B9 – 5

# Exposure of Medical Staff during CT Fluoroscopy

Kanae Nishizawa, Masaki Matsumoto, Tetsuo Ishikawa, Kazuo Iwai[1)],
Takahiro Uruma[2)], Yuichi Takiguti[2)], Takayuki Kuriyama[2)] Noriyuki
Yanagawa[2)], Suguha Tsutusmi[3)]

Div. Human Radiat. Environ. National Inst. Radiol. Sciences, [1)]Fac. Dentistry, Nihon Univ.,
[2)]School Med. Chiba Univ., [3)]Dept. Radiol. Koshigaya Municipal Hospital

## INTRODUCTION

The recent development of computerized tomography (CT) equipment has created various clinical applications. The CT fluoroscopy, that is one of them, enables the observation of real-time CT images. In addition, the biopsy examination performed by CT fluoroscopy has better accuracy and is easily manipulated than the conventional examinations. Due to these merits the number of application of CT is increasing.

Although the beam of CT is narrow the tube voltage and current are relatively high. It is expected that the occupational exposure of the medical staff that undertakes the examination is to be unavoidable. Therefor, the exposure of the physician and assistant during the examination was measured, and the possibility of occupational dose reduction was considered in the present study.

## METHOD

The exposure of the body surface of physician and assistant was measured during the 12 actual CT fluoroscopic biopsy examinations with thermoluminescence dosimeters (TLD). The measured locations were corner of eyes, neck (on the thyroids), upper arms, back of the hands, hand fingers, chest and abdomen (outside and inside of protector that is equivalent to 0.2mm Pb). The duration of exposure was estimated from the staff's action record in the examination room.

Two kinds of glass encapsulated TLD were used for the measurement, a Panasonic UD-170A (BeO) and an UD-110S (CaSO4:Tm). The UD-170A has a lower sensitivity than 110S, but the energy dependency of UD-110S is larger than that of 170A, hence the physical characteristics are complementary. Therefor, three tips of each type of TLD, six as a total were used for a measurement. The TLDs were then calibrated inside and outside of the radiation field on a Taff-water phantom (Kyoto Kagagu Co.). The exposure at the position of each TLD on the phantom was determined with an ionization chamber that is traceable to the Japanese National Standard of the Electrotechnical Laboratory in Tsukuba, Japan. TLDs used in the measurement were selected by the sensitivity that fell within 7 % of their mean in the prior sensitivity test.

The CT equipment of model Somatom Plus (Siemence Co.) was used for the present study. The first fluoroscopic condition was 120kV tube voltage, 50mA tube current, 5mm beam width and 0.75 sec per scan. Other conditions, 140kV and 43mA, 80kV and 75mA were

examined for the consideration of dose reduction. In addition, the biopsy needle holder was applied in some cases.

The effective dose was estimated using the table in Appendix 2 of ICRP Publ.74.

## RESULTS and DISCUSSION

The mean duration of the 12 cases of CT fluoroscopy for biopsies was 416.3 sec ± 221.5 sec. Table 1 shows the measurement results and estimated effective doses. The duration varies greatly according to the condition of patient and focus position. The results were shown with the unit of mGy/100second. Mean surface dose of the chest and abdomen under the protector was 0.07mGy/100sec for the physician.

Since X-ray beam of the CT is collimated precisely, the dose on the outside of the direct beam was comparatively low. However, mean dose ratio of inside and outside of the protector was 10-20 for physician and 3-7 for assistant at the chest and abdomen. The doses are high at the hands and fingers that have a lot of opportunity to be inside of the direct beam. The dose reduction was achieved by the change of exposure condition or introduction of a special holder of biopsy needle. The use of needle holder reduced the dose at the back of hands and fingers considerably. In addition, the doses of other parts were also reduced. It seems that standing position of the physician need not to be so near to the CT gantry and the cautious positioning might reduce the dose of the physician.

## CONCLUSION

The radiation dose of the physician and assistant during the biopsy examination by CT fluoroscopy were measured. The highest dose was found at the back of the hand. It was about 20-30 mGy per 100 sec. And the second highest dose was 5-10mGy at the finger.

The possibility of the dose reduction was considered with the change of condition, such as the tube voltage and the use of a supplementary tool. The dose was found to be reduced with the decrease of tube voltage and usage of a holder of biopsy needle. The dose at the back of the hand became no more than 1mGy/100sec and the dose at the fingers was reduced down to the 2mGy.

Table 1. Exposure during CT fluoroscopy (mGy/100sec)

| Fluoroscopic conditions | | 120kV, 50mA | | 140kV, 43mA | 140kV, 43mA | 80kV, 75mA |
|---|---|---|---|---|---|---|
| Needle holder | | no | | no | with | with |
| Staff | | Physician | assistant | physician | physician | physician |
| Corner of eye | Right | 0.18 | 0.03 | 0.34 | 0.20 | 0.03 |
| Neck (Thyroid) | | 0.16 | 0.03 | 0.27 | 0.04 | 0.02 |
| Upper arm | Right | 0.24 | 0.03 | 0.32 | 0.29 | 0.04 |
| Back of hand | Right | 18.2 | 0.03 | 35. | 0.76 | 0.48 |
| Hand finger | Right | 4.5 | 0.08 | 11.3 | 1.99 | 0.17 |
| Chest (under protector) | | 0.07 | 0.011 | 0.016 | 0.016 | 0.002 |
| Effective dose | (μSv) | 14.8 | - | 21.7 | 8.26 | 1.64 |