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Abstract:
With the large number of clinical practice guidelines available, there is an increasing need for a comprehensive unified model for acute ischemic stroke treatment to assist in clinical decision making. We present a unified treatment model derived through review of existing clinical practice guidelines, meta-analyses, and clinical trials. Using logic from the treatment model, a Bayesian belief network was defined and fitted to data from our institution's observational quality improvement database for acute stroke patients. The resulting network validates known relationships between variables, treatment decisions and outcomes, and enables the exploration of new correlative relationships not defined in current guidelines. © 2013 IMIA and IOS Press.

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Unifying Acute Stroke Treatment Guidelines for a Bayesian Belief Network

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Abstract and Objective

With the large number of clinical practice guidelines available, there is an increasing need for a comprehensive unified model for acute ischemic stroke treatment to assist in clinical decision making. We present a unified treatment model derived through review of existing clinical practice guidelines, meta-analyses, and clinical trials. Using logic from the treatment model, a Bayesian belief network was defined and fitted to data from our institution's observational quality improvement database for acute stroke patients. The resulting network validates known relationships between variables, treatment decisions and outcomes, and enables the exploration of new correlative relationships not defined in current guidelines.

Keywords

Acute Ischemic Stroke Treatment, Bayesian Belief Network

Introduction

Improved acute stroke survival rates are attributed to thrombolytic agents and a variety of continually evolving endovascular treatment options [1]. Presently, there is no universally accepted model for acute ischemic stroke diagnosis and therapy. Due to circumstantial variability, it is important to study the conditions and decisions that result in successful outcomes so that treatments can be modified to each patient's unique case. . We present a unified acute stroke treatment model and an ensuing Bayesian belief network (BBN) to study the relations between a stroke patient's symptoms, therapy, and outcomes [2].

Methods

A review of thirteen existing clinical practice guidelines, meta-analyses, and clinical trials of acute stroke care was performed to extract the set of relevant variables and treatments (e.g., blood pressure, symptom onset, IV-tPA, etc.) and decisions (e.g, do not administer tPA if hemorrhage is present) for inclusion in the unified treatment model. Identical variables from different sources were consolidated into a single variable, and those with different ranges were averaged to create a single value. All variables and treatments were mapped to National Institute of Neurological Disorders and Stroke (NINDS) common data elements (CDEs) to facilitate data collection and sharing. Based on a review of available data points in our institution's acute stroke quality improvement case database, a subset of 14 variables was selected to instantiate a BBN. 790 unique cases of acute ischemic stroke were extracted from the last five years (2006-2012).

Results

The unified treatment model consists of 56 different variables and three decisions, taking into account diagnostic, treatment, and outcomes variables from expert sources. We found that despite their prevalence, few guidelines indicated the use of mechanical thrombectomy devices. Recent clinical trial literature was more helpful in this regard, but supporting evidence remains unclear. Reasons for this include challenges in defining appropriate cohorts for interventional clinical trial studies, and impediments to subject recruitment due to the large number of concurrent stroke clinical trials [3]. The BBN was used to predict several outcome measures including, modified arterial occlusive lesion (an imaging-based assessment of recanalization, F_1=0.92), thrombolysis in cerebral infarction (an imaging-based assessment of perfusion, F_1=0.90), and discharge modified Rankin scale (an assessment of disability, F_1=0.53).

Conclusion

The unified stroke treatment model provides a standardized resource for clinicians during practice and a guide for researchers to examine the possible outcomes from different combinations of patient evidence and interventions. The BBN allowed investigators to observe outcomes for a variety of mechanical thrombectomy procedures, while controlling for factors not studied in the clinical trial literature [3]. Preliminary results indicate strong relationships between interventions and direct outcomes (e.g., mechanical recanalization and resulting imaging assessments); however additional variables are needed to predict functional outcomes, a point of future work.

References

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