Role Of Radiographic Modalities In Detecting Child Abuse

Introduction:

The radiographer will encounter many types of injuries one of them which is refers as (Non accidental trauma or sometimes called as child abuse. Many children especially children younger than the age of three will face this abuse. In addition, worldwide suffer from child abuse which can result from verbal, physical or sexual harm by parents or other adults. The most important method in detecting child abuse is using of medical imaging. It is an effective tool that can help these children to know the cause of this abuse because this issue can affect their lives in a bad way, affecting their relationship with others, leading to many behavioural problems such as a substance abuser and emotional problems. The radiologist must be familiar with the conditions to choose the correct imaging modality in order to get the suitable diagnosis and to differentiate between the normal and abnormal pathology and anatomy. The patient will benefit by getting effective treatment.

Definition of child abuse:

Child abuse meaning that the child has emotional harm or injury which cause harm to the child and death. This can happen when the child is forced to action, fall or subjected to a strong act by somebody. However, there are a lot of forms of child maltreatment, including physical abuse, maltreatment, emotional and sexual abuse. (4)

Role of the radiologist in child abuse:

The ability to recognize child abuse comprise an essential concern to those involved to take care of children. The radiologist can be the initial person who suggest the correct diagnosis based on the imaging modalities in the radiological department. For example, CT scan can perform to evaluate neurologic symptoms or seizures and other diseases. In addition, there is a protocol to image the abuse and to give high-quality radiographic images. So, the radiologist has the highest impact to recognize these features and to choose the correct method that fit with the cause of abuse.Moreover, the radiologist must have good knowledge about the mechanism of the child abuse so, interventions can be made to help the child. (7)

Role of radiographic modalities in detecting child abuse:

Radiographic imaging modalities plays an essential role in detecting child abuse mostly the child with physical abuse. However, using the correct modality will help the radiologist to get the good diagnosis. Radiographic imaging can provide enough information for many organs and body parts of the child that may be affected. For example, head trauma, skeletal trauma and thoraco-abdominal trauma. Moreover, the variation of the imaging modalities can help to improve the outcomes by focusing on the specific place of the injury and reduce the fear of the child by choosing the correct modality. This, will reduce the time and reduce the amount of exposure. Accuracy must be taken to get a better diagnosis and treatment.

1) X-ray

X-ray skeletal survey:

Using of radiographic skeletal survey is the essential imaging examination and strongest radiographic indicator to detect the presence of fractures and help to know the cause of child abuse. It is available in every place and not expensive choice when comparing to other imaging modalities. Skeletal radiographs help to detect the damage of the bones and to get additional information related to injury. However, skeletal survey was usually done for pediatric patients that they are less than the age of two. While for children with age more than 5 years, this survey has a little value to screen these types of injuries. This type of skeletal survey with high quality to precise the results and give the good evaluation of physical abuse in children. This survey must compose of lateral and frontal images of the skull, lateral thoracolumbar spine, lateral cervical spine and views of feet, hands, abdomen and chest. Add to that, taking radiographic views with oblique position to the ribs will increase the precision to diagnose the presence of rib fractures. Having the images should be done with using of systems with high detail and precise the area of interest of the body parts with a separate view to the forearm, arm, leg, hands, foot and thigh. Mostly, the fractures will be found in long bones and lastly to involve in other body parts such as the clavicle, skull, pelvis and spine. Moreover, Skeletal scintigraphy which is bone scan is a good adjunct to the skeletal surveys, but extreme care must have when using this method especially with infants. It can be used to raise the sensitivity to detect rib fractures and shaft fractures. (5)(6)(8)

2) CT

CT has a major role to help in detecting child abuse. Doing CT without using of intravenous contrast should be done like a part in the primary evaluation of suspected strike in head (head injuries and facial injuries). It has a high specificity and sensitivity for diagnosing head abnormalities such as acute subarachnoid, intraparenchymal, epidural and subdural haemorrhage. Any abnormalities that need surgical because of the emergency condition in the head also it will be good demonstrated.So, children with Intracranial injuries must have a CT because it is a radiographic modality that is easily to have and faster which it used multiplanar reconstruction which is beneficial especially for those with serious diseases. So, head injuries can be happened by many reasons such as shaking the baby with force. Moreover, CT is preferable than MRI for detecting of acute haemorrhage. Add to that, associated facial and skull fractures also can be diagnosed with proper use of bone window setting. (5)(6)(9)

3) Ultra-sonography

Sonography in small infants has a limited but essential role to assist the long and short-term consequences related to head injury. The presence of tears in the Subcortical white in anterior and frontal-parietal parasagittal regions can be seen with this technique. Moreover, sonography can differentiate between subarachnoid collections and subdural collections and it may used with CT and MRI when the radiologist suspected a traumatic injury. Add to that, ultrasonography can give more details, help to estimate the degree of organ injury and diagnosing of skull fractures. (5)(9)

4) MRI

The MRI is a useful radiographic modality to asses and detect intracranial injury, including intraparenchymal haemorrhages, extra-axial collections, swelling in the brain or edema and shear injuries. Imaging should be done with T2 and T1 weighting with using of inversion-recovery sequences or proton-density to differentiate water containing lesions from cerebrospinal fluid. However, using of gradient echo sequences can help to detect haemorrhage. The MRI give and shows the high level of specificity and sensitivity to diagnose chronic injuries and should be used when having a typical skeletal injury related to shaking or other causes for child abuse. MRI has the advantages that the not using of ionizing radiation. So, the risks related to x radiation will not be there like using of CT, the child will not receive radiation that may affect him more and it used multiplanar reconstruction technique so, the chance of reposition of the patient will be decreased. Add to that, MRI can help to detect the alteration in the central nervous system and for infants with a symptom related to shaken baby syndrome. Moreover, MRI can show the pattern of the injury and MRI is a highly sensitive to detect subdural hematoma. (5)(2)(9) Radiological findings (Injuries associated with abuse):

- CML (Classic metaphyseal lesion):

Also known as corner fracture or bucket-handle fracture is the most widespread non-accidental injury that related to skeletal system and it seen a lot in child abuse. It can be cause by applying a direct force to the extremities. However, X-ray will help to detect this type of fracture to demonstrate it clearly which will help the radiologist to diagnose the cause of abuse. In addition, CML can be seen on a radiograph image perpendicular to the long bones and it mostly happened to the distal femur and tibia. The radiographic appearance of this type of injury will depends on the position of the area that affected by the injury and the fragment size (5)(1)(6)(7)
- Rib fractures:

Rib fractures especially in children when they are younger than three years have a value about 95% indicator for abuse. So, this type of fracture mostly happened with infants. Imaging modalities will help to detect this type of fracture. X-ray is a useful radiographic modality that will help to detect fractures to the ribs and shows the outlines of the ribs with the correct shape for them. However, Rib fractures especially posterior rib fractures have the high range for child abuse. This can happen when shaken the baby which call it as shaken baby syndrome. This action causes a force with pressure to be apply to the child, squeezing the child violently which will cause the ribs to be affected and get hurt. (5)(1)(6)(7)(8) - CNS injuries associated with abuse:

1. Subdural hemorrhage
2. Subarachnoid hemorrhage
3. Cerebral edema

Head trauma will lead to death especially in children younger than two years. Children and Infants with intracranial injury must have MRI or CT Cranial radiograph. Ultrasound also can detect intracranial injury, but it cannot give the adequate information that the radiologist can exclude or evaluate the injury in a fully way. However, CT without contrast is the initial imaging modality that can be used to evaluate intracranial injury. For examples, CT can detect subarachnoid which means bleeding in the ventricle. So, CT will give the precise details of the images that will help to diagnose correctly. Add to that, the appearance of subdural hematoma can give the radiologist enough information that will help him to know the time of injury.

Although, the time of injury can be detected, it can also be used with conjugation with the patient history detail and the information from the physical exam.(7)(3)(6) - Skull fractures:

Skull fractures are prevalent injury related to child abuse. The patterns of skull fracture in child abuse include impression fracture to the occipital bone and fractures to the sutures. Also, like an eggshell fractures pattern. The skull of infants is very impedance to trauma. So, any fracture that is incompatible with the patient history will increase the questions that might be a non-accidental injury. X-ray will help to detect this type of fracture and see these abnormalities with precise diagnosis. (6) (2)(7) - Thoracoabdominal Trauma

Thoracoabdominal Trauma is an injury that involve the abdomen and chest. It is not common like the skeletal and head injuries, but it has a negative impact on the patient. Children that suffer from this injury and has a trauma will undergo firstly to x-ray in the x-ray emergency department to examine the chest and to see the condition of the ribs. After a time, patient may undergo the CT scan because CT is a sensitive and effective radiographic modality that help to identify injuries related to lungs, pleural cavity and abdominal organs. Add to that, the using of helical CT to the thorax and abdomen with the used of IV contrast that help to visualize the organs better. However, small children less than one year, they may have ultrasound radiographs to detect these abdominal injuries. Add to that, children who has an abuse will have more incidence of duodenal and pancreatic injury, bowel perforation and solid organ injuries. (6)(7)(8)

- Spinal trauma

Using plain radiographic imaging are usually enough for evaluation of spinous and vertebral compression fractures and the presence of mass. Also, radiographic images can be taken to cervical However, compound fractures demand the used of CT with multiplanar reconstruction technique. In addition, MRI also may be used when there is nerve or spinal cord injury. (6)(7)(9)

- Long bone fractures:

Pediatric bones will be affected and have bad consequences more when comparing to adults and the other age groups. The fractures of the long bones have low or small specificity lesions for child abuse. This make it an important as they are prevalent in children with child abuse. However, when the child is experience to the child abuse their bones, especially diaphyseal fractures to this bone will be seen. So, X-ray radiographs will help to detect this type of fracture and see the abnormalities to the bones in order to diagnose correctly. In addition, adequate knowledge must have about the configuration of the bones in children to make it enough for interpretation. (5)(6)(7)

Conclusion:

To conclude, radiology science can help a lot in detecting the reasons and injuries related to child abuse. Although Child abuse can cause by many reasons such as physical and emotional harm. The child will suffer much because of this abuse which will affect him either physically or emotionally. The radiologist has a major role to find the abnormalities in order to get the diagnosis. However, the variety of radiographic modalities will increase the accuracy and the reliability of the diagnosis and results. Each modality will give different radiological findings

depending on the degree and type of injury. So, these techniques will assist the child to overcome the problem and suggest the correct treatment related to the child’s condition.