Detection of Patients with Low Serum Cholinesterase Activity: Inadequacy of "Acholest" Method

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The "Acholest" test-paper method for estimating serum cholinesterase activity has been suggested as a preoperative screening test for patients potentially liable to prolonged apnea after use of succinylcholine. The method was tested on selected sera from normal persons and from patients with various hereditary variants of serum cholinesterase and results were compared to those obtained with a standard quantitative assay. The Acholest method failed to detect 12 of 20 cases at high risk of prolonged apnea after succinylcholine. It cannot therefore be considered as a suitable screening procedure.

Additional Keyphrases • apnea after succinylcholine • screening method • diagnostic kits

Patients with low serum cholinesterase (acylcholine acyl-hydrolase, EC 3.1.1.8) activity, particularly that associated with certain inherited variants, are subject to prolonged apnea after use of the muscle relaxant succinylcholine (1-6). Although most patients with prolonged apnea do well with modern anesthetic management, a few undergo unrecognized hypoxia and sustain serious complications including cerebral damage, and death occasionally results (7-9).

It has been suggested repeatedly that clinical laboratories screen sera of patients before surgery to identify cases with low values, because in such circumstances succinylcholine could be replaced by another relaxant. Relatively few hospital laboratories undertake such screening programs; indeed, very few hospital laboratories are equipped to investigate the occasional case of prolonged apnea after succinylcholine.

Recently, we have learned of several laboratories that screen for serum cholinesterase with the "Acholest" commerical kit (E. Fougera & Co., Inc., Hicksville, N. Y. 11802). We had previously compared the kit with several standard methods for estimating cholinesterase and found the kit entirely inadequate. In view of the apparent growing popularity of the kit, we present here some data documenting its inadequacy.

Methods

Fresh normal sera and plasma were obtained from healthy ward and laboratory personnel. The sera showing various hereditary variants of cholinesterase came mainly from our extensive library of such sera (9-11). The F serum was obtained from Dr. James Liddell, Guy's Hospital, London, England and the AP and FS sera from Dr. Nancy Simpson, Queen's University, Kingston, Ontario. The case histories of these rare types have been described (9, 12).

The Acholest kit determination was carried out as given in the instructions; one kit was obtained in 1965 and one in 1971. The kits have no expiration dates. Papers from the 1965 kit were used in both 1965 and 1971 on samples obtained in 1965 and on fresh sera. Sera tested in 1965 as well as fresh sera were also tested with the 1971 kit papers. Agreement was excellent; in no case would the interpretation have been altered. In the test, two 50-μl drops of serum are pipetted onto opposite ends of a microscope slide. The control paper is put on one spot and the test paper containing the reagent on the other, and both are covered with another slide. The indicator in the test paper turns green-blue on soaking with serum and the time required to reach the color of the control strip is recorded, 20 min being stated by the manufacturer to be the upper limit of normal. Although several authors (15-16) have indicated that the substrate in the test strip is acetethylcholine, the literature with the kit states it is a "special substrate."

For the present purpose we compared results with the Acholest Kit with those obtained with a generally accepted assay based on the Ellman reaction at 37°C with propionylthiocholine iodide (2 mmol/liter) as substrate, in phosphate buffer of pH 7.6 (11).
Twenty individuals. The broken line at 20 min is the suggested upper limit for the Acholest method, and the double-arrowed line is the range of values for serum cholinesterase in normal subjects (11). The symbols in the insert refer to the phenotypes of serum cholinesterase at the E1 locus as given by Motulsky (17). The individual letters represent the following variants of the E1 gene for cholinesterase: U, usual allele; A, atypical or dibucaine-resistant allele; F, fluoride-resistant allele; and S, "silent" or absent allele. Single letters are homozygous persons, and double letters, all possible heterozygous types. The symbol "I" is often used to express the heterozygote for the normal and atypical alleles and stands for "intermediate."

Results

Figure 1 shows how results of the Acholest method compare with those of the quantitative assay. The phenotypes subject to high risk of prolonged apnea after administration of succinylcholine are underlined. Twenty of the 22 sera with cholinesterase activity below the lowest limit of normal by the quantitative assay are from patients with hereditary variants that strongly predispose to prolonged apnea after succinylcholine. Of these 20, 12 are normal by the Acholest method. Thus, it is clear that the Acholest method gives "normal" results in many subjects who clearly should not receive succinylcholine. This test therefore cannot be recommended as a screening procedure.

References