QUERI

Evidence Brief: Near Infrared Spectroscopy for Detecting Brain Hematoma

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PREFACE

The VA Evidence-based Synthesis Program (ESP) was established in 2007 to provide timely and accurate syntheses of targeted healthcare topics of particular importance to clinicians, managers, and policymakers as they work to improve the health and healthcare of Veterans. QUERI provides funding for four ESP Centers, and each Center has an active University affiliation. Center Directors are recognized leaders in the field of evidence synthesis with close ties to the AHRQ Evidence-based Practice Centers. The ESP is governed by a Steering Committee comprised of participants from VHA Policy, Program, and Operations Offices, VISN leadership, field-based investigators, and others as designated appropriate by QUERI/HSR&D.

The ESP Centers generate evidence syntheses on important clinical practice topics. These reports help:

- Develop clinical policies informed by evidence;
- Implement effective services to improve patient outcomes and to support VA clinical practice guidelines and performance measures; and
- Set the direction for future research to address gaps in clinical knowledge.

The ESP disseminates these reports throughout VA and in the published literature; some evidence syntheses have informed the clinical guidelines of large professional organizations.

The ESP Coordinating Center (ESP CC), located in Portland, Oregon, was created in 2009 to expand the capacity of QUERI/HSR&D and is charged with oversight of national ESP program operations, program development and evaluation, and dissemination efforts. The ESP CC establishes standard operating procedures for the production of evidence synthesis reports; facilitates a national topic nomination, prioritization, and selection process; manages the research portfolio of each Center; facilitates editorial review processes; ensures methodological consistency and quality of products; produces “rapid response evidence briefs” at the request of VHA senior leadership; collaborates with HSR&D Center for Information Dissemination and Education Resources (CIDER) to develop a national dissemination strategy for all ESP products; and interfaces with stakeholders to effectively engage the program.

Comments on this evidence report are welcome and can be sent to Nicole Floyd, ESP CC Program Manager, at Nicole.Floyd@va.gov.

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EXECUTIVE SUMMARY

Background

The ESP Coordinating Center is responding to a request from the Office of Community Engagement's Center for Compassionate Innovation for an evidence brief on use of near infrared spectroscopy (NIRS) to evaluate patients in nursing homes including VA Community Living Centers for the presence of brain hematomas after falls. Findings from this evidence brief will be used to inform Subject Matter Experts' consideration of NIRS' clinical use and research, as well as program prioritization, in the nursing home setting.

Methods

To identify studies, we searched MEDLINE®, Cochrane Database of Systematic reviews, Cochrane Central Register of Controlled Trials, and other sources up to June 2017. We used prespecified criteria for study selection, data abstraction, and rating internal validity and strength of the evidence. See our PROSPERO protocol for our full methods.

Falls are a common cause of injury among elderly populations, particularly those residing in nursing homes. Most falls in nursing homes occur at the ground level and are low impact. Injuries resulting from these types of falls are variable and range from serious orthopedic and head injury requiring transport to an emergency department (ED) or trauma center to mild injury that can be managed with closer short-term monitoring by nursing staff.[1] The American Medical Directors Association (AMDA) Clinical Practice Guideline recommends that facilities have written policies to guide fall management including initial patient evaluation, monitoring for signs of delayed injuries, determination of the circumstances of the fall, and mitigation of risk factors for future falls.[2]

Initial patient evaluation after falls involves conducting a physical exam to evaluate the extent of injuries, including impaired consciousness as measured by the Glasgow Coma Scale (GCS), and considering baseline risk factors for intracranial hemorrhage, a potential complication of head injury. Identifying patients with moderate-severe injuries in need of transport and head imaging is usually straightforward. However, determining which patients with mild injuries need further evaluation can be more challenging as many elderly patients have pre-existing dementia or other cognitive disorders that impair the physical exam and GCS assessment, as well as higher baseline risk for intracranial hemorrhage due to use of anticoagulants. A further challenge in evaluating patients with possible head injury after falls is that a subset of patients who initially have a normal exam will develop delayed intracranial hemorrhage and could worsen quickly. For these reasons, guidelines on management of mild head injury including those by the American College of Emergency Physicians/Centers for Disease Control and Prevention commonly recommend head computed tomography (CT) for all patients ≥ 65 years old, even with a normal GCS.[3]

Despite these guidelines, excessive use of CT and implications for patient safety remains a concern due to radiation exposure.[4] While the exact rate of normal CT scan findings in nursing home patients presenting after falls is unknown, most patients evaluated for head injury in the ED have normal CTs. A retrospective study using data from the National Hospital Ambulatory Medical Care Survey in the US found that 91% of the approximately 3.9 million head CTs obtained in ED patients to evaluate for head injury in 2009-2010 did not reveal a traumatic intracranial abnormality.[5]

Near infrared spectroscopy (NIRS) is a diagnostic tool that could be used to evaluate patients after falls and aid in decision-making to avoid unnecessary CTs. NIRS is an imaging technique that identifies intracranial hematomas by detecting asymmetry in light absorption over the right and left sides of the head. Handheld NIRS devices offer a portable, noninvasive, and quick

means of evaluating patients for the presence of a brain hematoma. Infrascanner© 2000 is the only commercially available NIRS device in the US and is currently being used by clinical staff at the VA Pittsburgh's Community Living Center (CLC) to evaluate patients with mild injuries after falls when the clinical suspicion for head injury is low. The aim of this evidence brief was to evaluate the potential impact of NIRS as a diagnostic test for hematomas in nursing home patients after falls by synthesizing the evidence on the performance characteristics of NIRS for detecting brain hematoma, its impact on clinical decision-making, patient outcomes, potential harms, and cost-effectiveness.

Ideally, NIRS use would reduce unnecessary CTs and ED visits among nursing home patients who have mild injuries. This potential benefit must be weighed against the potential harm of a negative NIRS scan in a patient who truly has a brain hematoma in need of further intervention. In general, NIRS is not well-suited to identify bilateral hematomas, small hematomas, and deeply located hematomas with a greater distance from the scalp. Some hematomas that would not be detected by NIRS, but would be identified by CT, are unlikely to cause symptoms or a further change in patient's function. Other small hematomas could expand over time, causing symptoms and functional decline, and these hematomas would be important not to miss. In addition to the potential for missing a clinically important hematoma, there could be other unintended consequences of NIRS use. For example, fewer ED transfers could place additional strain on nursing home staff due to the need to monitor patients more frequently. Fewer ED transfers could also represent missed opportunities to identify reasons for patient falls if they do not undergo more extensive testing. The ideal study of NIRS would aim to capture not only the false positive rate, but these other potential harms.

Unfortunately, studies of NIRS to date have almost exclusively focused on demonstrating the technical feasibility of the device and its diagnostic accuracy in series of patients who are referred for a CT scan. These studies therefore provide little insight on how use of NIRS impacts clinical decision-making, patient outcomes, and healthcare utilization. Moreover, it is unknown how NIRS performs in older nursing home patients with mild injury after falls because this type of use has not been studied. Only one study of Infranscanner© 2000 has been conducted in patients with mostly mild injuries, and in that observational study of 85 patients presenting to a neurosurgical center with predominantly mild head injury (85% with GCS 12-15), Infrascanner© 2000 failed to identify 2 hematomas among 43 patients with hematomas on CT.[6] Patients had a mean age of 48, high prevalence of hematomas (53%), and unreported baseline risk factors. The findings of this study are not necessarily predictive of how NIRS would perform in nursing homes with a different makeup of patients and overall lower prevalence of hematomas.

Given concerns about overuse of CT and the potential benefits of NIRS as a diagnostic tool in nursing home patients with mild injuries after falls, it would be reasonable to consider implementation of a NIRS protocol in a pilot study among VA CLCs. A pilot could provide reliable estimates of CTs and ED transfers averted. However, because positive CT scans are rare in this situation, a much larger study (or decision modeling) would be needed to assess the frequency and clinical consequences of false negative NIRS scans.