Coagulation testing in the evaluation of suspected child abuse

M. Olivieri; K. Kurnik; C. Bidlingmaier
Paediatric Haemophilia Centre Munich, Dr. von Haunersches Children’s Hospital, LMU Munich, Germany

Keywords
Child abuse, coagulation

Summary
Every year in Germany nearly 3000 cases of child abuse were reported. When children are presented at emergency units with suspicious injuries and bruises a detailed documentation an evaluation is necessary after emergency treatment. As differential diagnosis inherited or acquired bleeding disorders should be excluded. In addition to a detailed evaluation of personal and family history and a physical evaluation different coagulation test to exclude defects of primary and secondary hemostasis should be performed. Clinician must know the limitations of these tests and keep in mind that an abnormal coagulation test does not exclude child abuse. Coagulation defects may be the consequence of child abuse and neglect or the two conditions may coexist.

Schlüsselwörter
Kindesmisshandlung, Gerinnung

Zusammenfassung

Two cases
Battered child syndrome

An eight months old infant was presented at our emergency department with haematomas on the hand. Clinical examination showed no other pathologies and no further bruises. The parents explained the injuries by accidental entrapment. Coagulation testing showed reference values for aPTT, PT and closure times in the platelet function analyzer (PFA100®). The haematomas declined within one day and the child was dismissed with diagnosis of accidental entrapment.

A few months later the child was presented again in the emergency unit with suspicious haematomas and recurrent vomiting. CCT and MRI scans showed large intracranial hygromas as residual state for recurrent intracranial bleeds, suspicious for the diagnosis shaken baby syndrome. A coagulopathy was excluded by detailed laboratory workup. Additionally radiologic diagnostic showed an old thigh fracture. The diagnosis of battered child syndrome was posed.

Haemophilia B

A nearly coeval infant presented in a peripheral emergency unit with the same type of haematomas on the hand. Clinical examination showed no further haematomas or injuries.
The child was dismissed without further laboratory testing. A few days later the parents presented her child again in the emergency unit because the haematoma did not resolve.

Because of suspicious haematoma and young age of the parents the diagnosis of child abuse was expressed. A whole body x-ray scan revealed a possible fissure on the right upper arm, supporting the theory of child abuse. To prove the diagnosis, whole body scintigraphy was performed. For this examination a peripheral venous line was placed and at this occasion blood testing was performed.

The tests showed a pathological aPTT prolongation (>100 s), but normal thrombocyte count, normal prothrombin time and normal fibrinogen levels. At the same day the infant was transferred to our hospital for further tests. The factor IX level was <1%, confirming the diagnosis of severe haemophilia B.

The dilemma

The two cases reported show the dilemma of the physician confronted with a child with unclear injuries:

- The physician must keep in mind the possibility of child abuse.
- Child abuse is rare and being falsely accused leads to great stress and psychological trauma within the family.

Therefore, the evaluation of unexplained injuries has to be conducted in a sensible, respectful manner, allowing the quick and secure diagnosis of the child. Missing a child abused by its caregivers or other adults puts the child at a high risk for severe morbidity and even mortality. Unfortunately, there are no evidence based guidelines how to achieve the goal of quick and secure diagnosis.

Abuse or coagulation disorder?

Here we present the algorithm established at our centre for the distinction of child abuse and coagulation disorders. We do not include the numerous differential diagnosis such as malignancies, connective tissue disorders (e.g. Ehlers Danlos syndrome).

History, examination

The detailed and standardized evaluation of a child’s history and its family is an important tool to distinguish suspected child abuse from bleeding diathesis. Bleeding history (Table 1) should include questions for

- occurrence of skin bleeds like haematomas, petechiae, mucosal or gingival bleeds, epistaxis,
- problems in wound healing or umbilical cord bleeds (characteristic for factor XIII deficiency),
- severe joint or intramuscular bleeds (occur in severe haemophilia).

Furthermore, increased bleeding during or after surgery, need of transfusions or coexisting gastrointestinal, liver or renal disorders and recent intake of drugs like acetylsalicylic acid, valproic acid or antibiotics must be noted.

In addition, to the personal history also the detailed family history for bleeding symptoms including menorrhagia, postpartal bleeds and bleeding during or after surgery has to be evaluated.

While taking the history the physician can obtain essential information leading to the diagnosis of suspected child abuse (Table 1). For example, important hints (9) are

- delay in seeking medical attention,
- incompatible pattern of injury with the reported mode of injury.

The physician has to take into consideration that the results of the history might be biased by the attempt of the suspect to conceal his deeds. General limitations of taking a bleeding history, such as under- or overestimating previous bleedings, language problems or an unknown family history might also hamper the gathering of information (3).

A thorough physical examination together with a complete documentation is an integral part of the examination, not only for medical but also for legal reasons. While some coagulopathies might mimic physical violence, it is possible in some cases to distinguish between the two conditions.

- In coagulopathies bruises usually do not have the same morphology, while in battered child syndrome morphology is often identical in different injuries sites.
- The pattern of the injuries allows to guess the shape of the instrument causing the injury in some cases.

While there are established radiological techniques to estimate the age of a bone fracture, it is difficult – if not impossible – to estimate the age of a bruise (2). Cutaneous haematomas change sequential their colour while subcutaneous bleeds were decomposed and reabsorbed gradually and mucosal bleeds never change their colour.

In addition to detailed skin inspection organ injuries should be excluded and gynecological visitation should be performed.

Coagulation tests

Although tests of coagulation are not generally necessary for the examination of children with injuries susceptible for physical

<table>
<thead>
<tr>
<th>important</th>
<th>question</th>
</tr>
</thead>
<tbody>
<tr>
<td>skin bleeding (haematomas, petechiae, bruises)</td>
<td></td>
</tr>
<tr>
<td>umbilical cord bleeding</td>
<td></td>
</tr>
<tr>
<td>bleeding during/after surgery</td>
<td></td>
</tr>
<tr>
<td>breastfeeding without vitamin K substitution</td>
<td></td>
</tr>
<tr>
<td>epistaxis, joint or muscle bleeding</td>
<td></td>
</tr>
<tr>
<td>menorrhagia, hypermenorrhagia</td>
<td></td>
</tr>
<tr>
<td>bleeding after vaccination</td>
<td></td>
</tr>
<tr>
<td>need for blood transfusion because of bleeding</td>
<td></td>
</tr>
<tr>
<td>liver or renal disease</td>
<td></td>
</tr>
<tr>
<td>bleeding tendency in family history</td>
<td></td>
</tr>
<tr>
<td>delay in seeking medical aid</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>hints to physical child abuse</th>
</tr>
</thead>
<tbody>
<tr>
<td>incompatible pattern of bruises with reported mode of injury</td>
</tr>
<tr>
<td>multiple haematoma in a non-walking child</td>
</tr>
<tr>
<td>injuries of different ages not compatible with the history</td>
</tr>
<tr>
<td>inconsistent or absent account of the trauma</td>
</tr>
<tr>
<td>signs of injury compatible with instruments causing the injury</td>
</tr>
</tbody>
</table>
child abuse (12), we recommend it for all cases if not for medical but for legal reasons. In contrast to the perioperative setting the treating physician is confronted with an already existing bleeding or injured child. Furthermore, the evidence gained from the standardized bleeding history is limited. Therefore, exclusion or proof of a coagulopathy is crucial in order to allow quick and adequate treatment in case of a bleeding disorder.

An extended history should be taken, but for the limitations already stated the results cannot be taken for granted and must be amended by workup. As in the preoperative setting, the sole use of the global tests of coagulation and subsequent loss of coagulation factors.

However, if a coagulopathy is diagnosed, the possibility of coexisting injury has to be ruled out. It has to be stressed that the development of an acquired coagulopathy might be the result of neglect and maltreatment.

malnutrition may cause factor deficiencies.

bleeding can lead to the activation of coagulation and subsequent loss of coagulation factors.

An acquired coagulopathy may be the result of poisoning, i.e. with warfarin (1).

Using a standardized, systematic and tailored approach, coagulopathies and haematologic disorders (such as acute immune thrombocytopenia or acute lymphatic leukaemia) should not be missed. Table 2 summarizes our rather extensive approach. Diseases not detectable by screening parameters must be ruled out by applying adequate tests, such as von Willebrand factor measurement and test for thrombocyte function. Only a full laboratory work up will provide the legal evidence necessary to exclude a coagulopathy if it is claimed as responsible for the injuries by the suspected violators. The extend of laboratory workup can be tailored to the individual patient especially if the suspect person confesses, the mode of injury is clear and there are no physical or anamnestic hints for a coagulopathy.

An interdisciplinary approach together with haematologists, radiologists, psychologists and social workers is recommended.

References

Table 2
Proposed coagulation workup in cases of suspected physical child abuse

<table>
<thead>
<tr>
<th>primary diagnostic</th>
<th>pathological values</th>
<th>further diagnostic</th>
</tr>
</thead>
<tbody>
<tr>
<td>blood (count, smear, group), liver and renal parameters</td>
<td>aPTT →→→</td>
<td>factors IX, XI, XII, Lupus anticoagulans (including cardioliopin- and o2-glycoprotein antibodies)</td>
</tr>
<tr>
<td></td>
<td>PT →→→</td>
<td>factors II, V, VII, X</td>
</tr>
<tr>
<td>von Willebrand factor (VWF)</td>
<td>→→→</td>
<td>VWF multimers</td>
</tr>
<tr>
<td>→→→</td>
<td>fibrinogen, factor XIII, PFA100®</td>
<td>→→→</td>
</tr>
<tr>
<td>aggregometry:</td>
<td>→→→</td>
<td>further evaluation at a specialised centre</td>
</tr>
<tr>
<td>→→→</td>
<td>transmission (Born), whole blood (Multiplate®)</td>
<td></td>
</tr>
</tbody>
</table>

Conclusion
The correct identification of paediatric victims of physical child abuse but also the correct diagnosis of diseases mimicking child abuse (1) Tab. 1, Tab. 2) depends on the treating physician. Children with underlying bleeding disorders must be diagnosed in time to receive adequate treatment. Children having suffered from child abuse must be identified equally quickly to install measures to help them and their families and to protect those at risk. Helpful tools not to overlook child abuse is a careful and standardized evaluation consisting of:

standardized bleeding history,
re-evaluation of the proposed mechanisms of injury,
proper documentation of the results of physical examination complemented with laboratory tests.