Abstract

Purpose. The purpose of this study was to compare exposure of patient and operator to ionising radiation during percutaneous vertebroplasty performed under combined computed tomography (CT) and fluoroscopic guidance or fluoroscopic guidance alone.

Materials and methods. With the collaboration of our physics department, we measured exposure on ten patients undergoing vertebroplasty with combined CT and fluoroscopic guidance and on ten undergoing vertebroplasty with fluoroscopic guidance alone.

Results. Mean operator dose was approximately 0.8 microSv during vertebroplasty done with combined CT and fluoroscopic guidance and 5.8 microSv in procedures with fluoroscopic guidance alone. Mean patient dose was approximately 6 mSv for combined guidance and 8 mSv for fluoroscopic guidance, a difference that was not found to be statistically significant.

Conclusions. Although combined CT and fluoroscopic guidance is normally preferred for difficult areas such as the cervical and upper thoracic vertebrae, to ensure operator radiation protection, the technique should also be considered for areas normally treated under fluoroscopic guidance alone. However, a larger patient series is needed to correctly evaluate the real contribution of low-dose CT to patient exposure.

Keywords
Vertebroplasty · Dose · Interventional radiology · Vertebral compression fracture

Riassunto

Obiettivo. Scopo del lavoro è confrontare la dose a cui sono esposti paziente e operatore in corso di vertebroplastica percutanea sotto guida combinata TC e radioscopica e sotto esclusiva guida radioscopica.

Materiali e metodi. In collaborazione con la fisica sanitaria abbiamo eseguito misurazioni su 10 pazienti sottoposti a vertebroplastica con guida combinata e su 10 pazienti sottoposti a vertebroplastica con guida esclusivamente radioscopica.

Risultati. In base a questo studio si osserva come la dose all’operatore sia in media circa 0,8 microSv in corso di vertebroplastica eseguita con guida combinata TC e radioscopica, mentre si attesti attorno a 5,8 microSv se eseguita con guida esclusivamente radioscopica; per quanto riguarda i pazienti la dose è di circa 6 mSv per la guida combinata e circa 8 mSv nel caso di guida esclusivamente radioscopica; tale differenza non risulta statisticamente significativa.

Conclusioni. Se la guida combinata TC e radioscopica risulta preferibile per sedi complesse come il trattamento a livello del rachide cervicale e dorsale “alto” essa è da prendersi in considerazione qualora si privilegi la protezionistica dell’operatore anche per quei metameri vertebrali solitamente trattati con esclusiva guida radioscopica, tuttavia serve una più ampia casistica per poter valutare il reale contributo della TC a basso dosaggio nell’esposizione del paziente.

Parole chiave
Vertebroplastica · Dose · Radiologia interventistica · Fratture vertebrali da compressione
Although most operators perform percutaneous vertebroplasty (PVP) using fluoroscopic guidance alone, there continues to be controversy as to whether the procedure should be performed under fluoroscopic guidance alone or with a combination of computed tomography (CT) and fluoroscopic guidance. One of the most common criticisms of CT guidance is that it slows down the procedure and substantially increases patient exposure to ionising radiation. In fact, the majority of studies investigating dosimetry during vertebroplasty have focused on operator and patient exposure during PVP performed with fluoroscopic guidance alone. These papers have reported highly variable fluoroscopy times, 10–60 min, and high operator doses, above all at the hand level [1]. However, when PVP is performed by experienced operators, fluoroscopy time is reduced to 10 min on average [2].

The aim of this study was to evaluate the effective radiation dose to operators and patients during PVP performed under combined CT and fluoroscopic guidance and to compare it with corresponding dose measurements obtained during PVP carried out under fluoroscopic guidance alone.

**Materials and methods**

Dose measurements in previous studies were obtained both by using electronic and thermoluminescent dosimeters (TLD) [1] and by recording the dose-area product (DAP) and the entrance skin dose [3, 4]. In our study, operator dose was measured with an electronic dosemeter, whereas patient dose was determined by measuring the DAP both with Gafchromic films and with an ionisation chamber, from which we derived the effective dose. This value was added to the effective dose of CT in the case of procedures with combined guidance. DAP is defined as the integral of the absorbed dose to air across the area A of the beam:

\[ \text{DAP} = \int_A D_{air}(A) \, dA \]

DAP has the useful property of being invariant with distance from the X-ray tube focus. This means it can be measured at any plane between the tube and the patient, as long as care is taken to avoid points of measurement with nonnegligible backscattered radiation from the patient and to ensure that the beam is focused on the detector. As well as dose, DAP also provides a measure of the beam area and thus of the collimation used, thereby incorporating information on an important protection factor. In the case of a uniform beam, as is assumed as a first approximation in diagnostic imaging, the equation becomes:

\[ \text{DAP} \approx D_{air} A \]

Other fundamental concepts are the absorbed dose and,