Q.A. Collectible

Sponsored by CRCPD's Committee on Quality Assurance in Diagnostic X-ray (H-7)

Dose-Area Product (DAP)

Some fluoroscopic and radiographic systems have dose-area product (DAP) meters. DAP meters measure the radiation dose to air, times the area of the x-ray field. The relationship between DAP and exposure-area product (EAP) is essentially a single conversion factor that relates dose to exposure. EAP is expressed in roentgen-cm^2 (R-cm^2) and DAP is expressed in gray-cm^2 (Gy-cm^2).

How is DAP measured?

An ionization chamber larger than the area of the x-ray beam is placed just beyond the x-ray collimators. The DAP ionization chamber must intercept the entire x-ray field for an accurate reading, one proportional to the EAP. The reading from a DAP meter can be changed by altering the x-ray technique factors (kVp, mA, or time), varying the area of the field, or both. If the chamber area is larger than that of the collimators, as the collimators are opened or closed the charge collected will also increase or decrease in proportion to the area of the field.

For example, a 5 x 5 cm x-ray field with an entrance dose of 1 mGy will yield a 25 mGy-cm^2 DAP value. If the field is increased to 10 x 10 cm, with the same entrance dose of 1 mGy the DAP increases to 100 mGy-cm^2, which is 4 times the DAP for the 5 x 5 cm field.

Why DAP?

Dose-area product is relatively easy to measure. DAP meters have been around for many years, and were actually used in the 1964 and 1970 U.S. X-ray Exposure Studies. Advocates of DAP meters contend that the DAP is a better indicator of risk than entrance dose alone, since DAP incorporates the entrance dose and field size. DAP has been shown to correlate well with the total energy imparted to the patient, which is related to the effective dose and therefore to overall cancer risk.

Are there problems with DAP?

There are several problems with the use of the DAP value. The configuration of the DAP meter may introduce a bias to the DAP value. For example, if any material is placed between the meter and patient, the patient will receive less than what is implied by the displayed DAP value. For an undertable fluoroscopy system this can be the tabletop and pad.

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Consequently, the use of DAP to estimate skin entrance exposure or skin dose is complex and should only be attempted by a qualified medical physicist. This is particularly true for fluoroscopic procedures where multiple beam directions, source-skin distances, and field sizes may be used.

DAP meters are difficult to calibrate and maintain. Large changes in the DAP meter response can occur over time, particularly if meters are adjusted for couch transmission factors. Calibration should be done in the field after any changes that might alter the DAP and at least annually.

Summary:

DAP meters are valuable quality control tools for monitoring changes in equipment and procedures. DAP does not represent radiation dose per se, and use of a DAP meter to determine patient dose should only be attempted by a qualified medical physicist. DAP meters need to be recalibrated on a regular basis—at least annually—to maintain adequate accuracy.

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