Medical Applications

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Examination of a new angiographic system with a highly sensitive receiver and synchrotron radiation for reducing the dose of contrast medium

Taisuke KONISHI[1]*, Shonosuke MATSUSHITA[1], Kazuyuki HYODO[2], Shizu AIKAWA[1], Chiho TOKUNAGA[1], Yoshiharu ENOMOTO[1], Shinya KANEMOTO[1], Fujio SATO[1], Yuji HIRAMATSU[1], Yuzuru SAKAKIBARA[1]

[1]Department of Cardiovascular Surgery, Graduate School of Comprehensive Human Sciences, University of Tsukuba, Tennodai, Tsukuba, Ibaraki 305-8575, Japan

[2]KEK-PF, Tsukuba, Ibaraki 305-0801, Japan

Introduction

In angiography, an iodine contrast medium must be used. However, side effects caused by contrast medium are a major problem. Dose, high osmolality, ionicity and viscosity have been noted as risk factors associated with contrast medium. Contrast medium induced nephropathy (CIN) is one of serious complications associated with angiography and interventional angioplasty, and accounts for 10 to 12% of all cases of acute renal failure in hospitalized patients. Nephrotoxicity of the contrast media is dosage dependence. On account of this the use of contrast medium must be canceled when the dosage limitation is reached. However, there is a limit to the improvement of the contrast medium which can be achieved. It was assumed that the occurrence of side effects could be decreased by reducing the dose of contrast medium. This could be made possible with an improved angiographic system in which clear images could be obtained even with lower concentrations of contrast medium. The effectiveness of such a high resolution and high contrast angiographic system developed by our group was thus investigated using diluted contrast medium and synchrotron radiation micro-angiography.

Manuscript preparation

In-vitro: The contrast medium was diluted and a 24 gauge intravenous catheter was filled with it. Scans using synchrotron radiation and a HARP receiver were performed. The difference in gray scale value between the background and contrast medium was calculated.

In vivo: Contrast medium was diluted and angiography of rat hindlimbs using synchrotron radiation and a HARP receiver was performed. The availability of each image was evaluated by counting the number of arteries.

Results

In vitro: The difference in contrast medium at low levels was detected with the HARP receiver, but it was not detected in CCD camera.

In vivo: The photon density of synchrotron radiation with the HARP receiver was 1/5 that with the CCD camera. The HARP receiver has about 5 times greater sensitivity than CCD cameras.

Conclusions

It is considered that this new angiography system that utilizes synchrotron radiation and a HARP receiver makes it possible to perform angiography with extremely low concentrations of contrast medium.

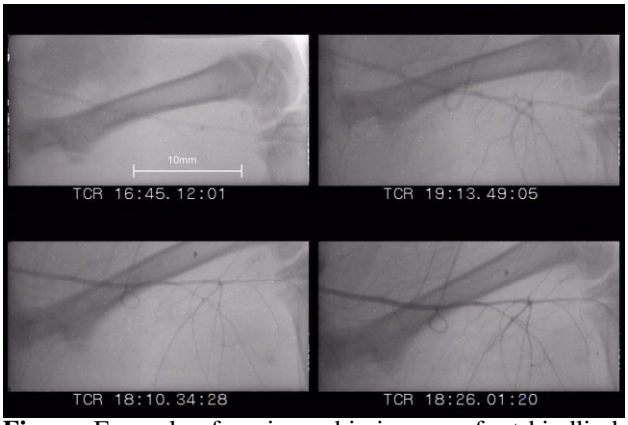

Figure. Example of angiographic images of rat hindlimb using the HARP receiver and synchrotron radiation micro-angiography. Exposure time was fixed to be 30 msec. Images were taken by 4%(left upper), 8%(right upper), 16%(left lower), and 32%(right lower) of iodine in contrast medium. Contrast medium containing 8% of iodine was able to identify femoral artery clearly and up to the second branches, which was almost indistinguishable from in case of contrast medium containing 32% of iodine.

References

[1] K. Miyakawa et al., SPIE. 7536(753604), 1-8 (2010)

[2] T. Konishi et al., Am. J. Roentgenol. 197, W1-W6 (2011).

* Taisuke-koni@medical.email.ne.jp