Radio–Opacity of Commonly Consumed Bony Fish in Kelantan, Malaysia

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SUMMARY

Fish is one of the major sources of protein among Malaysians. This has made incidents of fish bones lodged in the throat fairly common clinical problems. Plain radiograph, which is the first line of imaging in such cases, has been reported to have low sensitivity. Besides the location, the degree of radio-opacity of the bone is another important factor and is species dependent. This study was undertaken to determine the radio-opacity of bones from commonly consumed fish in Malaysia. A total of 15 types of fish were identified, six of them were opaque even when embedded and three were visualized in the simulated airway. In terms of radio-opacity, the commonly consumed fish in Malaysia possessed opaque bones and this fact can help doctors identify the location of the foreign body in the throat.

KEY WORDS:
Foreign Body, Bone, Fish, Malaysia, Radiograph, Opacity

INTRODUCTION

Bony fish is common in the diet among Malaysians. One reason is because fish is a cheap source of protein. It is not uncommon in Otolaryngology practice to have patients with fish bones stuck in the throat or esophagus presenting in outpatient clinics. Usually adult patients will point towards the site of discomfort in the throat and that will suggest the location of the foreign body.

If clinical examination, which includes laryngoscopy, fails to locate the fishbone, usually a neck radiograph can help. The common modalities used are anteroposterior and lateral views neck radiographs. Plain radiographs are often taken to localize fish bones which lodge in the pharynx [1].

There is little study on opacity of fish bones in the English literature. Most of those available are studies done for the commonly consumed bony fish in Western countries population. This study is undertaken to determine the opacity of common fishbone consumed by Malaysian population.

MATERIALS AND METHODS

This prospective study was conducted in Hospital Universiti Sains Malaysia, Kelantan which is located in the East Coast region of West Malaysia. A list of bony fish that were commonly consumed by local people was obtained. The bones, preferably the ribs of the identified fish, were collected. The thickness and the size however could not be standardized because of the nature of the fish skeleton itself differs from one to another. Chicken meat was used to simulate the soft tissue of the neck (STN).

Simulated model

Selection of chicken meat was used as the simulated model was based on the finding it had a Hounsfield Unit (HU) measurement that was similar with human neck soft tissue (Figures 1A & 1B). Two pieces of chicken meat, 5cm thick were made to simulate the right and left sides of the soft tissue neck. A gap of 2cm simulating the airway was created in between the two pieces of meat (Figures 2A & 2B).

Computed radiograph (CR) was performed after embedding the bones in an orthogonal position in the chicken meat. Half of the length of the bone was embedded into the simulated STN and another half was exposed in the air simulating the airway. Distance and radiation factors of 55 kilovoltage (kV), range of miliamperes (mAs) from 2-5 and 100cm subject to source distance (SSD) were used in this study, as to simulate the physical parameters used in soft tissue lateral neck radiography for foreign body detection (Figure 3). The CR images are then sent and stored into the Picture Archiving and Communicating System Integrated Web (PACS-IW) and the images were reviewed using FDA approved BARCO computer monitors at the designated workstation by 2 observers (1 radiologist and 1 otolaryngologist). Toolbar functions in the PACS-IW BARCO monitor which containing factors of contrast windowing, pan and zoom/magnification were modified accordingly in order to gain optimize visualization of the bone opacity.

RESULTS

A total of 15 types of fish bones were identified. The majority of them (9) demonstrate radio-opacity including when fully embedded (the bone is in the tissue) or in the airway (the jutting out portion of the bone in between 2 STNs) (Table I).

DISCUSSION

In current practice, persistence of symptoms is the indication for exploration under anesthesia which includes direct laryngoscopy and oesophagoscopy despite of normal lateral neck radiograph. This practice is in agreement with available literature that plain radiograph has low sensitivity in

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Table I: Type of fish bones and the degree of opacity

Degree of opacity	Opaque even embedded	Opaque in airway	Radiolucent
Types of fish	Seabass Catfish Pangas Tuna Snapper Hardtail scad	Grouper Herring Croaker	Black pomfret Yellowstripe scad Yellowtail scad Pony fish Mackerel Short Mackerel

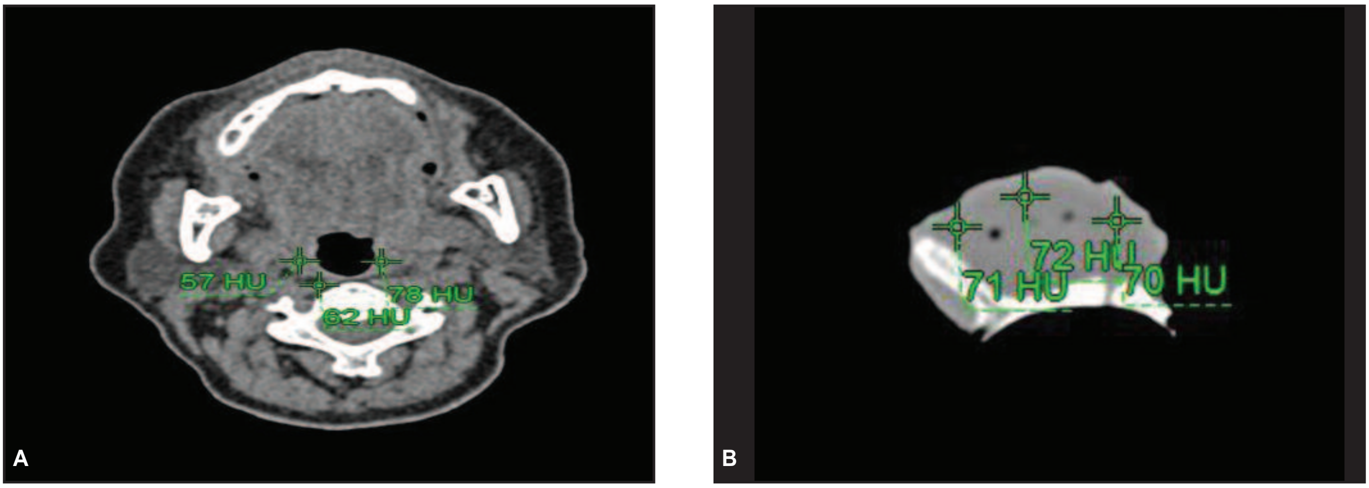

Fig. 1A & 1B : Computed Tomography (CT) scans of the normal human adult neck (soft tissue of the neck is 57-78 HU) and that of the simulated model using chicken meat (70-72 HU).

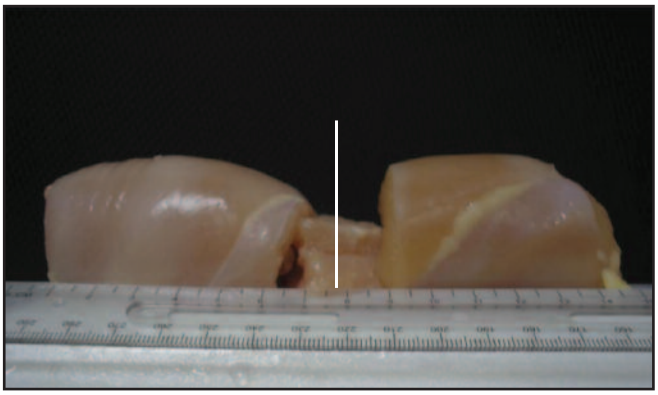

Fig. 2A : Simulated model using chicken meat, with white line representing the position of bones inserted. The two 5cm-length meats on the sides simulating soft tissue neck (STN), while gap in between is the airway.

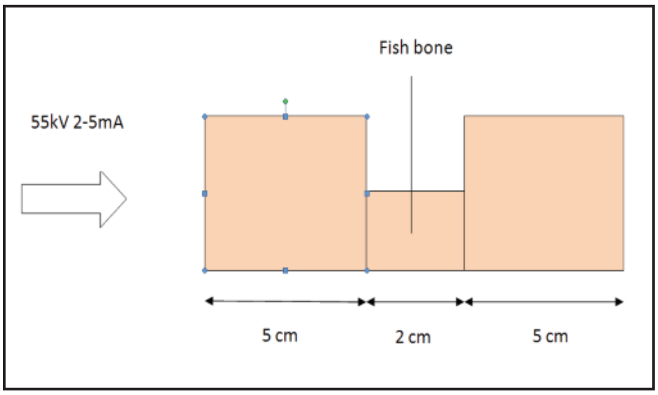

Fig. 2B : Schematic diagram of the simulated model.

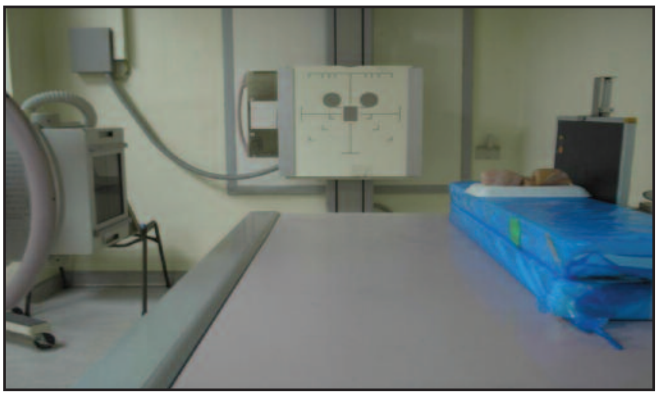

Fig. 3 : The distance and exposure factors used are similar to that for the lateral soft tissue neck radiograph. Note the x-ray tube on the left and the simulated model with detector panel on the right.

detecting fish bone in the throat [2]. For Malaysia, the radio-opacity of bony fish that people commonly consume has yet to be studied. The current conclusion of low sensitivity in detecting fish bone in throat was based on data from Western countries, which used their local fish in the study [1-4]. For example, radiography is very useful to detect the bones of cod, haddock, lemon sole, cole fish, grey mullet and plaice; and useful for red snapper, monk fish, gurnard and salmon [4].

There are multiple factors that affect the visualization of an impacted fish bones in plain radiograph, and one of them was types of fish itself. The thickness and length of the bones may influence the visualization as well. Besides that, the location of the impacted bones may play a role in the detection on plain x-ray. For example, the bones which lie near the cricoids may be masked with the calcification of the laryngeal cartilages. Fish bones which lie behind the human facial bones will be more difficult to be visualized and this explained why bones in tonsils, though they are common are often missed on plain x-ray as compared to the hypopharynx impaction [4]. The orthogonal position is the best to detect fish bone in throat on imaging [5]. Altogether we managed to obtain 15 types of fish bones, which was the biggest collection in the study of fish bone radio-opacity available in the literature. Techniques of cooking was postulated to affect the degree of opacity, however was found to have no influence [5]. This study has included all desired bones regardless how the preparation of the fish was made. A future study could be designed without using any simulated soft tissue to determine the degree of opacity of the individual bones. This is because the soft tissue factor itself, even though controlled (fix model) and matched (with human soft tissue HU on CT) can affect the visualization. The thickness and density of the tissue itself may make the 'radio-opaque' fishbone become radiolucent because of its invisibility in the soft tissue variables. A degree of opacity could be further determined if control instrument for bone opacity is present for gold standard comparison.

Out of 15 selected bones of commonly consumed fish by local people, 9 of them were found to be opaque of clinical significance. They were either visualized even in embedded condition or in the airway. Adjusting the contrast of the CR image(s) on the workstation may improve the visualization of the fish bone, if any. This will reduce the need for repeat radiographs to adjust exposure factors, thus reduce the cost and radiation exposure to the patients. In addition, with the adjustments made using designated toolbars functions, if film printing is needed, only one best visualized image on the screen can be chosen hence reduce the need to print multiple films.

Some authors concluded that although it is less sensitive, the plain radiography is specific enough for positive results to warrant oesophagoscopy without any further imaging [3]. Another study from South East Queensland using an ovine model revealed the sensitivity of the technique in detecting an impacted fish bone was 79% overall, but varied significantly between fish species [6]. In our study, it demonstrated opacity of majority of commonly consumed fish bones tested. These findings further emphasized the role of plain radiograph as the first line screening tool for suspected fish bone ingestion in our community.

CONCLUSION

Majority of the bones from the commonly consumed fish in Kelantan, Malaysia showed good radio-opacity and this can help the treating doctors to detect and locate any fish bone in the throat. Our study finding was in agreement with other available study in literature that CR should be used as the first line radiological investigation in cases where fish bone impaction is suspected. Even though we do not produce printed film in this study as comparison, the experience using digital CR has shown its effect in avoiding repeated exposure and film printings as optimization of the contrast in the digital imaging would improve visualization of the fish bone.

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