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Are false-positive rates of diagnostic medial branch blocks correct? Introducing the inconsistency rate

A recent article on the validity of diagnostic blocks [1] mentioned that single diagnostic blocks were unacceptable because they had high false-positive rates. Upon reading this article, the senior author of the present article (SK) had difficulties understanding how those false-positive rates were determined, and difficulties in explaining those data to others. He, therefore, contacted the co-author of the present article (NB). During an extensive exchange of emails, several realisations and explanations emerged. Because these realisations might of interest to others, the two authors composed the present communication.

1. Principles

In order test the validity of a diagnostic test, Biostatisticians and Clinical Epidemiologists construct a 2x2 contingency table, in which to record the results of a study that compares the results of the test in question with the results of a criterion standard (Fig. 1). From such a table certain statistic can be calculated. The ratio A/(A + C) constitutes the sensitivity of the test, and D/(B + D) is its specificity. From these values the positive likelihood ratio of the test can be calculated, which is the ratio between the sensitivity of the test and [1 – specificity]. The latter entity amounts to B/(B + D) and constitutes the false-positive rate of the test.

2. The issue

The several studies that reported the false-positive rates of single diagnostic blocks did not use B/(B + D) to calculate their values [2–7]. What they reported were the values of the ratio B/(A + B). This ratio has no formal name, but it is not the false-positive rate.

3. Explanation

In order to determine the sensitivity, specificity, and false-positive rates of a diagnostic test, all cells of a contingency table must be populated, as in Fig. 1. This requires that patients whose test results are negative must nonetheless undergo the criterion standard, just as do the patients whose test results are positive. This did not happen in the studies that reported false-positive rates of single diagnostic blocks [2–7]. Fig. 2 illustrates what happened in those studies.

All subjects underwent a first diagnostic block. N1 patients had a positive response, N2 patients had a negative response.

Those patients who had negative responses were not investigated further. Their negative response was assumed to be true-negative. To test this assumption would have been a logistic burden, and questionably ethical. For example, according to the binomial theorem, it would take a further 7 blocks, for a total of 8 blocks, to show with 95 % confidence that an initial genitive response was false-negative. (The calculation is ${}^{n}C_1/2^n \leq 0.05$).

Only those patients with a positive response underwent testing with a second block, whose results were used as the criterion standard. Of these N1 patients, A patients responded to the second block, and were considered true-positive, while B patients had a negative response, and were considered to have had a false-positive response to their first block. The ratio B/(A + B) was considered to represent the false-positive rate of the first block; and this is what was reported.

This representation, however, was not correct. From the data collected, the correct false-positive rate: (B/(B + D), could not be calculated, because the “C” and “D” cells of the contingency table were not populated. For those cells to be populated, the N2 patients with initial negative responses would also have had to undergo a second block, which did not happen. The ratio B/(A + B) is not the false-positive rate; it measures something else.

Another complication is that data in the form of Fig. 2 cannot be used to assess validity, because the rules for validation require that the criterion standard must be independent of the diagnostic test being tested. Consequently, a first diagnostic block cannot be tested against a second diagnostic block. Therefore, the ratio B/(A + B) measures something other than validity.

4. Resolution

The values of the “A” and “B’ cells reflect the consistency between the responses to the first and second blocks. Positive responses to the second block were consistent with the positive response to the first block. Negative responses to the second block were inconsistent with the response to the first block. In those terms, the ratio A/(A + B) can be regard as the consistency rate between blocks, and B/(A + B) becomes the inconsistency rate.

5. Discussion

The reflections covered above might, superficially, appear pedantic and irrelevant; but they do have significance for understanding, communicating, and explaining data about diagnostic blocks. In the first instance, the ratio B/(A + B) is not the false-positive rate of a single block and is not a measure of the validity of a single block; but that ratio is not irrelevant.

Consistency is a crucial feature of diagnostic blocks, for which reason consistency has been argued, in a theoretical paper [8], as a necessary criterion for the proper conduct of blocks. A positive response to a second block serves to corroborate the positive response to the first block and is consonant with the source of pain having been found (although

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		Result of Criterion Standard	
		Positive	Negative
Result of Diagnostic Test	Positive	A	B
	Negative	C	D

Fig. 1. Structure and contents of a contingency table for measuring the validity of a diagnostic test.

		Response to Second Block	
Response to First Block		Positive	Negative
Positive	N1	A	B
Negative	N2		

Fig. 2. Structure and contents of a contingency table used to test the validity of a single diagnostic block.

not proven beyond doubt). In contrast, a negative response to a second block raises questions. Was there a technical error? Was the first response false? Was the second response false?

Although these questions might be debated, there are no published data that help to answer them. No-one has conducted the studies necessary to produce those data. Nor are they likely to be conducted, given the logistic and ethical issues involved.

In the meantime, the reflections discussed in this Commentary call for a revision in language. Let us stop referring to the false-positive rates of diagnostic blocks, and instead refer to their inconsistency rates.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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