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Ergonomic investigation of interventional radiology

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Abstract

Interventional radiology (IVR) refers to a variety of minimally invasive procedures using small-caliber catheters under fluoroscopic or ultrasound guidance for the treatment of vascular and digestive diseases. Common IVR applications include dilatation, occlusion, and selective cannulation of vessels and the digestive canal without open surgery. Indications for IVR are rapidly increasing. However, ergonomic problems of IVR for physicians have not been considered. Such ergonomic problems and countermeasures were investigated in this study. Ergonomic problems during hepatic arterial catheterization and placement of a stent in the digestive canal, two frequent IVR procedures, were investigated. Ergonomic problems of IVR, problems induced by X-ray protectors, inadequate working postures and asthenopia induced by the apparatus, impaired maneuverability and neuro-muscular fatigue forced by small caliber catheter for intra-vascular catheterization, lacks of intuitive usability and standardization the devices and instruction documents are revealed in this study. For the continued safe development of IVR, outstanding ergonomic and technological problems must be resolved. Potential solutions include the development of adequate holding and accessory devices for small-caliber devices, improved educational software, and head-mounted displays. Further analyses of the workflow and ergonomic medical device design with input from end users are also critical.

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Keywords: Intervetional radiology; Mnimally invasive treatments; Ergonomics

1. Introduction

Interventional radiology (IVR) refers to a variety of minimally invasive procedures using small-caliber catheters under fluoroscopic or ultrasound guidance for the treatment of vascular and digestive diseases. Common IVR applications include dilatation, occlusion, and selective cannulation of vessels and the digestive canal without open

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surgery. Indications for IVR are rapidly increasing. However, ergonomic problems of IVR for physicians have not been considered. Such ergonomic problems and countermeasures were investigated in this study.

2. Material and methods

Ergonomic problems during hepatic arterial catheterization and placement of a stent in the digestive canal, two frequent IVR procedures, were investigated (Fig. 1, Fig. 2).

3. Results

Common ergonomic problems of IVR:

- 1. Neuromuscular fatigue and perspiration due to heavy X-ray protectors, resulting in risk of slip and fall.
- 2. Inappropriate working postures imposed by unfavorable arrangement of imaging apparatus such as X-ray and ultrasonography systems and their displays.
- 3. Eyestrain due to dim lighting and impaired maneuverability of devices due to placement of the X-ray monitor.
- 4. Neuromuscular fatigue during small caliber catheter placement for intravascular catheterization.
- 5. Lack of intuitive usability and standardization of IVR devices and instruction manuals.

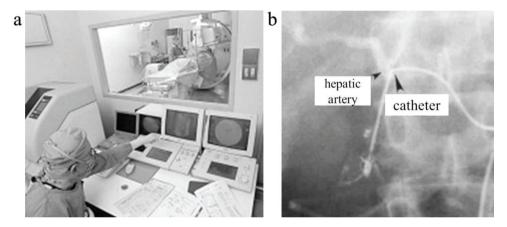


Fig. 1. (a) Scenes of IVR at the angiography room; (b) Intra-hepatic arterial catheterization by IVR.

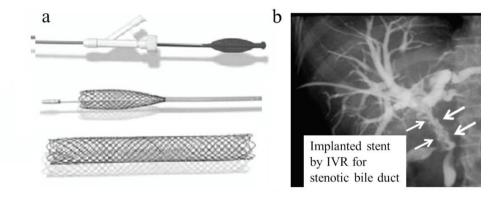


Fig. 2. (a) The stent device for stenotic digestive canal; (b) Implantation of stent for stenotic bile duct.

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