Research on a New Spot-first-aid of Foreign Body Asphyxia Hypopharynx

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Abstract. Airway suffocation is a kind of unexpected emergency. The author's research group proposed a new spot-first-aid method of foreign body asphyxia in the hypopharynx, and compares it with traditional “Heimlich Maneuver” first aid method by simulation comparative study. This article mainly introduced the main contents and methods of the research, primarily on: the processing of CT Imaging data, including: Visual C++ program is used to realize the contour extraction algorithm processing based on CT images pre-processing, and restore the respiratory organs in asphyxia status in the processing of image morphology. Compare the two spot first aid methods by simulation. The Main research steps including: establishing simulated equivalent circuit simulation to compare two different spot first aid methods influence on the change of respiratory airway pressure and the animals steps of the experiments.

Keywords: foreign body asphyxia, Heimlich maneuver, new spot-first-aid method, simulation research, Visual C++

1 Introduction

Foreign body in respiratory tract is frequent emergency with short disease duration and high mortality rate. Foreign body asphyxia can be a life-threatening emergency. The most effective time after the foreign body asphyxia of on-the-spot first aid is only 5 minutes, which is called "5-minute prime time” [1,2]. The most important question to consider is: How to provide a quick, effective treatment and avoid the occurrence of complications in the “prime time”?

At present, the traditional spot-first-aid methods just like “Heimlich Maneuver” emergency procedure is easy to make the patients attacked by the foreign body asphyxia suffer syndromes frequently and great injuries, and the success rate of these methods are low as well [3,4,5].
2 Materials and Methods

Simulation details

2.1 Data Sources

In this study, the three-dimensional reconstruction data that is applied by the authors sourced from the CT imaging materials of the affiliated hospital of Gannan Medical University in Jiangxi Province. Besides, the human tissue organ materials came from the archives of anatomy teaching and case histories. The data visualization is this research foundation.

2.2 Software Tool

At present, LifeMod (Multi-Body dynamics simulation software) is the advanced human body dynamics simulation software in the world. LifeMod automatically produces standard plots of force, displacement, velocities, accelerations, torques, and angles. These powerful post-processing capabilities make creating clear, concise reports and attention-grabbing presentations complete with animations, plots, and charts. This simulation software is an excellent simulation tool.

The simulation experiment, which is introduced in this paper, is put into implementation under the environment of this software.

2.3 Methods and Ideas

First of all, the members in the research group get an understanding of a great number of the basic structures of the respiratory tract of human being.

Second, the research group’s members that devote themselves to the anatomical major carry out a description on the shape and characteristics of the respiratory tract of the normal human being.

Third, the materials used in this paper about the case histories of the respiratory tract foreign bodies are collected, and the description on the characteristics of the shape change is conducted for the data with images.

Fourth, the simulation model is established so as to carry out an analog simulation on the foreign body asphyxia in the human respiratory tracts.

Fifth, the simulation and comparison research are conducted for over two spot-first-aid methods.
3 Results and Discussion

3.1 Image border extracting

Following diagram shows the contour extraction processing example, in which Figure 1 is the original image; Figure 2 is the result of the contour extraction.

![Epiglottis image](Fig. 1. Epiglottis image)

![Epiglottis outline](Fig. 2. Epiglottis outline)

It can be seen contour extraction algorithm can extract the inside outline of the target image.
3.2 Comparison of two methods on first aid simulation

Firstly, the research group reference mechanics classical modeling method of mechanical system, established the related force and displacement of the linear mechanical system:

\[ f = K\ddot{X} + R\dot{X} + M\dot{X} \]

The \( f \) represents the force; \( X \) indicates that displacement; \( \dot{X} \) represents the velocity in first-aid techniques, \( \ddot{X} \) for acceleration, (such as: first aid impact velocity of impact method)

The \( K \) represents the linear elastic coefficients, \( R \) indicates the linear frictional resistance coefficient; \( M \) for the inertia force coefficient.

The second is established simulation equivalent circuit.

"The Heimlich Maneuver" is widely used, and this research group summarizes the research of "Inverted Shock Maneuver" in a certain range successfully treated many patients with respiratory laryngeal pharynx ministry foreign body choking, the research group assumed the key factors influencing the treating results hypothesis as: spot first-aid operation techniques change the pressure of lungs and airway resistance that the role about the two main parameters of respiratory tract [11].

The one-order linear model represents the Movement of respiratory is:

\[ P = \frac{V}{C} + R\dot{V} + I\dot{V} \]

Among them: \( P \) is force, \( V \) is capacity, \( C \) for compliance, \( R \) for resistance coefficient, \( I \) for inertia coefficient.

4 Conclusion

According to the simulation and animal experiments that have been implemented by now, we come to the observed results as follows:

The new first aid methods “Inverted Shock Maneuver” emergency procedure can exert a better role in the discharge of the foreign bodies that exist in the respiratory tracts than the traditional “Heimlich Maneuver” emergency procedure.

The new first aid methods “Inverted Shock Maneuver” emergency procedure can increase aerodynamics effects in the respiratory tracts more rapidly and stronger than used the traditional “Heimlich Maneuver” emergency procedure.

The Inverted Shock Maneuver emergency procedure can implement a timely first aid and also can prevent the residual sequelae of the consequences completely.
Acknowledgements. This work was financially supported by Natural Science Foundation of Jiangxi Province of China (No. 20122BAB215002); the Science & Technology(S&T) Plan Projects of Jiangxi Provincial Education Department (No. GJJ1255); the project of the Industry-University-Research Cooperation of the Higher Education Institutions of Jiangxi Province of China (No. KJLD13082); the Science & Technology(S&T) Plan Projects of Jiangxi Provincial Health department(No. 20113137), and also supported by the 2014 grants of Young Core Instructor and Domestic Visitor Foundation from the Education Commission of Jiangxi Province.

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