D27 Optimizing Radiographic Image Quality in the Postmortem Investigation of Child Abuse

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After attending this presentation, attendees will gain a further appreciation of the importance of skeletal imaging in the investigation of sudden, unexplained deaths in infants and children. The attendees will acquire an understanding of the imaging techniques necessary to optimize image quality, and therefore, to best demonstrate subtle fractures.

This presentation will impact the forensic science community by providing an understanding of the imaging techniques recommended in order to enhance radiographic image quality and discussing the techniques which should be avoided during postmortem pediatric skeletal imaging.

This research includes 29 deceased infants and children aged several days to five years that underwent autopsy and radiographic examination at the Office of the Chief Medical Examiner in Farmington, Connecticut between the period of December, 2005 and December, 2007. “Babygrams” and skeletal survey examinations were performed. In addition, various combinations of image receptor speeds (400, 100, and 50 relative speed index (RSI)) were used in order to observe the differences in recorded detail for each image receptor speed. To establish optimal exposure factors for various sized infants and children, the length, weight, kVp, mAs, RSI, source-to-image distance (SID), and the presence or absence of a grid were recorded. Bilateral oblique views of the thorax were included in the protocol to determine if those projections enhanced the ability to detect rib fractures in these cases.

Two of the cases demonstrated rib fractures and the affected ribs were extracted and specimen radiographs were performed.

The results of this study confirmed the superiority of the skeletal survey images over the “babygram” images as anticipated. In addition, 50 RSI image receptors offered superb recorded detail compared to the 100 and 400 RSI counterparts. Rib fractures demonstrating abundant callus formation were present in two of the 29 cases (case # 1 and case #29). Both infants suffered from multiple bilateral fractures of the posteriolateral ribs. AP thorax radiographs in case #1 demonstrated evidence of healing fractures of the left 3^{rd}-6^{th} and right 2^{nd}-7^{th} posteriolateral ribs with abundant callus formation bilaterally. Addition of AP oblique views of the thorax provided improved fracture visualization and demonstrated abundant callus formation and possible new fractures through the bony callus. Specimen radiographs provided improved visualization of the fracture sites and confirmed the new fractures through the bony callus; however, no additional fractures were identified in case #1 through this method since the bony callus allowed for easy fracture visualization.

The initial AP radiograph of the thorax in case #29 failed to demonstrate evidence of bony thoracic trauma. The addition of AP oblique views of the thorax resulted in visualization of multiple rib fractures with callus formation of the left 4^{th}-6^{th} posteriolateral ribs. The entire thoracic cage was removed at autopsy and specimen radiography was performed using 50 RSI image receptors. The specimen images resulted in improved visualization of the left posteriolateral rib fractures which were also easily visualized upon gross inspection. However, specimen radiographs revealed multiple fractures of the right 4^{th}-6^{th} posteriolateral ribs which were not easily visualized on the previous radiographs or upon gross inspection. Additionally, a 3° cephalic angle was utilized in order to demonstrate the fractures from another perspective and further enhanced the visibility of the fracture of the 5^{th} rib.

Many child abuse fractures are subtle and can easily be overlooked, therefore optimal images are critical. In order to produce images with the best diagnostic quality, specific protocols and image receptors must be used, and “babygrams” should never replace skeletal survey examinations. Proper positioning of the anatomy is imperative, otherwise fractures can be missed. The addition of oblique views of the thorax increased the fracture yield in case #29 and proved to be beneficial since rib fractures have a high specificity for abuse and oblique views can increase the visibility of such fractures. In this study, the addition of a 3° cephalic angle during specimen imaging better demonstrated the fracture line of the right 5^{th} rib in case #29. This finding reinforced the fact that the relationship between the x-ray tube, anatomy, and image receptor plays a significant role in fracture visualization, particularly with rib fractures.

Radiography, Child Abuse, Rib Fractures

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