

The medical assessment of bruising in suspected child maltreatment cases: A clinical perspective

Michelle GK Ward, Amy Ornstein, Anne Niec, C Louise Murray; Canadian Paediatric Society Child and Youth Maltreatment Section
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Abstract

Bruises commonly occur in children and are most often the result of a minor accidental injury. However, bruises can also signal an underlying medical illness or an inflicted injury (maltreatment). Although bruising is the most common manifestation of child physical maltreatment, knowing when to be concerned about maltreatment and how to assess bruises in this context can be challenging for clinicians. Based on current literature and published recommendations, this practice point will help clinicians to distinguish between accidental and inflicted bruises, to evaluate and manage bruising in the context of suspected child maltreatment, and to evaluate for an underlying medical predisposition to bruising.

Key Words: Bruise; Bruising; Child abuse; Children; Coagulopathy; Maltreatment

Bruises are common childhood injuries that usually result from minor accidental trauma, such as a bump or fall, sustained during routine active play. For the present purposes, this type of injury will be referred to as 'accidental'. When an underlying medical illness or bleeding disorder is present, bruising may occur from minimal or no recognized trauma. However, bruises can also occur as a result of maltreatment; these injuries are referred to as 'inflicted'. In the field of injury prevention, the terms 'unintentional' and 'intentional' are frequently used to describe injuries. Because intentionality cannot be determined from an objective medical assessment, and both terms may carry unintended meaning for the justice system, they should be avoided in the discussion of injuries related to possible maltreatment.

Skin injuries are the most common manifestation of physical harm in substantiated child maltreatment cases in Canada.^[1] When evaluating bruises, clinicians must first identify that the lesions are true bruises and exclude skin findings that

mimic bruising such as slate-grey nevi (Mongolian blue spots), hemangioma, skin staining from dyes or other skin discolorations. Once bruising is identified, it becomes important that clinicians distinguish between accidental and inflicted bruises, when possible, and that concerns about maltreatment are appropriately recognized and communicated to a child welfare authority. Both over- and underidentification of abusive injuries can cause harm. Failing to recognize physical abuse can predispose to further injury or even death^{[2][3]} and identifying abuse where it has not occurred may lead to unnecessary child protection or legal interventions, stress for the family and/or a delay in diagnosing an underlying medical disorder.

This practice point addresses two key questions for clinicians in the context of current published recommendations and relevant Canadian data on child and youth maltreatment.

- What factors should raise concern about inflicted injury (maltreatment) when clinicians observe bruising?
- What assessments should be performed to evaluate for other possible medical causes or predispositions to bruising?

Differentiating bruising from accidental and inflicted trauma

Bruises indicate bleeding beneath the skin. They are usually caused by an impact between a part of the body and another object or surface. Affected tissue is compressed or crushed, leading to blood vessel damage and bleeding into subcutaneous tissue layers.

Bruises resulting from common accidental childhood trauma tend to be relatively small, oval to round in shape with nondistinct borders, located above or near bony prominences on the front of the body (often the forehead, knees or shins), and do not have a recognizable shape or pattern (eg, a handprint or loop-shaped mark).^{[4][12]}

Bruising must be evaluated in the context of a child's developmental abilities and the explanation for injury that is provided. No one specific location on the body or bruise characteristic is diagnostic of inflicted injury, but some bruises raise greater concern for maltreatment than others (Box 1). Coagulation disorders such as hemophilia, von Willebrand disease and platelet abnormalities may present only with bruising, including bruises that – judging by appearance only – could raise suspicion for abuse.^[13] Although bruises on the face and head are frequently nonspecific in ambulatory children, they should prompt questioning as to how they happened in a child of any age, because of the potential for associated injury to the head and neck.

Box 1: Red flags for inflicted injury in a child with bruising

- Bruises in babies who are not yet cruising
- Bruises on the ears, neck, feet, buttocks or torso (torso includes chest, back, abdomen, genitalia)
- Bruises not on the front of the body and/or overlying bone
- Bruises that are unusually large or numerous
- Bruises that are clustered or patterned (patterns may include handprints, loop or belt marks, bite marks)
- Bruises that do not fit with the causal mechanism described

Adapted from references [4]-[6][9]-[11][15]

Special considerations

The following three factors require special consideration when evaluating a child's bruises.

Bruises in babies

The likelihood of having bruises is highly correlated with a child's level of mobility.^{[4][6][9][14]} Babies who are not yet cruising rarely have bruises.^{[4][9][10][15]} Less than 1% of babies younger than nine months of age show bruising, compared with 40% to 90% of children nine months of age and older.^{[7][9][10][16][17]} Clinicians should be aware that bruises or a history of bruising in babies may be a 'sentinel' injury for risk of current or future harm from maltreatment (eg, fractures or head injuries)^{[3][18]} or may represent the first manifestation of a coagulopathy.^[18] Therefore, any unexplained bruising in a nonmobile child requires further evaluation for possible maltreatment and coagulopathy.

Patterned bruises

Unexplained bruises that have a pattern should raise concern for possible maltreatment. Patterned bruising is usually caused by impact with an object of the same or similar shape, and can reflect either a positive imprint (eg, of a shoe sole,

from impact with a shoe) or a negative imprint (eg, parallel linear lines representing the spaces between fingers, from impact with a hand). Other common patterns of inflicted skin injuries include bite marks, loop marks from impact with a cord, and parallel linear lines from impact with a belt (for illustrated examples, see Hobbes and Wynne^[19]).

Colour of bruises

The presence of injuries of different ages in a child is often considered to be a red flag for maltreatment. In the past, colour was used to estimate the age of bruises. However, the current literature indicates that neither the colour nor the progressive changes in colour as bruises heal are reliable indicators of the age of bruises.^{[4][10][20][24]} There is wide variability in the appearance and healing of bruises, both among individuals and among injuries on the same individual; physicians' ability to date bruises based on examination or photographs is now considered to be "highly inaccurate".^{[10][21][25][26]}

Bruises from a hematological or other medical cause

In some cases, children present with larger than expected bruises or with bruises from minor (or no) recognized trauma because of an underlying predisposition to bruising. This can occur with an inherited or acquired coagulopathy and with other medical conditions. The most common acquired disorder of coagulation is immune thrombocytopenic purpura (ITP). The most common inherited coagulation disorder is von Willebrand disease, with an incidence of up to 1% in the general population. The next most common coagulation disorders are factor VIII deficiency (hemophilia A) and factor IX deficiency (hemophilia B), which occur in 0.02% and 0.005% of live male births, respectively.^[27] Other specific factor deficiencies and platelet disorders are more rare but, as a group, platelet function disorders are relatively common. The Canadian prevalence (total number of cases in children and youth <18 years of age) of hemophilia and other inherited disorders of coagulation is shown in Table 1.^[28] These data highlight that factor VIII deficiency is the most commonly diagnosed inherited disorder of coagulation in the Canadian paediatric population because of its relatively severe symptoms and earlier presentation. Von Willebrand disease is not diagnosed in childhood at a rate that matches its population incidence due to its more subtle presentation in many cases.

Medical conditions that are associated with bruising include: infections (eg, meningococemia), malignancy (eg, leukemia, neuroblastoma), nutritional deficiencies (eg, vitamin K, vitamin C), severe systemic illness (eg, disseminated intravascular coagulation), connective tissue disorders (eg, Ehlers-Danlos syndrome, osteogenesis imperfecta) and autoimmune or inflammatory disorders (eg, ITP, Henoch-Schönlein purpura, Gardner-Diamond syndrome).^{[27][29][30]}

Other nontraumatic skin findings that have been mistaken for bruising include striae, Mongolian blue spots or slate-grey nevi, hemangiomas, nevi of Ito, erythema multiforme, eczema, incontinentia pigmenti, cultural practices such as coining and cupping, phytophotodermatitis, and skin staining from dye or ink.^{[27][29][30]}

Coagulation disorders, whether acquired or inherited, need to be considered when evaluating bruises.^[31] In the context of possible child maltreatment, it is important for the clinician to be able to differentiate between bruising caused by minimal (or no) recognized trauma but related to an underlying medical predisposition, and bruising caused by significant trauma with no underlying predisposition. It should also be noted that identifying a coagulation disorder or medical illness does not exclude the possibility of inflicted injury and, conversely, confirming inflicted trauma does not exclude the possibility of a coagulation disorder.

Table 1
Prevalence of hemophilia and inherited bleeding disorders in Canadian children <18 years of age

Disorder	Male	Female	Total
Most common			
Factor VIII deficiency (hemophilia A)	706	36	742
von Willebrand disease (all types)	360	299	672*
Factor IX deficiency (hemophilia B)	124	12	136
Rare inherited coagulation disorders (all types)	83	91	174
Factor XI deficiency	22	37	59
Factor VII deficiency	37	2	64
Factor XIII deficiency	6	9	15
Fibrinogen disorders	5	7	12
Rare inherited platelet disorders (all types)	127	73	200
Undefined platelet disorder	63	34	97
Glanzmann's thrombasthenia	10	7	17
Familial thrombocytopenia undefined	11	6	17
Ehlers-Danlos syndrome	3	5	8

*Data presented as n. *Total includes 13 cases with sex not reported. Adapted from reference [28]*

Evaluating the child with bruising and suspected maltreatment

Recommendations on the evaluation of bleeding disorders as a cause of bruising in child maltreatment cases have been published by the British Royal College of Paediatrics and Child Health, by independent authors and, most recently, by the American Academy of Pediatrics.^{[29][32][35]}

In Canada, paediatricians with expertise in child maltreatment have developed the unpublished National Guidelines for the Diagnostic Evaluation of Suspected Child Physical Abuse: Work in Progress, based on the literature and on expert review at the annual Canadian Symposium on Advanced Practices for Child Abuse Pediatrics (2010-2012). A survey of eligible child maltreatment experts has also identified current and recommended practices by this group^[36] and input has been provided by Canadian paediatric hematologists. The following suggested clinical approach is based on the above sources, with references indicating agreement with other published recommendations.

History

A thorough history related to possible maltreatment, an underlying hematological condition or other predisposing medical condition should be obtained. This history should include details about the onset and progression of bruising, associated symptoms and any known injury events.

Medical history should include any previous bleeding or bruising, other injuries and the child's response to previous challenges to hemostasis (eg, surgery, dental extractions, venipuncture, trauma). Platelet abnormalities generally present with mucocutaneous bleeding, while factor deficiencies generally result in 'deep tissue' bleeding, such as in the joints, soft tissues, gastrointestinal or genitourinary tracts, or in bleeding after surgical procedures. Specific questions to elicit signs or symptoms of a bleeding disorder should be asked (Box 2).^{[33][37]} A medication and developmental history, with attention to gross motor abilities (to corroborate the described mechanism of injury), should also be included.

The family history should include similar information on challenges to hemostasis, as well as the diagnosis of any known bleeding disorder or other heritable medical disorder that may predispose to bruising (eg, Ehlers-Danlos syndrome, osteogenesis imperfecta). A history of consanguinity may be a clue to an unrecognized autosomal recessive inherited bleeding disorder in the child. Special attention should be given to the mother's menstrual and postpartum bleeding history, as well as to a history of postoperative bleeding, the need for transfusion or recurrent, severe epistaxis in any family member.

A review of the psychosocial history can help to identify risk and protective factors within the family. Questions about the

child's behaviour and the family's methods of discipline may also be of value.

Box 2: Key points on history for a possible bleeding disorder

Infant

- Postcircumcision bleeding
- Birth cephalohematoma
- Umbilical stump bleeding or delayed stump separation
- Postvenipuncture bleeding
- Macroscopic hematuria
- Petechiae at clothing line pressure sites
- Bruising at sites of object pressure, such as infant car seat fasteners

Index child or family members

- Spontaneous, easy or excessive bruising
- Mucocutaneous bleeding (eg, gingival bleeding)
- Epistaxis that is spontaneous, lasts >10 min or requires medical treatment
- Bleeding from minor wounds that lasts >15 min or recurs within seven days
- Prolonged bleeding after surgical procedures
- Bruises with palpable lumps beneath them
- Joint swelling with minor injury
- Blood in the stool or urine
- Menorrhagia
- Unexplained anemia
- History of blood transfusion

Adapted from references [33][37]

Physical examination

The clinician should conduct a complete physical examination, giving special attention to general appearance, hydration, vital signs, and growth parameters (including head circumference) and dysmorphisms. The oropharynx should be examined for signs of bleeding, trauma or healing injury to the frenulae, along with dentition. The entire skin surface should be examined, with special attention to the neck, trunk, buttocks, genitalia, anterior and posterior pinnae, hands and feet. The presence of hepatosplenomegaly and lymphadenopathy should be noted. The musculoskeletal sys-

tem examination should include assessment for joint hypermobility, skin laxity and bony deformity. The neurological, developmental and behavioural status of the child should also be assessed. Examination of the parent for joint laxity may be indicated when assessing very young children (for Ehlers-Danlos syndrome and benign joint hypermobility syndrome).

Laboratory evaluation

The goal of laboratory testing is to exclude, with reasonable certainty, bleeding disorders or other medical conditions predisposing to bruising that are considered in the clinical context. Not all children require laboratory investigation. Testing is recommended when the results may impact the health and/or the child welfare outcome, when there is a clinical suspicion of an underlying predisposition to bleeding or bruising, or when there is unexplained bruising in a precruising baby (Box 3).

Box 3: Recommended first-line laboratory testing for bruising and suspected maltreatment

- Complete blood count (CBC) (including platelets)^{[29][32]-[35]}
- Peripheral blood smear^{[29][32][34][35]}
- Prothrombin time (PT)/International normalized ratio (INR)^{[29][32]-[35]}
- Activated partial thromboplastin time (aPTT)^{[29][32]-[35]}
- Fibrinogen^{[29][32][34][35]}
- von Willebrand studies^{[33]-[35]}
- Blood group (for interpretation of von Willebrand levels)^{[33][34]}
- Factor VIII level^{[33]-[35]}
- Factor IX level^{[33]-[35]}
- Liver function tests (for secondary platelet dysfunction)^{[29][34]}
- Renal function tests (for secondary platelet dysfunction)^{[29][34]}

In the case of precruising babies with unexplained bruising, additional testing for occult bone, head and eye injury is often recommended, in consultation with clinicians in child maltreatment paediatrics. This should include a skeletal survey for all children younger than two years of age with injuries from suspected physical abuse (eg, bruises, fracture). Consideration should also be given to head imaging and an ophthalmology assessment for occult injuries in this group.

Von Willebrand disease, platelet function disorders and mild factor deficiencies can be difficult to diagnose. Therefore, second-line testing should be conducted if there is a personal or family history or a physical examination finding that raises suspicion of a bleeding disorder (even with normal first-line

test results), or if first-line test results are abnormal. Second-line testing should be undertaken in consultation with a hematologist and may include additional factor levels, thrombin time, platelet disorder testing (eg, platelet aggregation studies or platelet function analyzer-100 testing) or other specialized tests. Bleeding time testing is no longer recommended because of its poor sensitivity and specificity, as well as the invasive nature of the test.^[38] The test results should be compared with age-specific reference ranges, and preanalytic causes for abnormal results (eg, over- or underfilling phlebotomy tubes or drawing blood from a heparinized line) must be considered.

Documentation and consultation

All clinical information should be carefully and objectively documented. Recommendations for documentation are reviewed in Ornstein's article entitled 'An approach to child maltreatment documentation and participation in the court system'^[39] and in a CPSP Highlight entitled 'From bruises to brain injury: The physician's role in the assessment of inflicted traumatic head injury'.^[40] Skin findings should be documented using a body diagram or drawing indicating their measured size, shape, colour, location and contour (flat or palpable). While this information cannot be used for dating a bruise, it is useful for confirming that a lesion is a bruise, for evaluating the injury mechanism and in formulating a differential diagnosis. Photographs, taken with a measuring tool and colour bar and stored securely as patient information, are also recommended.

Clinicians in child maltreatment paediatrics can provide support, guidance and expert opinion on the differential diagnosis, possible mechanisms of injury and the degree of certainty that maltreatment has occurred. A hematologist should be consulted if a bleeding disorder in the child or family is suspected or when there is a significant abnormal result on initial laboratory testing. A dermatologist can also help to clarify undifferentiated skin lesions. A child welfare authority should be consulted whenever there is concern for maltreatment as a cause of bruising.

Conclusion

Bruising occurs frequently in childhood from minor accidental injury and is also the most common finding in child physical maltreatment. The clinician's role is to recognize bruising that may signal maltreatment or a medical disorder, to conduct a thorough medical assessment and initiate testing, to communicate maltreatment concerns to child welfare authorities and to document all information clearly. This practice point offers a practical, evidence-based approach to evaluating bruises in the context of suspected child maltreatment, consistent with other published recommendations.

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Principal authors: Michelle GK Ward MD, Amy Ornstein MD, Anne Niec MD, C Louise Murray MD