REVIEW ARTICLE

Denialism Preserves Scientific Controversies: a Case Study of Abusive Head Trauma Research

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Abstract

The traditional theory of abusive head trauma requires scientific scrutiny. Those who question the validity of this theory have been accused of denialism for the purpose of obfuscating evidence in legal settings and supporting abusive caregivers. The traditional theory holds that abusive head trauma results from "shaken baby syndrome". In reference to abusive head trauma in the absence of external signs of trauma, we argue that it is the child-protection clinicians and concerned researchers who represent denialism. We have identified three types of denialism in this area: (i) denialism of the presence of a scientific controversy; (ii) denialism of relevant scientific distinctions between abusive head trauma cases *with* versus *without* external signs of trauma; and (iii) denialism of circular reasoning as a major risk of bias. The analysis discloses that the scientific controversy pertaining to abusive head trauma is real and that it is problematic to lump together all alleged abusive head trauma, *with* and *without* external signs of trauma. Further, it has been ignored that circular reasoning results in a high risk of bias. We conclude that denialism preserves rather than promotes scientific developments on abusive head trauma research.

Keywords: abusive head trauma; child abuse; circular reasoning; denialism; shaken baby syndrome

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Introduction

In conducting scientific research, scientists usually focus on relevant aspects and ignore what might be considered irrelevant. Usually, theories form the framework scientists use to focus on relevant issues and ignore irrelevant issues. Ignoring irrelevant aspects of a scientific object is a normal phase of scientific procedure (1). However, in cases of scientific controversy, defined as *"a persistent antagonistic discussion about a disagreement concerning a substantial scientific issue that is not resolvable by standard means of the discipline involved"* (2), opinions may differ as to which aspects are relevant and which are irrelevant.

The scientific controversy to be addressed in the present text concerns research on abusive head trauma (AHT), which can be divided into two types. In Type 1 cases, the infant exhibits *external signs of trauma,* which might have been inflicted accidentally or intentionally. An example of the latter is shaking the baby combined with slamming the

infant's head against a hard surface. Of all alleged AHT cases reported, approximately 2/3 exhibit external signs of trauma (3, 4). In the remaining 1/3, in this text referred to as Type 2 cases, the infant typically exhibits subdural bleeding, retinal hemorrhages and sometimes symptoms of encephalopathy, but displays *no external signs of trauma,* that is, no conventional signs of trauma whatsoever. According to the traditional theory of "Shaken Baby Syndrome" (SBS), such cases are attributed to isolated violent shaking. However, with respect to Type 2 cases, there are competing theories whereby the findings might be attributable to natural causes, implying that such infants have not necessarily been violently shaken (5). Moreover, a recent systematic literature review showed that studies of the diagnostic accuracy of SBS - or AHT without external signs of trauma - are highly biased (6).

Denying factual claims might be referred to as denialism (7). Researchers questioning the traditional SBS concept have been labeled "child-abuse denialists" (8, 9), and have been accused of fabricating scientific controversy with the assumed purpose of obfuscating evidence and assisting lawyers defending caregivers accused of child abuse (10, 11). In a legal context, the presence of a scientific controversy can result in reasonable doubt about guilt, leaving an allegedly abused infant unprotected and a suspected perpetrator acquitted. This point of view might also explain why the proponents of the traditional SBS/AHT theories argue that there is in fact no real scientific controversy (12).

In the present text we argue that proponents of the traditional SBS/AHT theories not only ignore but actively deny or overlook relevant and important aspects. We have identified three such aspects:

(i) They deny the existence of a scientific controversy within the field of SBS/AHT research, despite the existence of several competing theories and hostile discussions in the scientific community.
(ii) They deny the relevance of a distinction between alleged AHT cases *with* and *without* external signs of trauma, despite the fact that this is one crucial component of the ongoing scientific controversy.
(iii) They deny that circular reasoning is an issue in traditional SBS/AHT research, despite the fact that this methodological flaw results in a high risk of bias in studies of the diagnostic accuracy.

In the subsequent sections, we present and discuss these three types of denialism.

The emergence of the SBS/AHT controversy

To demonstrate that the ongoing scientific controversy in the field of SBS/AHT research is real and not fabricated, we briefly present the traditional SBS/AHT theories regarding infants with subdural hemorrhage, retinal hemorrhages, and symptoms of encephalopathy, for example, seizures or unconsciousness. These three findings are often referred to as the *triad* and for the past four decades have usually been attributed to violent shaking of an infant, typically ~2 months old (13-15). The triad might be present both *with* and *without* external signs of trauma such as bruises and scalp injuries. If external signs of trauma are also present, it is assumed that the infant has not only been violently shaken but that its head has also been slammed against a hard surface. In triad cases *without* external signs of trauma, it is assumed that the injurious mechanism is violent shaking only.

According to the traditional SBS/AHT theories of mechanism, violent shaking of an infant in a whiplash manner will cause: (i) brain damage by disrupting nerve fibers, resulting in immediate symptoms, for example, seizures or unconsciousness; (ii) bridging vein rupture resulting in a subdural bleeding; and (iii) cleavage of the vitreous body and the retina resulting in retinal hemorrhages (13). Infants allegedly abused as described can die, or survive with or without sequelae (14, 15).

The SBS/AHT theories of mechanisms described embrace several paradoxical phenomena and anomalies (16), and have been criticized (13). An example of paradoxical phenomenon is that if the subdural bleedings were caused by rupture of one or more bridging veins, one would expect a localized, space-occupying hematoma, but in SBS/AHT cases without external signs of trauma, there is a thin film of subdural blood over both brain hemispheres (13). However, during 2001-2004, Geddes et al. presented a new theory suggesting that the subdural bleeding was not the result of rupture of a bridging vein and that the symptoms from the brain were not due to disruption of nerve fibers (17-20). Based on microscopic examination of fatalities of infants with and without external signs of trauma, Geddes et al. found that triad cases without external signs of trauma suffered from hypoxia and subsequent brain swelling and increased intracranial pressure (17-20). The latter findings could explain the shape of the subdural bleeding due to leakage from small veins and capillaries. In other words, the thin subdural bleeding described by Geddes et al. was considered *secondary* to *the hypoxia-brain-swelling-increased-intracranial-pressure-cascade*. Similarly, the retinal hemorrhages were considered *secondary* to the increased intracranial pressure.

Moreover, according to the studies by Geddes et al., triad cases *with* external signs of trauma – two infants with multiple skull fractures – were the only ones who had brain injury with disrupted nerve fibers. Geddes et al. were the first to suggest the relevance of discriminating between triad cases *with* and *without* external signs of trauma. However, instead of further developing this new theory of mechanism, the proponents of the traditional SBS/AHT theories criticized it (21, 22), and even achieved its demolition in the context of a court of law, whereby it was classified as "a premature

hypothesis" (23). Despite the fact that the theory by Geddes et al. were corroborated by several research groups (24-27) and deemed considerably more plausible than the traditional AHT theories when exposed to Bradford Hills' criteria for discussing causality (28), nothing changed within the SBS/AHT research area. This state of affairs obviously reflects a serious lack of consensus over a substantial issue which is not resolvable by the standard procedures of the relevant discipline (2) and illustrates the existence of a scientific controversy.

Denial of the relevance of distinguishing triad cases with and without external signs of trauma

A systematic literature review of triad cases without external signs of trauma (6) was criticized by the proponents of the traditional SBS/AHT theories because the focus on isolated triad cases was considered irrelevant (10, 29, 30). However, a study compiled from four studies including triad cases both *with* and *without* external signs of trauma reported that of all alleged AHT cases, about 1/3, had no external signs of trauma (3, 4). Since the two groups might represent two completely different causes and pathophysiologic mechanisms, the one-third of triad cases without external signs of trauma will be ignored or obfuscated if lumped together with the majority of alleged SBS/AHT cases, which do exhibit external signs of trauma. Both the traditional SBS/AHT mechanism theories and the theory of Geddes et al. might be applicable – the former to some AHT cases *with* external signs of trauma, the latter to cases *without* external signs of trauma and where shaking is not necessarily the cause (20).

Denialism of the relevance of distinguishing between the two groups of triad cases seems to be motivated by the consequences a subdivision would imply scientifically, legally, and societally (10, 11). Claiming that the distinction between the two groups is irrelevant can be compared to claiming that all kinds of headache, for example, one caused by a brain tumor and the other due to a migraine, have a similar etiology and pathogenesis and should be treated and prevented in the same manner. This is obviously not correct.

The legal consequences of denying the relevant difference between the two groups is that all triad cases will be diagnosed as AHT cases when at least one third should not necessarily be associated with abuse. Instead, such cases could be attributed to natural causes, for example, the immature brain function of very young infants or gastroesophageal reflux. In such cases, any shaking could have been performed *after* the infant's collapse, that is, shaking was part of resuscitating (5, 6, 16). Moreover, the ethical, legal, and societal consequences of this denialism is problematic; removal of infants from a safe family, splitting up the family, and imprisonment of an innocent caregiver (16). In other words, denying or ignoring the relevance of this distinction has had, and continues to have, serious consequences. This would probably never have occurred if the research subject had been, for example, migraine, which leads us to the next denialism issue.

Denying that circular reasoning is an issue in scientific research

The previously cited systematic literature review of isolated triad findings for predicting traumatic shaking claimed that circular reasoning in diagnostic accuracy studies results in a high risk of bias (6). This problem was found in the vast majority of the studies assessed. Several critics objected to this assessment, and one critic suggested that avoiding circular reasoning would make it difficult, if not impossible, to conduct observational studies, and that to claim that unbiased studies are needed is too strict a criterion (31). Although circular reasoning within traditional SBS/AHT research has been repeatedly highlighted ever since year 2000 (32-36), the criticism indicated that circular reasoning should not be considered a big issue when assessing diagnostic accuracy.

The reason why circular reasoning was and still is an issue is that the diagnosis of SBS/AHT in most studies was determined by a child protection team and based on the traditional SBS/AHT theories (16, 37). These diagnoses were subsequently applied to classify true positive cases by researchers in observational studies on which the diagnostic accuracy studies were based (6). Since all triad cases without external signs of trauma were classified as true positive (TP) and accordingly none was classified as false positive (FP), the positive predictive value [TP/(TP+FP)] became 100% (37). Such studies will obviously present results that are too good to be true and would ostensibly corroborate *any* theory, including the traditional SBS/AHT theories (38). But what is supposed to be empirically studied has in this process already been taken for granted as true and this represents nothing but circular reasoning. To avoid circular reasoning when calculating diagnostic accuracy, the diagnostic test must be separated from the reference test or gold standard (38). The risk of circular reasoning and the subsequent high risk of bias in diagnostic accuracy studies is established common knowledge, previously described by clinical epidemiologists and considered to be a classical fallacy. Accordingly, this is an issue which cannot be ignored with reference to the chosen theory and the chosen focus.

Discussion

Using Freudenthal's definition of a scientific controversy, the existence of a scientific controversy within the field of SBS/AHT research is real; it is certainly not "an issue constructed merely to assist lawyers defending caregivers accused of child abuse" (10, 11). Ignoring irrelevant aspects when conducting scientific research is not an issue if no scientific controversy or competing theories exist. But if there are competing theories, particularly if these are more plausible than the

traditional theories regarding specific aspects of the issue, even proponents of these theories should listen and reconsider what aspects are relevant. Although denied, the distinctions between alleged AHT cases *with* and *without* external signs of trauma should be considered relevant. Continuing to lump the two groups together will obfuscate the potential scientific implications of the differences.

Denying the scientific controversy and denying that it is relevant to distinguish between triad cases *with* and *without* external signs of trauma as well as denying that circular reasoning is an issue, might all be associated with the primary aim of not missing one single case of possible infant abuse. Although societally and legally deeply problematic, this preference might be justified among clinicians that deal with child abuse cases. But as these clinicians use the traditional SBS/AHT theories in the diagnostic process, the scientists conducting observational studies must abstain from uncritical use of such diagnoses. Otherwise, they will only automatically corroborate the traditional theories and the resulting diagnostic accuracy will - falsely - appear to be perfect. Such research is based on circular reasoning and will not result in new knowledge; instead, it just becomes a positive feedback loop and impedes scientific progress (38).

Moreover, denialism combined with certain preferences should not preclude normal statistical reasoning in SBS/AHT research. Even traditional SBS/AHT research should acknowledge that circular reasoning results in high risk of bias and that such reasoning must therefore be avoided. Preferring the traditional SBS/AHT theory as applicable for all alleged SBS/AHT cases to theories allowing different etiologies and pathogeneses will consequently obfuscate both the ethical, legal and societal as well as the scientific consequences. Moreover, basic and established scientific, logical and statistical rules must be followed independently of the chosen theory. Contradictions and paradoxical phenomena should be scientifically investigated, and wrongful calculations should be excluded. Also, failure to separate diagnostic tests from reference tests, should not be accepted.

The reason why clinicians and scientists who support the traditional SBS/AHT theories deny the existence of a scientific controversy, deny that it is an issue lumping together allegedly AHT cases *with* and *without* external signs of trauma, and deny that circular reasoning is a major problem probably results from their inclination to protect an infant rather than considering more plausible scientific theories. When embracing the traditional SBS/AHT theories, the infant will likely be removed from its caregivers; however, this may not always be in the child's best interests as not all cases assessed using traditional SBS/AHT theories may be true abuse cases. For example, if one were to embrace the *hypoxic-brain-swelling-increased-intracranial-pressure-cascade-theory*, an infant without external signs of trauma would probably not be classified as an SBS/AHT case (37). Although protecting infants is understandable among child-protection clinicians, the use of such a value-based judgment by the concerned scientists when classifying AHT cases in scientific studies will become a huge problem (39, 40).

Conclusion

It is perhaps to some extent understandable that the proponents of the traditional SBS/AHT theories have argued that the claimed scientific controversy is something fabricated to aid lawyers in their defense of child abusers. But one of the reasons why the traditional SBS/AHT theories are criticized is that triad cases *without* external signs of trauma are lumped together with triad cases *with* external signs of trauma, hence obfuscating possible relevant differences. We do of course not deny that child abuse exists, but both pathoanatomical and epidemiological studies indicate that at least triad cases *without* external trauma are not correctly diagnosed under the traditional theories, and presuppose other mechanism theories. As it is obvious that there is an ongoing scientific controversy and that the empirical support of the traditional SBS/AHT theories is highly biased due to circular reasoning, proponents of the traditional SBS/AHT theories should reconsider the scientific rationality of lumping together the two groups of triad cases. Denialism of these aspects does not promote the scientific development of SBS/AHT research. On the contrary, it preserves the controversy and impedes scientific progress.

Conflict of Interest

The authors declare no conflict of interest with reference to with respect to research, authorship, and/or publication of this article.

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