

Chapter 6: Evaluating Burn Trauma

Reading:

Feldman, KW. "Child Abuse by Burning" in The Battered Child, 4th Ed. Kempe & Helfer, Eds. 1987, Univ of Chicago Press, Chicago, Ill: 197-213

So far, we have been talking about children who may be brought to the CHAMP physician's office for diagnosis and care, and needn't be sent elsewhere for inpatient or subspecialty care. Some burns fall into this category as well. The patient may be brought to the CHAMP physician as the first medical contact, and the CHAMP physician may both consult for the requesting agency and provide care for the child's medical needs.

Some burn cases, however, are brought to emergency departments and admitted to the hospital, or transferred to children's hospitals and regional burn centers. This is the first situation we have mentioned in which the CHAMP physician may need to consult for a requesting agency, in the absence of direct contact with the child. Such situations are often difficult. The CHAMP physician will be dependant on the recorded medical history of other providers, photographs of the actual injuries, and cooperation between local investigators, and distant medical providers in obtaining laboratory and imaging studies. Despite these limitations, the CHAMP physician can be of great assistance to local investigators in understanding what is going on with the child's medical care, and in communicating with medical systems that provide that care. The limitations, however, must be taken into account when rendering any opinion and preparing a report. Arguing a point from the records of another provider is not as secure as making the point from your own assessment. There are likely to be gaps in your knowledge of how history was obtained, and what was actually said. You may have to rely on drawings, photographs or descriptive reports, in place of performing an examination yourself. Such limitations must be acknowledged, and caution is warranted.

A. History:

The history, in a burn assessment, is similar to that of a bruise assessment. A complete medical history is taken. The events leading up to and resulting in a burn event are obtained in detail. Where no burn event is reported, all events of the days preceding the recognition of the suspected burn are reviewed. The evaluation of burns, however, may call for unusual details. In the case of tub and tap water burns, the state of the plumbing may be as important as the state of the child. Was a child's bath being run as the first use of plumbing after a cold night, or had three other people taken a shower before preparing the child's bath? Was a dishwasher running adjacent to where a child was burned in a sink bath, and does that dishwasher discharge into the sink drain? Does the tub water control use two rotating handles or a single central handle? Did someone flush the toilet, or start a washing machine, while hot water was running on the child? Similar issues come up with clothing iron burns. What was the setting on the iron? Does it have an auto-off feature if left unattended? How much time passed between when the iron was turned off, and the burn occurred? When a cigarette burn is suspected, it is important to

know if there are smokers in the home. When a burn is suspected, but no burn event is reported, the fact that the family was playing in the sun and drinking lime based fruit drinks can be important. Photophyodermatitis is a skin condition that may redden, brown or blister skin when lime or other fruit juices are on sun exposed skin. Patterns, such as hand marks or cup rims may be seen as suspicious. Some of these details can be logically anticipated, but others are idiosyncratic, and do not seem important until the right question is asked. A far reaching history is the best preparation for subsequent considerations.

B. Physical Examination:

Again, it is unnecessary to delineate here every aspect of a complete examination. Many burn evaluations make use of the same examination and documentation techniques discussed in the bruising and photography chapters. We will confine the discussion to certain findings. When a cigarette burn is suspected, the condition of the nares, and throat may have special significance. Bullous impetigo has been mistaken for cigarette burns, and is the most common medical condition mistaken for physical abuse. Rhinorhea and crusts about the nose, or exudative tonsillitis raise the issue of strep or staph, though their absence does not rule out impetigo. The presence of fever and general illness may signal an underlying illness. A febrile infant with erythroderma and a positive Nikolski sign may have scalded skin syndrome, and a sick febrile adolescent female may have toxic shock syndrome.

Burns are generally divided into fluid burns, and contact burns, meaning contact with a heated solid. Fluid burns may be identified by their ability to follow the curves and crevices of the body. Often the burn is of uniform depth, though drip marks may be found to have decreasing depth as the fluid dripped and cooled. Small islands of burning surrounding an area of larger contact may be from a splash, and scattered islands of burning distributed about a denser center usually signal splatter. When burns involve a complete extremity or the entire lower body, ending in a sharp demarcation, it may be possible to position the child such that the burn edges align on a single plane. This phenomenon is called the “high tide mark” and indicates that the child was immersed into hot fluid up to a level, making that “high tide mark.”

Areas of sparing within the immersed tissue may be caused by body parts pressing together, or being pressed against the vessel that contained the hot fluid. In this way the position of the child, during the burn event, may be reconstructed. If it is a natural position, then the CHAMP physician must consider whether the child could have gotten themselves into the situation. If the position is unnatural, or does not allow for self support, then the child must have been placed in the situation.

The presence or absence of splash marks has been given great significance. Certainly a flailing child, trying to escape may put extremities in and out of the fluid, and splash the fluid on non-immersed body parts. A clear border without splash marks is very suspicious, but, an inflicted burn may involve some splashing as well. The presence of splash marks do not eliminate abuse. There have also been anecdotes of children

freezing when only their legs or feet are being burned, causing a “high tide” mark, and no splashing. Splash marks help to recreate the burn event, but do not by themselves fully distinguish abuse from a non-inflicted burn.

When fluids are spilled, they invariably fall downward. If the volume is small, they cool and lose the ability to burn as they fall. By looking at burn distribution and depth, and considering falling fluid, it is often possible to recreate the position of a child during a spill burn. If a right arm and axilla, face, left shoulder, and anterior or posterior trunk are burned, we might imagine a child reaching up with their right hand, while looking at a pot they are about to pull off of a stove. If the back of the neck, top of the head, both shoulders and lower chest are burned, we might imagine a child looking down and hiding their face, while coffee is thrown at them. In both cases, lesser burns of the abdomen and lower extremities, with drip patterns might be expected.

When a heated solid touches the skin, it will leave an image of where it contacts the skin, so long as it does not slide during contact. A full sole print of an iron means that the iron was pressed hard enough to flatten the curves of the skin and make full contact, without sliding. Such an imprint suggests inflicted injury, unless a history provides for exactly such a contact. A partial imprint, with a sharp edge or stem vent, however, only means partial contact without motion. Given how fast a steam iron can burn, this may occur during a fast bounce. A history still must explain such a contact, but it would be easier to accept an accidental scenario under such circumstances.

Just as with bruises, multiple injuries will be looked for. The presence of multiple unexplained injuries in young children forms the “battered child syndrome” and strongly suggests child abuse. When multiple dry contact burns occur, it is harder to explain with a single accident. When burns occur on the body, such that contact with a single large surface could not explain them, they are said to be on “multiple planes” of the body. Usually this means multiple injury events, though every given history must be evaluated on its own merits.

C. Burn Scene Investigation

An investigation of the scene may be helpful in many abuse evaluations, but nowhere is it more important than with burns. The CHAMP physician may not go to the scene of the injury, but must coordinate with investigators who will, both before and after the scene investigation. Let’s review a case that demonstrates all aspects of a well evaluated scene.

A child presents with second and third degree burns of the lower extremities, perineum, buttocks, low back and low abdomen. This is recognized as an immersion burn, with a sharp high tide mark, and no splashes. There is sparing of the anterior and medial flexural creases of the thighs, behind the knees, and in a belly roll. The medical staff positions the child in such a way that a high tide line is readily seen. In this position, the distance from the lowest part of the child, to the high tide mark, is eight inches. All these facts are shared with the law enforcement.

The history indicates that at the end of a busy day of doing laundry and housework, mother took a shower, then decided to give the two year old a bath. She adjusted the water to the proper temperature, then plugged the drain, and put the child in as the water ran. The phone rang, and she went to answer it, but told the caller to call back later as she had a child in the tub. She estimates the call took her away for about 30 seconds. As she returned she heard the two year old screaming, and found him standing in the water with red, but not yet blistered burns.

Law enforcement officers went to the home, and ran the hot water for some time, to prime the pipes as they were in the history. They then put a ruler and a fast reading thermometer in the tub, and another fast reading thermometer under the tap. They started a stop watch and turned the tap on full hot. The water emerged at about 90 degrees, but the thermometer rose to 135 degrees within 20 seconds, and stabilized. Water in the tub rose slowly to eight inches depth, taking about five minutes to rise to that level. Initially the tub water was 75 degrees. Within a minute, it had risen to 115 degrees. By the time the tub was filled to eight inches, the water temperature was 125 degrees.

This scene investigation tells us several things. The tap water is too hot, and may cause full thickness burns within a few seconds when fully hot. On the other hand, the tub water, while painfully hot, would require a few minutes to cause full thickness burns. Additionally, filling to eight inches takes five minutes, not the thirty seconds reported by the mother.

In order to cause such a burn, without restraining the child for an unreasonable time, the mother would have had to run fully hot water into the tub initially, to warm the tub and prime the tap. Then she would have had to run the tap for five minutes to achieve an eight inch depth. If all this preparation resulted in tub water that was still 135 degrees, the temperature at the tap, the mother still would have had to restrain the two year old in the flexed abnormal position during a ten second immersion to produce the particular burn pattern.

D. Imaging and Laboratory Investigation

Several infectious differential diagnoses have been listed. If clinically indicated, cultures will support these diagnoses. Unusual conditions such as bullous pemphigus can be confirmed on skin biopsy, if clinically suspected. Otherwise, no routine labs are done to rule out alternative hypotheses.

While there is literature suggesting that burn patients are less likely to have evidence of other inflicted injuries, a reasonable search should be performed. Skeletal X-ray survey in the child under two is required. A severely burned older child will be on pain medications, and unable to reliably indicate other injuries, so they should also be investigated with skeletal X-ray survey. AST, ALT, amylase, lipase and urinalysis should be collected to evaluate for visceral injury. Visceral injury and burn injury have the same peak age of incidence. Screening imaging of the head is not required, but a

child with depressed consciousness should have a head CT.

E. Assessment and Diagnosis

A diagnosis of abusive inflicted burning may be made where the burn pattern is unmistakably abusive in nature. Clear immersion burns of the buttocks and lower extremities, with sharp high tide mark, and limited splashing should be regarded as abusive, barring a very unusual history. Where the child is neurologically handicapped and might be expected to remain in painfully hot water without alarming or moving, an exception may be made. Spill burns require more careful evaluation of the history. Full imprint contact burns are highly suspicious. When they occur repeatedly or the history fails to reasonably explain them, abuse should be diagnosed. Partial imprints will again require consideration of the history, and how it emerges.

Many burns that are not the clear result of abuse, have an element of supervisory neglect. Defining when lack of supervision is neglect, and when neglect rises to a reportable or criminal level is difficult. When a child suffers a significant injury, or was placed at risk for severe or fatal injury, by caretaker oversight, diagnosing child neglect and reporting this to CPS is reasonable.

F. Diagnosis and Treatment Plan

Mild burns may be treated topically in the outpatient setting. Severe burns require specialized treatment and will be referred away from the CHAMP physician. In this setting, the CHAMP physician will need to support the investigating team in requesting assistance of the treating facility, interpreting medical records, and coordinating the scene investigation. Most diagnostic issues in burning are rapidly resolved. Long term care, however, may be quite involved, prolonged, and taxing. Assuring that the family, or CPS system adheres to follow-up treatment is difficult, and may again raise issues of neglect. Victims of severe non-inflicted burns may also have significant emotional consequences. Assuring that mental health treatment occurs further contributes to the child's best outcome.

G. Conclusion

Minor burns are evaluated much like bruises and other cutaneous trauma. Major burns will likely place the CHAMP physician in the position of outside consultant. This is a difficult but valuable role. Simply assuring that a quality burn scene investigation is performed contributes in a great way, to the evaluation. Another role for the CHAMP physician is educational. Burns and burn scene investigation is a topic that may be presented to CPS and law enforcement before the next burn case is investigated. This will both cement the relationship between physician and system, and prepare the system for a good first response.