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Diagnostic accuracy of premanipulative vertebrobasilar insufficiency tests: A systematic review

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ABSTRACT

Study Design

A systematic review of diagnostic accuracy studies.

Objective

To evaluate the diagnostic accuracy of the premanipulative vertebrobasilar insufficiency (VBI) tests.

Summary Of Background Data

The aim of premanipulative vertebrobasilar testing is to evaluate the adequacy of blood supply to the brain, by compressing the vertebral artery and examining for the onset of signs and symptoms of cerebrovascular ischemia. Although clinicians consider pre-manipulative testing important before applying spinal manipulations, the diagnostic accuracy has not been systematically reviewed.

Methods

A search was made in PUBMED, CINAHL and EMBASE databases from their date of inception until 2nd May 2012. Studies were included if they compared a VBI test with a reference test, and sensitivity and specificity were reported or could be calculated. The methodological quality of the studies was evaluated using QUADAS. Agreement between reviewers was calculated and expressed as a percentage and quantified by kappa statistics.

Results

Of the 1677 potential citations only 4 studies were included, all of questionable quality. Sensitivity was low and ranged from 0 to 57%, specificity from 67 to 100%, positive predictive value from 0% to 100%, and

negative predictive value from 26 to 96%. The positive likelihood ratio ranged from 0.22 to 83.25 and the negative likelihood ratio from 0.44 to 1.40.

Conclusion

Based on this systematic review of only 4 studies it was not possible to draw firm conclusions about the diagnostic accuracy of premanipulative tests. However, data on diagnostic accuracy indicate that the premanipulative tests do not seem valid in the premanipulative screening procedure. A surplus value for premanipulative tests seems unlikely.

ANALYSIS

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Background Information

Premanipulative vertebrobasilar tests typically involve the compression of the vertebral artery by rotating and/or extending the patient's head and neck while observing for the onset of signs and symptoms of vertebrobasilar insufficiency (VBI). When signs and/or symptoms of ischemia are elicited during the test (positive findings), the adequacy of blood supply to the brain is thought to be compromised which might contraindicate the use of cervical manipulation.

Normally, when one of the vertebral arteries becomes occluded, as in vertebrobasilar testing, the opposite vertebral artery continues to carry blood to the hindbrain by means of collateral circulation, resulting in no positive neurological findings. A positive vertebrobasilar test, where collateral circulation is undersupplied, could, if the test was accurate, be regarded as an indicator of a patient's risk of developing vertebrobasilar complications following cervical manipulation.

Pre-manipulative vertebrobasilar testing is considered important by many clinicians; however, the diagnostic accuracy of the test has not been systematically reviewed and is considered extremely controversial.

The purpose of this systematic review was to evaluate the diagnostic accuracy of premanipulative vertebrobasilar tests in terms of sensitivity, specificity, predictive values and likelihood ratios in adults.

PERTINENT RESULTS

Out of 1677 potential citations, only 4 studies (references 4-7 below) met all of the inclusion criteria and were incorporated into the review. The studies that were included were Coté et al., 1996; Petersen et al., 1996; Li et al., 1999; and Sakaguchi et al., 2003.

There were marked differences between subjects in the included studies, as follows.

- Subjects in the Sakaguchi et al. study were from a series of consecutive patients undergoing neurovascular examination.
- Li et al. included 2 groups of non-selected, asymptomatic subjects.
- The Coté et al. study included a select group with a positive Wallenberg test and another group consisting of healthy controls.
- Petersen et al. included a previously selected group of patients with vertebrobasilar ischemia and a healthy control group.

The vertebrobasilar tests in three of the studies involved cervical extension with rotation, whereas one of the studies used rotation only. The tests' end range positions were held from 10 to 30 seconds.

Reference tests that were used in the studies to monitor blood flow included duplex, color-coded duplex, and transcranial Doppler.

All of the studies were affected by various types of bias, including incorporation bias, spectrum bias, test review bias and clinical review bias. Below are definitions of these types of bias (1, 2).

- Incorporation bias refers to the results of the study test being incorporated as evidence for the final diagnosis.
- Spectrum bias occurs when cases are included that are only within a limited range of a disease spectrum.
- Test review bias occurs in retrospective studies where the study test is performed after the diagnosis has been established.
- Clinical review bias occurs when clinical information, such as age, sex, and symptoms, are made available during the interpretation of test results which may affect the test's performance.

Diagnostic accuracy values for the included studies are as follows:

- Sensitivity ranged from 0 to 57%, which is considered insufficient.
- Specificity ranged from 67 to 100%, which is considered moderate to good.
- Positive predictive values ranged from 0 to 100% and negative predictive values from 26 to 96%.
- Positive likelihood ratios ranged from 0.22 to 83.25 and negative likelihood ratios ranged from 0.44 to 1.40.

Variability in the data was high concerning positive and negative predictive values, as well as for likelihood ratios, resulting in large confidence intervals and correspondingly imprecise estimates.

CLINICAL APPLICATION & CONCLUSIONS

Sensitivity for the premanipulative tests was low, which means that the rate of false negatives (i.e., people with the condition not being identified by the test) was high. Specificity, on the other hand, was acceptable, meaning that the rate of false-positives (i.e., people who do not have the condition are actually identified as having it) was low. Unfortunately, acceptable specificity is less important than sensitivity in this case because a false-positive test result would not be potentially harmful for a patient.

Most of the subjects in the included studies were not representative of patients typically treated in clinical practice. For instance, patients in the Coté et al. study were preselected via a positive premanipulative test; as well, healthy controls and students that were used in the other studies are, in many ways, dissimilar to patients indicated for manipulation. Thus, the populations were probably not representative for the group of patients that are usually treated in clinical practice.

Diagnostic accuracy may have been overestimated because of the higher prevalence of the condition in the 3 studies that used separate groups of volunteers with and without the condition. Studies that include consecutively recruited patients, as in the Sakaguchi et al. study, alleviate much of this problem.

Even if the literature had shown that premanipulative tests were valid, the tests are only designed to test the adequacy of maintaining hindbrain perfusion in case of injury to one of the vertebral arteries. Whether a pre-existing vertebral artery insufficiency is a risk factor for developing vertebral artery dissection has not been firmly established. Furthermore, whether the risk of developing complications after spinal manipulation can be predicted is unknown. The reasoning behind the use of premanipulative tests, however, is that if a patient's collateral vertebral artery circulation is found to be deficient, that person would be more likely to have a catastrophic outcome if they did experience a dissection post-manipulation.

A number of risk factors for cervical artery dissection have been identified (e.g., connective tissue disorders, migraine, hypertension, infection, hyperhomocysteinemia, etc.); although which specific risk factors predispose patients to arterial dissection following neck manipulation is not known.

The authors concluded that… "The question remains whether the risk of developing complications after spinal manipulation can be predicted, or whether these complications are unpredictable."

Given the paucity of evidence that supports the validity of premanipulative screening, the prudent clinician can best serve his or her patients by being vigilant for signs and symptoms of vertebrobasilar insufficiency, including dizziness, drop attacks, diplopia, dysarthria, dysphagia, ataxia, nausea, numbness and nystagmus. When one or more of these signs/symptoms are present, the patient may need to be referred for a neurological evaluation, sometimes urgently. Symptoms such as mild dizziness and numbness may not require referral, but it may be wise to employ other forms of treatment until the symptoms begin to improve (3).

STUDY METHODS

A literature search of several databases was performed independently by a librarian and one of the reviewers using terms such as vertebral artery, diagnostic parameters, spinal manipulation and movements of the cervical spine. The reference sections of the included papers were also checked for relevant studies that were possibly missed in the electronic databases.

Studies were included if they met both of the following criteria:

1. studies comparing a premanipulative test with a reference test in which sensitivity and specificity were reported or could be calculated using a 2 X 2 table; and.
2. full paper reports.

Studies were excluded if they were:

- abstracts,
- congress reports, or
- animal or cadaver studies.

The titles, abstracts, and (as required) full publications were independently screened by two reviewers. Any possible discrepancies were resolved by a third reviewer.

Included studies were independently scored by two reviewers using the criteria specified in the QUADAS tool. Scoring differences were discussed and, where necessary, solved by a third reviewer.

The diagnostic parameters from the included studies were recalculated, although no statistical pooling was performed because of substantial clinical and methodological heterogeneity. As an alternative, a qualitative descriptive analysis was provided.

Calculated sensitivity, specificity and predictive values were considered sufficient if they were no less than 80%. Likewise, positive likelihood ratios (LR+) of > 10 and negative likelihood ratios (LR-) of < 0.1 were considered to be sufficient.

STUDY STRENGTHS / WEAKNESSES

This was a well-executed review that presented a seemingly balanced perspective on the usefulness of screening tests for the risk of vertebral artery dissection associated with cervical manipulation.

The "condition" that was the object of the vertebrobasilar tests in this study was the presence of diminished blood flow, not vertebral artery dissection and/or stroke. Hence, not only are there questions about whether the tests can accurately predict blood flow abnormalities, but there are even more questions about whether the tests are capable of predicting which patients are more likely to develop a dissection following manipulation.

Most of the included studies were older articles in which the selection criteria and performance of both the index and reference tests were not always reported appropriately. Furthermore, it was largely unclear what information about the subjects was available during the performance of the tests.

Additional References

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