Neuropsychological Assessment of Concussion

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Abstract

Neuropsychological testing has become recognized as a critical component in managing concussions because of the method's strengths over other testing techniques. Neuropsychological testing is sensitive to changes that occur as a result of sport-related concussions, whereas neuroimaging techniques often fail to show abnormalities following these injuries. Furthermore, neuropsychological testing also decreases reliance on subjective self-reporting, which is often prone to bias leading to the underreporting and underrepresentation of concussion prevalence. Computerized neuropsychological testing has become increasingly prominent with recent technological advances. Computerized testing is less costly, less time consuming, may be more sensitive to mild concussion sequelae than traditional tests, and offers a number of practical advantages (e.g., ease and standardization of administration). Neuropsychological testing can be completed using a number of methods, primarily with testing following subjective resolution of concussion symptomatology or testing at fixed time points. Comprehensive neuropsychological batteries utilizing multiple measures allow examiners to assess for a wide range of neuropsychological deficits that may be present (e.g., attention, concentration, cognitive processing, learning and memory, working memory, executive functioning, and verbal fluency deficits). Neuropsychology's relevance and significance to the medical management of sport concussion will be discussed.

INTRODUCTION

Neuropsychological Assessment of Concussion

With the growing interest and resources that have been directed at sport related concussion, a primary concern by clinicians, coaches, athletic trainers, and others associated with sports has been identifying optimal ways to determine the presence and severity of concussive injury. To this extent, neuropsychological testing has become recognized as a critical component in managing concussions [1-3]. A primary reason these tests have become so important to concussion management is because they are sensitive to changes that occur as a result of sport-related concussions, whereas neuroimaging techniques (e.g., computer tomography [CT scan], magnetic resonance imaging [MRI], x-ray) often fail to show abnormalities following these injuries [1-2,4]. Although it should be noted that some neuroimaging techniques can detect these changes—particularly in more severe injuries (e.g., functional magnetic resonance imaging [FMRI])—these methods are often impractical in sport contexts due to cost and availability issues, and are rarely utilized in the assessment of common sport concussions [1].

Another reason that neuropsychological tests have gained favor in concussion management is their alleviation of a major difficulty in determining the presence of a concussion—reliance on subjective self-reporting [3]. An athlete's self-report of concussive symptoms is often based on various factors, such as the rapport between the athlete and examiner, as well as their desire to return to sport participation [5,6]. These factors are often influenced by the athletes perceived need to resume participation for reasons such as pressure from coaches/teammates, job security, incentives, internal motivations, etc., [5] as athletes are “often known minimize the severity of their symptoms to remain on the active roster” [7(p297)]. This self-report bias serves as one of the primary reasons that concussion prevalence is often underreported and underrepresented [8].

As neuropsychological testing becomes more prominent in sports assessment and concussion management, computerized testing has gained particular favor as technological advances have occurred in recent years. Traditional neuropsychological testing (i.e. paper and pencil tests) is limited because its administration and interpretation require trained personnel,
such as neuropsychologists, and because it is time consuming and costly to administer to large groups, or entire teams of
athletes [9]. Furthermore, it has been suggested that computerized neuropsychological tests may be more sensitive to mild concussion sequelae than traditional tests, while offering better detection of performance variability [10]. Additionally, computerized tests offer a variety of practical advantages such as ease and standardization of administration, increased sensitivity in measurement, the ability to assess large numbers of athletes in short periods (approximately 20 minutes), computerized analysis that can identify subtle changes, the availability of multiple forms to reduce practice effects, and the ease of yielding rapid results [4,10].

As the use of neuropsychological testing has grown, two primary methods of testing have emerged with straightforward rationales [3,4]. The first method uses testing following the subjective resolution of concussion symptomatology, since it is well agreed that athletes should not resume sport participation while symptomatic. With this method, an athlete’s neuropsychological performance following a concussion can be compared to his or her own baseline performance, or norm groups. This allows for the detection of injury markers via cognitive deficits that may exist beyond the resolution of subjective symptoms. The second method involves testing at fixed time points (e.g., day 1, day 3, day 7), and is useful to track post-injury recovery. This method is especially useful in the absence of baseline performance, as it can help determine when a stable level of neuropsychological performance has been achieved, and presumably reached a baseline level [4,7].

Although many domains of cognitive functioning may be affected and assessed following sport-concussion, there is no single “best” test to use when evaluating sport concussion. Therefore, using multiple measures gives the benefit of assessing for a wide range of neuropsychological deficits that may be present [4,8]. Comprehensive batteries often include measures of attention and concentration, cognitive processing, learning and memory, working memory, executive functioning, and verbal fluency [4]. Technological advances have led to the development of various computerized neuropsychological tests, each having its own strengths and emphasis [3,10]. Grindel and colleagues [8] suggest that as technological advances progress, not only will computerized assessment continue becoming more effective in evaluating concussion, but will also offer functional tests of an athlete in game/event-like situations as a further evaluation of performance and readiness to return [8].

Concussion-based injury is relevant to a variety of sports, and continues to draw attention from both clinical researchers as well as popular press. Likewise, these injuries remain a major source of concern for all involved. Neuropsychology has thus far offered significant value to the medical management of sport concussion, by providing information that is relevant to the diagnosis of concussive injury, understanding the extent of the concussive injury, as well as assessing recovery [11]. Neuropsychology assessment has been considered a cornerstone of concussion management [2]. Given the unique niche and valuable role that clinical neuropsychology plays managing sports concussion, it should continue to be researched, incorporated, and evaluated for new potential as the on-going necessity for improved medical management in this critical area continues [2,11].

REFERENCES