formation was published in an erratum in the February issue of the Journal [2]. This is an obvious error, because the study, funded by Merck & Co., used the Merck & Co. product RECOMBIVAX HB/H-B-VaxII. The Discussion section discussed only the use of RECOMBIVAX HB/H-B-VaxII as a 2-dose regimen. It was not our intent to suggest that the Twinrix product did not stimulate a good immunologic response. We regret any confusion that this may have caused for the reader, and we certainly regret the concerns that it has caused for SmithKline Beecham and Merck & Co.

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Lack of Evidence of Borrelia Involvement in Alzheimer’s Disease

To the Editor—The etiology of Alzheimer’s disease (AD), the most prevalent cause of dementia in the elderly, is unknown. Various published reports have either supported or contradicted the possibility that Borrelia organisms have a role in the etiology of AD [1–5]. Here we present the results of our investigation, using polymerase chain reaction (PCR) analysis, of evidence of Borrelia infection among patients with AD.

Brain specimens from 15 patients with AD and 15 age- and sex-matched controls were obtained from the Johns Hopkins University Alzheimer’s Disease Research Center (Baltimore; National Institutes of Health grant AG 05146). The pathological diagnosis of AD followed the recommendations of the Consortium to Establish a Registry for Alzheimer’s Disease [6]. The mean ages of patients with AD and controls were 79 years (range, 56–93 years) and 79 years (range, 59–93), respectively. Autopsies were performed ≤19 h after death. Specimens were stored at −80°C.

DNA was extracted from a 50-mg piece of tissue from each specimen using the QIAamp Tissue Kit (Qiagen, Valencia, CA). For amplification of Borrelia DNA, 1 pair of oligonucleotide primers was selected (5′-[biotin]-GGCGGCACACTTAACA-CGTTAGCTT-3′ and 5′-GGCAAAGGCGAACTTCTGGGTC- AA-3′) that produces a 153-bp product from the 16S ribosomal gene from the Borrelia genus. The 16S gene primers are able to amplify B. burgdorferi sensu stricto, B. garinii, B. afzelii, B. andersonii, B. turdi, B. hermsii, and B. anserina. An internal control (IC), constructed by using the Borrelia primers extended on their 3′ ends to amplify a section of the pBR322 vector, was included in each amplification reaction tube. An IC probe binding sequence was selected, and the length of the amplified product was designed to be ~50 bp longer than the Borrelia amplicon.

The PCR analysis was performed in a mixture of 10 μL Tris-HCl (pH 8.3), 50 mM KCl, 3.0 mM MgCl2, 200 μM deoxynucleoside triphosphates, 2.5 U Taq polymerase, 0.4 μM of each Borrelia primer, 500 copies of IC, 25 μg/mL isosporalen-10, 2.5 mg/mL bovine serum albumin, and 10% glycerol in a total volume of 50 μL. After adding 5 μL of the extracted sample, the reaction tubes were incubated in a thermal cycler. An initial denaturation period of 4 min at 95°C was followed by 35 cycles of 95°C for 30 s, 69°C for 30 s, and 72°C for 1 min. Incubation concluded with a final extension period of 5 min at 72°C.

Borrelia PCR analysis was performed in triplicate on the extracted DNA from the frontal, temporal, and occipital lobes of 10 patients with AD and 14 controls and was performed in sextuplicate on extracted DNA from 5 patients with AD and 1 control. We inoculated 18 samples, from guinea pig brains, with B. burgdorferi strain LP3 as positive controls, and we used
14 samples from noninoculated guinea pig brains as negative controls. All samples were assayed in a blinded fashion.

Detection of the *Borrelia* and IC amplification products was performed using the DELFIA (dissociation-enhanced lanthanide fluoroimmunoassay) time-resolved fluorescence hybridization assay (Perkin-Elmer Wallac, Gaithersburg, MD), as described elsewhere [7]. Probe sequences were as follows: *Borrelia*: 5'-GATGCAACCTTGGTATCAAAAG-3'; IC: 5'-GC-GATGCTGTGGAACG-3'.

To assess the sensitivity and reliability of our PCR assay, the *Borrelia* PCR target region was cloned into the pCR 2.1 vector. A dilution series was performed, with the addition of 1750 ng human genomic DNA per reaction, and the target region was then amplified, using our PCR assay. Time-resolved fluoresence was measured to determine positive amplification reactions. The quantification of β-actin genes has been used to calculate that each cell in the trigeminal ganglia contains 15.6 pg of DNA [8]. Therefore, we calculated that our PCR sensitivity was at least 2 *Borrelia* genomes per 112,000 cells.

When our PCR method was used, no patients with AD or controls were positive for *Borrelia* species in the brain. Therefore, no brain sample in either group was positive by PCR analysis for *Borrelia* organisms, with a 95% confidence interval of 0%–20%. All 18 samples from guinea pig brains inoculated with *B. burgdorferi* were positive, whereas all 14 samples from noninoculated guinea pig brains were negative.

In summary, using a very sensitive PCR assay that is able to amplify a *Borrelia*-specific DNA target sequence from all *B. burgdorferi sensu lato* species known to cause disease in humans, we found no evidence of *Borrelia* organisms in brains of patients with AD.

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References