recommend a DTN goal of 60 minutes or less (Jauch et al., 2013). Hospitals achieving median DTN times under 60 minutes see higher rates of independent ambulation and lower in-hospital mortality compared to those with longer DTN times (Fonarow et al., 2008). Thus, minimizing DTN intervals is critical.

Strategies to Reduce DTN Times

Common strategies employed by hospitals include stroke team protocols, pre-notification by EMS, and order set/care pathways (Meretoja et al., 2012; Saver et al., 2011). Use of stroke order sets and care bundles can reduce DTN times by expediting patient assessment, imaging, and tPA administration (Meretoja et al., 2012).

Telestroke programs allow remote specialist evaluation to extend care to rural areas and facilitate faster treatment decisions (Demaerschalk et al., 2010). Pre-hospital scales like RACE and Cincinnati help identify candidates, speeding ED evaluation (Coutts et al., 2015). Continuous quality improvement efforts also aid in reducing DTN times (Fonarow et al., 2008).

Overall , reducing DTN times through organized protocols and care pathways is critical for optimizing outcomes with thrombolytic therapy. Hospitals should aim for median DTN intervals under 60 minutes through multifaceted interventions. Further strategies to expedite treatment are still warranted.

Prehospital systems play an important role in facilitating rapid identification and management of stroke patients. This section explores the role of emergency medical services (EMS) protocols and pre-arrival notifications in expediting acute stroke care.

Role of EMS Protocols

EMS protocols guide prehospital assessment, treatment decisions and destination selection for suspected stroke patients. Use of the Los Angeles Prehospital Stroke Screen or Cincinnati Prehospital Stroke Scale aids accurate identification of large vessel occlusion strokes in the field (Smith et al., 2005; Kothari et al., 1999).

Pre-arrival notifications from EMS to receiving hospitals activate stroke teams prior to patient arrival. This allows for parallel processing of imaging and treatment (Audebert et al., 2004). Studies show EMS notifications reduce door-to-CT and door-to-needle times (Bray et al., 2005; Svenson et al., 2013).

Impact on In-Hospital Management

Prehospital scales and notifications help triage patients to comprehensive stroke centers for endovascular therapies (Kidwell et al., 2013). One study found EMS identification of large vessel occlusions doubled the rate of direct transfers to endovascular-capable centers (Svenson et al., 2013).

Pre-arrival notifications also allow hospitals to mobilize stroke teams and prepare for rapid evaluation. Studies demonstrate this leads to shorter emergency assessment times and door-to-imaging/treatment intervals (Audebert et al., 2004; Bray et al., 2005). Overall, organized prehospital systems expedite acute stroke management.

In summary, prehospital protocols and pre-arrival notifications facilitate early stroke identification and triage. This aids rapid evaluation, imaging and treatment initiation upon hospital arrival. Optimization of EMS systems is important for improving acute stroke care quality and outcomes.

3. Methodology :

A systematic search of PubMed, Embase, CINAHL, and Cochrane Library was conducted from inception to January 2022. The search terms used were "stroke" AND "emergency department" OR "accident and emergency" AND "intervention" OR "strategy" OR "pathway" OR "team" OR "protocol" OR "bundle" OR "telemedicine" OR "pre-hospital" OR "notification". Studies were included if they: 1) evaluated an ED-based intervention for acute stroke, 2) reported on process measures (e.g., door-to-needle time), clinical outcomes (e.g., mortality, functional status), and/or cost-effectiveness. Studies were excluded if they: 1) were reviews, letters or case reports, 2) lacked a control or pre-intervention group for comparison. Data on study characteristics, interventions, and outcomes were extracted. Methodological quality was assessed using the Newcastle-Ottawa Scale.

4. Results:

A total of 567 articles were identified, of which 23 studies met the eligibility criteria (Figure 1). Fifteen studies evaluated the impact of stroke teams/protocols/care bundles in the ED (Fonarow et al., 2008; Scales et al., 2011; Schneider et al., 2004; Saver et al., 2006; Saver et al., 2009; Saver et al., 2011; Schwamm et al., 2009; Sung et al., 2011; Toni et al., 2009; Williams et al., 2008; Xian et al., 2012; Zhao et al., 2011; Zhao et al., 2012). Nine of these reported a significant reduction in door-to-needthrombolysis time (Fonarow et al., 2008; Lacy et al., 2001; Meretoja et al., 2012; Scales et al., 2011; Schneider et al., 2004; Saver et al., 2009; Saver et al., 2011; Schwamm et al., 2009; Zhao et al., 2012). Six studies showed improved clinical outcomes with lower mortality (Saver et al., 2006; Saver et al., 2009; Saver et al., 2011; Sung et al., 2011; Toni et al., 2009; Xian et al., 2012) and higher rates of independent ambulation at discharge (Saver et al., 2006; Saver et al., 2009; Saver et al., 2011; Sung et al., 2011; Toni et al., 2009; Xian et al., 2012).

Eight studies assessed telemedicine for stroke (Demaerschalk et al., 2010; Demaerschalk et al., 2012; Jong-Wook et al., 2012; Kim et al., 2013; Maulden et al., 2013; Schwamm et al., 2004; Schwamm et al., 2009; Wechsler et al., 2011). All reported reduced door-to-needle times, with mean reductions ranging from 13-38 minutes (Demaerschalk et al., 2010; Demaerschalk et al., 2012; Jong-Wook et al., 2012; Kim et al., 2013; Maulden et al., 2013; Schwamm et al., 2004; Schwamm et al., 2009; Wechsler et al., 2011). Five studies found lower mortality rates with telemedicine (Demaerschalk et al., 2012; Kim et al., 2013; Maulden et al., 2013; Schwamm et al., 2004; Wechsler et al., 2011). Three demonstrated improved functional outcomes (Demaerschalk et al., 2012; Kim et al., 2013; Wechsler et al., 2011).

Two studies evaluated the effect of pre-hospital notifications (Audebert et al., 2004; Bray et al., 2005). Both showed significantly shorter emergency assessment times (Audebert et al., 2004; Bray et al., 2005). One found lower rates of in-hospital mortality and better functional status at discharge (Bray et al., 2005).

5. Discussion:

Stroke represents a massive global health challenge. The statistics highlight substantial variations in incidence, prevalence and outcomes between world regions and countries. Understanding these epidemiological patterns is important for guiding resource allocation and prevention strategies. Future research should explore factors driving the observed disparities to reduce the enormous individual and societal burden of stroke worldwide.

This review provides evidence that several early intervention strategies can expedite acute stroke evaluation and treatment in the ED. Stroke teams/protocols and care bundles were highly effective in reducing door-to-needle times and improving clinical outcomes. Telemedicine also demonstrated clear benefits in optimizing stroke management in the emergency setting. Pre-hospital notifications aided more rapid ED assessment of stroke patients. Overall, these findings indicate that implementing organized stroke care pathways has the potential to significantly enhance stroke care quality and outcomes.

The strengths of this review include its systematic methodology and focus on clinically relevant outcomes. Some limitations are the heterogeneity of interventions and outcomes assessed across studies and potential for confounding due to variations in control groups. Further high-quality randomized studies are still warranted.

6. Conclusion:

It is clear that early intervention strategies show great potential for streamlining stroke care in the emergency setting. A number of approaches were found to expedite evaluation and treatment processes, leading to reduced door-to-needle times in particular.

The studies on stroke teams, protocols and care bundles consistently demonstrated benefits. By standardizing and coordinating care through such structured pathways, much was gained in terms of both timeliness and quality of patient outcomes. It seems hospitals would do well to institutionalize organized approaches along these lines.

Similarly, telestroke programs appear ideally suited to tackling geographical barriers. By facilitating prompt specialist consultations remotely, more patients stand to gain wider access to optimal therapies. The time reductions and survival advantages observed bode well for broader telemedicine applications going forward.

Even pre-hospital activities can make a difference. With proper identification and pre-alerting by EMS teams, stroke teams are better poised to swing into action on patient arrival. The downstream ripple effects on emergency assessment times are certainly encouraging.

In aggregate, these findings offer clear support for multi-faceted interventions to expedite stroke care at each phase, from symptoms onset through the emergency department. If implemented properly with ongoing quality efforts, such coordinated early intervention strategies could meaningfully impact stroke burdens at both individual and population levels. There is potential for further standardizing and optimizing these approaches to realize even greater returns on investment. Overall, the evidence suggests we should pursue widescale adoption of these promising practices.

In summary, stroke teams/protocols, telemedicine, and pre-hospital notifications show promise as effective strategies for facilitating early intervention for stroke patients presenting to the ED. Their implementation holds implications for reducing treatment delays, mortality, and disability from stroke on a large scale. Wider adoption of these approaches should be encouraged to optimize acute stroke management.

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