



# Abusive Head Trauma in Infants and Children in Japan

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Subdural hematoma in infants can be caused by abuse, and is thought to be more likely if subdural hematoma is associated with retinal hemorrhage and cerebral edema. In Japan, few doctors disagree that cases of subdural hematoma with retinal hemorrhage and cerebral edema with multiple findings on the body are more likely to have been caused by abuse rather than by household accident. On the other hand, in cases where there are no other significant physical findings, only subdural hematoma and retinal hemorrhage, there is a difference of opinion as to whether the injury was caused by an accident or abuse. The reason for this is that neurosurgeons in Japan promoted the concept that infants can develop subdural hematomas and retinal hemorrhages due to minor trauma at home before the concept of abusive head trauma became known. In addition, the age distribution of subdural hematomas in Japan differs from that in other countries, with peaks at around 8 months, and the reason for this remains unclear. Therefore, the etiology of infant subdural hematoma in Japan needs to be investigated in greater detail.

**Key Words :** Abusive head trauma · Subdural hematoma · Japanese.

## INTRODUCTION

In recent years, the number of cases of suspected child abuse reported to child guidance centers in Japan has been on the rise and is becoming increasingly serious. According to the Japanese Ministry of Health, Labor and Welfare, abuse is defined as physical abuse, sexual abuse, neglect, and psychological abuse. Among physical abuse, head trauma caused by physical violence is of great concern to society, because it can lead to severe permanent disabilities and even death. When examining a case of head trauma suspected of abuse, it is not difficult to suspect abuse when there are unnatural bruises on the body surface or multiple fractures on X-rays. However, in many other cases, it is not clear whether the trauma was

caused by abuse or an accident. The history of subdural hematoma in infants, which is often difficult to diagnose, and the current concepts in Japan and Western countries regarding the relationship between abuse and subdural hematoma are discussed, as well as the differences between Japan and Western countries.

## SUBDURAL HEMATOMA AND ABUSE IN INFANTS AND CHILDREN : A HISTORY IN WESTERN COUNTRIES

In 1946, Caffey<sup>2)</sup> reported a case of subdural hematoma and fracture of the long bones. Although the mechanism of injury

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was not clear at the time, it is now recognized as the first case report of subdural hematoma due to abuse. Later, in 1962, Kempe et al.<sup>13)</sup> summarized the characteristics of abusive trauma and published it as battered child syndrome. Later, Guthkelch<sup>9)</sup> reported two cases of subdural hematoma without conspicuous trauma to the body surface and considered that the injury was caused by shaking due to rapid acceleration and deceleration. In 1974, Caffey<sup>3)</sup> proposed the concept of “the whiplash shaken infant syndrome” as a condition in which head shaking causes intracranial and intraocular hemorrhage, resulting in irreversible brain damage and mental retardation. Since then, this condition with intraocular hemorrhage and subdural hematoma has been called “shaken baby syndrome” mainly in the USA, and more broadly, “abusive head trauma (AHT)” in recent years, and it has come to be regarded as a positive finding that raises suspicion of abuse<sup>7,17)</sup>. The mechanism of retinal hemorrhage associated with subdural hematoma has been postulated to be due to traction between the retina and vitreous body caused by shaking<sup>15)</sup>.

## SUBDURAL HEMATOMA AND ABUSE IN INFANTS AND CHILDREN : A HISTORY IN JAPAN

In Japan, however, a similar condition was reported to be caused by minor head trauma at home<sup>18)</sup>, and this condition became widely known as Nakamura’s type I pediatric head trauma. Nakamura classified pediatric head trauma into three types according to the intensity of energy at the time of injury (Table 1). Nakamura’s type I is caused by minor trauma, such as an infant who was standing on a tatami mat and fell backwards, bruising the back of the head. It is characterized by the presence of subdural hematoma and retinal hemorrhage, and convulsions. He described that if the subdural hematoma and convulsions are not treated properly, the patient’s condition may become severe or even cause death. In 1984, Aoki and Masuzawa<sup>1)</sup> reported in English an acute subdural hematoma in an infant that was thought to have been caused by a minor

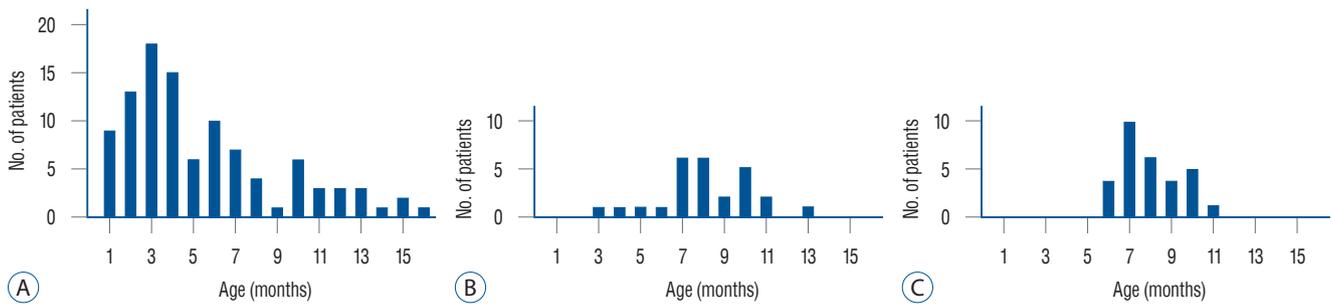
head injury. The report also referred to fundus findings, and stated that all cases had retinal hemorrhage. Ikeda et al.<sup>12)</sup> published a similar report. However, these reports did not examine the cause of injury in detail, presumably reflecting the situation in Japan at that time, where abuse was not actively suspected. Therefore, it is now suspected that the papers were not about minor household head trauma, but about abused cases<sup>20)</sup>. Subsequently, interest in AHT increased in Japan, and a systematic review published in the USA and Europe pointed out that cases with head trauma and retinal hemorrhage were more likely to have been abused<sup>7,17,21)</sup>. In Japan today, it is mandatory to notify the Child Guidance Center of suspected cases of child abuse. In particular, the Japanese Ministry of Health, Labor and Welfare’s Child Abuse Response Guide, which was revised in 2014, states that cases of infants with subdural hematomas are highly likely to have been abused. In addition, as a result of reviewing various literature and data, a report was published that calculated the probability of death from a fall of less than 1.5 m to be less than 1 in a million<sup>4)</sup>, and the possibility of a fatal subdural hematoma from minor trauma was considered to be extremely rare. This negates the possibility that Nakamura’s type I pediatric head trauma could be severe. However, a major change in the trend was announced recently. A systematic review showed that the presence of retinal hemorrhage, subdural hematoma, and cerebral edema, all part of the “triad” characteristic of so-called AHT, did not necessarily indicate abuse<sup>16)</sup>. By bringing this idea to the courts in Japan, 18 of 34 criminal cases of suspected AHT have resulted in acquittals since 2017 (<https://www.fnn.jp/articles/-/245888>). This is an unprecedented situation in Japan’s criminal justice system, where 99% of people are convicted once they are charged (<https://www.moj.go.jp/hisho/kouhou/20200120QandA.html>, Q13). Although a consensus statement on the existence of AHT has been published by experts mainly in Europe and the USA<sup>5)</sup>, the controversy is still raging in Japanese courts. As for AHT, the mechanism of injury, such as why widespread cerebral edema occurs, has not yet been clarified<sup>6)</sup>, and future research is expected.

**Table 1.** Nakamura’s classification of pediatric head trauma

Type I : Caused by common and small accidents in daily life

Type II : Caused by accidents that are not so severe but cannot be called minor external force

Type III : Caused by severe impact accident



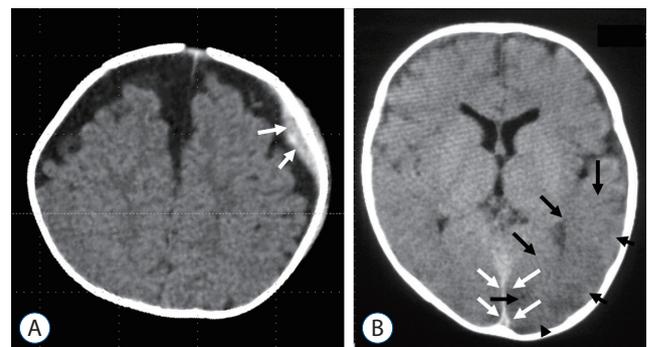
**Fig. 1.** Age distributions of subdural hematoma cases described in the articles by Kivlin<sup>14)</sup> (A), Aoki and Masuzawa<sup>1)</sup> (B), and Nishimoto and Kurihara<sup>19)</sup> (C).

## SUBDURAL HEMATOMA AND ABUSE : DIFFERENCES BETWEEN WESTERN AND JAPANESE REPORTS

In 2003, Gardner<sup>8)</sup> compared reports from a single center in Japan by Aoki and Masuzawa<sup>1)</sup> and Ikeda et al.<sup>12)</sup> and a single center in North America by Kivlin<sup>14)</sup> and found a difference in the age distribution of patients. Gardner<sup>8)</sup> noted that the age distribution of the cases with subdural hematoma and fundus hemorrhage reported in North America was too different from that reported in Japan, suggesting that the North American and Japanese cases may have been caused by different trauma backgrounds and injury mechanisms. Ganesh points out that there are statistical errors in Gardner's report<sup>8)</sup>, but questioned why the reports from Japan differ from those from elsewhere in the world. The age distributions of subdural hematoma cases described in the article by Kivlin<sup>14)</sup>, Aoki and Masuzawa<sup>1)</sup>, and Nishimoto and Kurihara<sup>19)</sup> are presented in Fig. 1.

A subsequent report from Japan also showed that subdural hematoma due to household trauma peaked at around 8–10 months<sup>19)</sup>, while a report from Sweden showed a large peak around 2 months and did not show a peak around 8 months<sup>10)</sup>.

Another paper was published from Japan that analyzed the data of the Diagnostic Procedure Combination payment system for AHT by defining subdural hematoma with retinal hemorrhage as possible AHT. They reported that there were 41.7 cases of possible AHT per 100000 population, with peaks at 2 months and 8 months, respectively<sup>22)</sup>. On the other hand, the peak at 8 months is similar to the peak of benign external hydrocephalus, which raises the question of whether it is not abuse<sup>11)</sup>. The difference in subdural hematoma between benign external hydrocephalus and abuse is shown in Fig. 2. In order to answer this question, many clinical cases need to be examined in detail. In addition, since most of the reports are



**Fig. 2.** A : A 6-month-old infant with benign external hydrocephalus. The guardian accidentally dropped the infant and bruised the infant's head; computed tomography (CT) scan shows a subdural hematoma in convexity (white arrows). B : A 5-month-old infant who was injured by abuse. The guardian confessed to having abused the infant. CT scan showed subdural hematoma in the interhemisphere (white arrows) and brain edema in the left temporal-occipital lobe (black arrows).

from Europe and the USA, the results of epidemiological studies not only from Japan, but from other Asian countries such as Korea and China, are required.

It is particularly necessary to examine how many cases of subdural hematoma and retinal hemorrhage in each country were admitted to be abuse by the caregivers.

## CONCLUSION

In Japan, there is little disagreement about diagnosing injuries due to abuse when there are intracranial and retinal findings, as well as findings in other parts of the body. However, for those cases where only subdural hematoma and retinal hemorrhage are observed, there is disagreement as to whether it is due to abuse or accident, and this has affected the judicial system. It is also unclear why the age in months of cases with subdural hematoma and retinal hemorrhage is different in Ja-

pan from in other countries. Therefore, in Japan, some experts believe that subdural hematoma and retinal hemorrhage are more likely to be caused by household trauma. More cases need to be studied in detail to clarify this point.

## AUTHORS' DECLARATION

### Conflicts of interest

No potential conflict of interest relevant to this article was reported.

### Informed consent

This type of study does not require informed consent.

### Author contributions

Conceptualization : MN; Data curation : MN; Formal analysis : MN; Methodology : MN; Project administration : MN; Visualization : MN; Writing - original draft : MN; Writing - review & editing : AA

### Data sharing

None

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