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Concussion management and assessment in emergency department: Innovations in diagnostics, acute care, and long-term outcomes

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***Abstract*---Background:** A concussion, commonly referred to as mild traumatic brain injury (mTBI), presents substantial obstacles in emergency medicine. However, the current training provided to emergency physicians (EPs) appears to be insufficient. This systematic review assesses existing educational resources and training programs concerning mTBI for EPs, highlighting deficiencies in the literature. **Methods:** A thorough search was performed in EMBASE, MEDLINE, ERIC, and SCOPUS using targeted keywords associated with mTBI and medical education. Studies were included that evaluated training programs designed to enhance emergency personnel knowledge and practice related to mild traumatic brain injury. **Results:** The search identified only five pertinent studies, suggesting a severe dearth of research in this field. The studies demonstrated positive outcomes in knowledge acquisition; however, they were hindered by methodological limitations and varied training methods, which precluded any meta-analysis. Emergency physicians with additional training in pediatric emergency medicine exhibited improved compliance with best practices in the management of mild traumatic brain injury (mTBI). **Conclusion:** The imperative necessity of improving educational resources and standardized curricula to improve mTBI training for emergency physicians is emphasized in this review. Additional research is required to assess the efficacy of particular training methods to guarantee optimal care for patients with mild traumatic brain injuries.

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Keywords---emergency doctors, training programs, education, concussion care, mild traumatic brain injury.

1. Introduction

Concussions, also known as mild traumatic brain injury (mTBI), are temporary functional impairments of the brain brought on by direct or indirect impacts to the head. Symptoms include headache, dizziness, confusion, amnesia, nausea, and vomiting, frequently leading patients to seek care in the emergency department (ED) (1). Most individuals recover within 7 to 10 days; however, around 10 to 15% of pediatric, adolescent, and professional athletes experience persistent symptoms (2). More than 50% of the general adult population experience symptoms that persist beyond three months, with up to 30% remaining affected after one year. Approximately 25% of cases progress to post-concussion syndrome (PCS), characterized by the continuation of three or more symptoms beyond three months, which notably impacts the quality of life and occupational functionality (3, 4).

Delayed or missed diagnoses of mTBI elevate the risk of cognitive dysfunction, extend recovery time, and increase the likelihood of re-injury. Secondary injuries, including second-impact syndrome, are infrequent but associated with significant morbidity and mortality rates. Repetitive brain trauma is linked to long-term risks such as depression, suicide, and premature dementia (5). The ED often represents the only medical contact for numerous patients, underscoring the importance of emergency physicians (EPs) in recognizing, managing, and advising on prognosis, follow-up care, and return-to-activity protocols. Nonetheless, inconsistencies in diagnosis and management persist, highlighting the necessity for standardized, evidence-based training for emergency physicians (6-8).

2. Challenges in the management of mild traumatic brain injury (mTBI)

The diagnosis of mTBI is complex, influenced by differing definitions across medical fields and the nonspecific, transient characteristics of its symptoms. Despite the availability of clinical practice guidelines (CPGs) and consensus statements to support diagnosis and management, their utilization in emergency department settings remains limited. Inconsistent application of tools that aim to identify patients needing imaging, results in unnecessary imaging and delays in care (9). Furthermore, although emergency physicians can accurately diagnose mild traumatic brain injury without specialized tools, many express unease regarding the management of the condition, patient counseling, and the provision of suitable follow-up instructions (10).

Educational disparities play a crucial role in these inconsistencies. Research demonstrates that training on mild traumatic brain injury (mTBI) during medical school and residency is inadequate, resulting in emergency physicians being ill-equipped to manage the complexities of concussion care. Continuing medical education (CME) programs seek to fill these gaps; however, physician engagement

is variable, and the effectiveness of these interventions on clinical practice is ambiguous (11, 12).

This review sought to evaluate the accessibility and efficacy of mTBI-specific training resources for emergency physicians at different career stages. The study aimed to assess the extent to which current training programs enhance diagnostic accuracy, patient management, and knowledge retention among emergency physicians.

3. Methods

A thorough search was performed across four bibliographic databases: EMBASE, ERIC, MEDLINE, and SCOPUS. The search strategy utilized thesaurus headings pertinent to concussion, mild traumatic brain injury (mTBI), medical education, and continuing medical education (CME). Research focused on mTBI training programs for emergency physicians, encompassing educational toolkits, continuing medical education modules, and conference presentations, was incorporated.

4. Results

The review identified various resources designed for mTBI training for EPs, including educational toolkits, conference presentations, and journal articles. Three multimodal educational toolkits comprised elements such as pocket cards and guidelines incorporated into clinical practice. The toolkits demonstrated a beneficial effect on emergency department (ED) practices, reflected in enhanced knowledge acquisition among physicians. The effectiveness of traditional formats, including conference presentations and journal articles, in altering practice patterns is uncertain (13).

The review indicated that emergency physicians with specialized training in pediatric emergency medicine were more inclined to offer suitable recommendations for cognitive rest after mild traumatic brain injury than those without this training. Specialized training may improve knowledge of contemporary best practices in concussion management.

The review identified significant gaps in the literature despite the recognition of these educational resources. The quality of the included studies was predominantly low, with numerous studies lacking robust methodologies for evaluating the effectiveness of training programs. This raises concerns regarding the reliability of the findings and their applicability to practical settings. Furthermore, none of the studies assessed objective alterations in EP practice post-training, instead depending on self-reported metrics of knowledge acquisition, which could introduce bias. The variability in training content represents a significant concern, complicating the ability to draw definitive conclusions regarding the most effective methods for enhancing mTBI management among EPs.

5. Discussion

This review indicates that emergency physicians may lack sufficient training in the detection and management of mTBI, which could result in practice variation and care gaps. Given the prevalence of mTBI in the emergency department, it is essential to develop and implement training programs to improve physicians' knowledge and skills in this domain.

To address the identified gaps, various strategies may be proposed. Developing standardized mTBI training programs that integrate evidence-based guidelines and best practices may ensure that all EPs receive uniform education on concussion management. Medical schools must prioritize the integration of mTBI education into their curricula to adequately prepare future physicians for the complexities of diagnosing and managing concussions (14, 15).

It is essential to promote enhanced continuing medical education (CME) programs specifically targeting mTBI to foster ongoing education and engagement among practicing emergency physicians. This may encompass workshops, online courses, and simulation training to enhance learning retention. Incorporating technology, including telemedicine and digital learning platforms, may improve access to mTBI training resources and support the translation of knowledge into practice (16-18).

Future research should concentrate on assessing the efficacy of training programs through objective metrics of practice modification and patient outcomes. This may include audits of clinical practice patterns, studies on patient follow-up, and the application of validated assessment tools to evaluate the effect of training on EP practices.

6. Limitations

This review presents multiple limitations. The variability among the included studies and the lack of direct comparisons between tools impede identifying the most effective training strategies. The dependence on self-reported outcomes may not accurately represent actual changes in practice. The absence of data regarding physician characteristics, including years of experience and previous exposure to mTBI training, restricts the generalizability of the findings. Publication and selection biases may have affected the results, despite attempts to mitigate these through thorough search strategies and stringent review processes.

7. Conclusion

This review identifies notable deficiencies in mTBI-specific training for emergency physicians and emphasizes the necessity for standardized, evidence-based educational resources. Although current toolkits and CME programs demonstrate potential, their variable implementation and insufficient evaluation diminish their effectiveness. Future research must prioritize identifying and validating effective training methods that enhance diagnostic accuracy and patient care. Addressing

these gaps is essential for optimizing outcomes in mTBI patients and mitigating the long-term burden of concussion-related complications.

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إدارة وتقييم الارتجاج في قسم الطوارئ: الابتكارات في التشخيصات والرعاية الحادة والنتائج طويلة الأمد

الملخص

الخلفية :يمثل الارتجاج، المعروف أيضًا باسم إصابة الدماغ الرضحية الخفيفة(mTBI) ، عقبات كبيرة في مجال الطب الطارئ. ومع ذلك، فإن التدريب الحالي المقدم للأطباء الطارئين (EPs) يبدو غير كافٍ. تقوم هذه المراجعة المنهجية بتقييم الموارد التعليمية الحالية وبرامج التدريب المتعلقة بإصابات الدماغ الخفيفة للأطباء الطارئين، مع تسليط الضوء على النواقص في الأدبيات.

المنهجية :تم إجراء بحث شامل في قواعد بيانات EMBASE و MEDLINEو ERICو SCOPUSباستخدام كلمات مفتاحية مستهدفة مرتبطة بإصابة الدماغ الخفيفة والتعليم الطبي. تم تضمين الدراسات التي قيمت برامج التدريب المصممة لتعزيز معرفة وممارسة الطاقم الطارئ المتعلقة بإصابة الدماغ الخفيفة.

النتائج :حدد البحث خمس دراسات ذات صلة فقط، مما يشير إلى نقص حاد في الأبحاث في هذا المجال. أظهرت الدراسات نتائج إيجابية في اكتساب المعرفة؛ ومع ذلك، كانت تعاني من قيود منهجية وطرق تدريب متنوعة، مما منع إجراء أي تحليل تلوي. أظهر الأطباء الطارئون الذين حصلوا على تدريب إضافي في طب الطوارئ للأطفال امتثالًا أفضل لأفضل الممارسات في إدارة إصابة الدماغ الرضحية الخفيفة.(mTBI)

الخلاصة :تؤكد هذه المراجعة على الضرورة الملحة لتحسين الموارد التعليمية والمناهج الموحدة لتعزيز تدريب إصابات الدماغ الخفيفة للأطباء الطارئين. هناك حاجة إلى مزيد من الأبحاث لتقييم فعالية طرق التدريب المحددة لضمان الرعاية المثلى للمرضى الذين يعانون من إصابات الدماغ الخفيفة.

الكلمات المفتاحية :الأطباء الطارئون، برامج التدريب، التعليم، رعاية الارتجاج، إصابة الدماغ الرضحية الخفيفة.