Evidence in Action

A 17-Year-Old With Headache

By Michael Tunning, DC

Patient Presentation

A 17-year-old male high school football player enters your office complaining of headaches. He informs you that he took a direct hit to the head during yesterday's practice and has had a headache ever since. You recommend he sit out school and practice until the headache resolves. After two days of monitoring by the ATC, DC, and MD, coupled with activity modifications, he tells you that he no longer has a headache. He would like to return to practice so he can get back on the field and play in next week's game.

Is he ready to do so? Does elimination of symptoms equal readiness to resume athletic participation? Can I be confident that he is ready to return to practice because the primary symptom of headache is gone?

Examining the Evidence

The effects of return to competition too soon can have the devastating effect of second-impact syndrome.[1,2] Guidelines have been developed that promote return to play in a stepwise process, ensuring a safe return without increased risk of further injury.[3] These guidelines recommend beginning when the patient is asymptomatic. Is that enough, or should we be doing more to determine readiness?

Neurocognitive testing tools, such as ImPACT, are performed at baseline in a non-concussed, healthy state and before the season to assess the cognitive domains most commonly affected by concussion. These include memory, attention, speed of mental processing, and reaction time. If an athlete suffers concussion, evaluations are conducted post-injury to determine the point at which clinical symptoms are no longer present. However, Lau[4] finds that including neurocognitive testing before beginning the return-to-play program can improve the sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) for the diagnostic evaluation of concussion.

Understanding Predictive Values

Predictive values can help a clinician better predict how likely it is that a condition is present. This information then allows the clinician to offer better recommendations and educate his or her patient to make a more informed decision about additional testing or about initiating treatment.

In this case, taking into account the resolution of symptoms only, should we educate patients about the increased likelihood of a recuperation period (this would be the PPV), or can we point to the likelihood that they fit into the quick-recovery category (NPV) and recommend with confidence they are ready to begin the return-to-play process?

We find the paper "Sensitivity and specificity of subacute neurocognitive testing and symptom evaluation in predicting outcomes after sports-related concussion."[4] In it, the author provides a statistical analysis that can help us make this decision. By constructing a simple 2x2 contingency table, we can locate true positive and true negative, and from that easily determine sensitivity, specificity, and predictive values.

Looking at symptoms alone as a determinant for short or long recovery, the 2x2 table would appear as:

Symptom Cluster Alone***

	>14 day recovery	less than or = 14 day recovery	
Symptoms +	*(true positive)* 23	14	37
Symptoms -	27	*(true negative)* 44	71
	50	58	

The 2x2 table helps put all numbers into place and allows us to see how the authors came to their conclusion. Twenty-three athletes reported positive symptoms and took longer to recover. This would be the true positive group in this scenario, and they were correctly identified through symptoms as a group that would take more than 14 days to recover. Forty-four would be the true negative, meaning that those 44 had no symptoms and had a quicker recovery.

Sensitivity and specificity also apply here. Sensitivity, the percent positive with the disease or condition, is used to help the clinician rule out a disorder. If the sensitivity is high in a diagnostic test, the clinician can be confident that the disease or condition is not present when the test is negative. In this example, the true positive number of 23 would be divided by the total number of long-recovery athletes, 50 (Sn=.46 or 46%).

Specificity, the percent negative in health, is used to help the clinician rule in a disorder. If specificity is high in a diagnostic test and that test is positive, the clinician can be positive the disorder is present. In this example, the true negative, 44 athletes, is divided by the complete number of early-recovery athletes, 58 (Sp=.75 or 75%). To report the predictive values, we calculate through the clinician's perspective. The clinician's only information while with the patient is if the patient has symptoms or does not have symptoms.

The clinician does not have the luxury of seeing 14 days into the future. Predictive values allow the clinician to better predict patient outcomes utilizing test results instead of the presence of the disorder for calculations. It becomes a better tool to use when facing a decision on further testing or patient management. In this case, the positive predictive value will take the true positive, 23, and divide it by all the symptom (+) athletes, 37 (PPV=.62 or 62%). The negative predictive value will then take the true negative tests, 44, and divide that number by all the symptom (-) athletes 71 (NPV=.61 or 61%).

Symptom Cluster and Neurocognitive Testing***

	>14 day recovery	less than or = 14 day recovery	
Symptoms and NCT +	33	12	45
Symptoms and NCT -	17	46	63
	50	58	

Sensitivity for combining symptoms and neurocognitive testing (NCT) would be calculated as 33/50. In this instance, sensitivity would equal .66, or 66%. Specificity would be 46/58. In this instance specificity would equal .79, or 79%. To achieve the positive predictive value, we would use 33/45. In this instance, the PPV would equal .73, or 73%. The negative predictive rule would then be 46/63. In this instance, the NPV would equal .73, or 73%. When combining patient self-reported symptoms with neurocognitive testing results, it can be seen that predictive values (PPV 62%/NPV 61%) improve to 73% for both the NPV and the PPV.

Using the 2x2 table to find predictive values empowers the patient and the clinician. The patient becomes more educated and more comfortable making decisions about his or her health. The clinician, through understanding the best next steps, can offer recommendations for further testing or management. In this particular case, after making the 2x2 table, we see greater than 10% improvement in the predictive values for concussion.

With the 17-year-old athlete, and using this evidence, what would your recommendation be? In this scenario, the patient has resolution of symptoms. When the clinician combines these results with the results of a neurocognitive test, the clinician will better predict the short- or long-term recovery that may be expected. So the question is yours to interpret: Do you take into account the devastating effect second-impact syndrome can have and look to gain more information through neurocognitive testing, or are you comfortable that this athlete is ready for the return-to-play process? As this study reports, clinicians can improve the predictive values when including neurocognitive testing. It is important to note that relying on one source of

information, in this case just the patient's self-reported symptoms, will result in less predictive value for the clinician. If available, neurocognitive testing is a useful tool for the clinician to include in the complete concussion exam.

****These figures in the boxes are rounded and slightly different from the original article to help aid in easier calculation and understanding. The original numbers were not round numbers due to some dropout that occurred.*

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References

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