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CLINICAL RESEARCH

Reduction of radiation exposure in transcatheter atrial septal defect closure: How low must we go?

Réduction de l'exposition aux rayonnements ionisants lors de la fermeture percutanée de communications inter-auriculaires : jusqu'à quel niveau doit-on aller ?

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KEYWORDS
Radiation exposure;
Atrial septal defect;
Transcatheter closure

Summary
Background. — Cardiac catheterization relies on X-ray imaging. Most procedures are now standardized. Interventionists must strive to minimize radiation exposure to reduce the risk of induced cancers.
Aims. — To describe the radiation level in our institution, and evaluate the components contributing to radiation exposure, during transcatheter atrial septal defect (ASD) closure.
Methods. — Radiation doses for ASD closure performed between January 2009 and November 2015 were reviewed retrospectively. Data on fluoroscopic time, dose area product (DAP), DAP/kg of body weight and total air kerma were collected.

Abbreviations: ASD, Atrial septal defect; ASO, Atrial septal occluder; DAP, Dose area product; f/s, Frames/second; QP/QS, Pulmonary flow/systemic flow.

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Results. — One hundred and seventy-four consecutive patients were included. Procedural success was 98.3%. Median procedural and fluoroscopic times were 15 minutes and 1.2 minutes, respectively. Median total air kerma, DAP and DAP/kg were 9.2 mGy, 88.3 μGy.m^2 and 3.2 μGy.m^2/kg, respectively. Risk factors associated with higher DAP were older age, larger ASD and device, need for balloon calibration, occurrence of complications and use of higher frame rate. Reduction of frame rate to 7.5 frames/second alone reduced by a factor of 2 the median DAP, DAP/kg and air kerma (99 vs 43 μGy.m^2, 3.5 vs 1.7 μGy.m^2/kg and 11 vs 4.8 mGy, respectively; $P < 0.001$).

Conclusions. — A low dose of radiation can be achieved for transcatheter ASD closure, even in complex ASDs, by following these recommendations: reduction of frame rate; avoidance of lateral view and cine acquisition; and limitation of fluoroscopic time by avoiding unnecessary manoeuvres and using echocardiographic guidance as much as possible.

MOTS CLÉS
Exposition aux rayons X ;
Communication inter-auriculaire ;
Fermeture par cathétérisme

Résumé

Contexte. — Le cathétérisme cardiaque repose sur l'imagerie aux rayons X. La plupart des procédures sont maintenant standardisées. Les cathétériseurs doivent travailler à réduire l'exposition des patients aux rayons X pour réduire le nombre de cancers radio-induits.

Objectifs. — Exposer les mesures implémentées pour réduire l'exposition aux rayons X et donner un référentiel de doses lors de la fermeture percutanée de communications inter-auriculaires (CIA).

Méthodes. — Nous avons rétrospectivement revu l'exposition aux rayons X de tous les enfants ayant eu une fermeture de CIA entre 1er janvier 2009 et 1er novembre 2015. Les données suivantes ont été collectées : temps de scopie, produit dose surface (PDS), produit dose surface par kilo de poids et la dose dans l'air (Air kerma).

Résultats. — Cent soixante-quinze patients ont été inclus. Les temps médian de procédure et de scopie étaient respectivement de 15 min et 1,2 min. Les doses médianes dans l'air, PDS et PDS/kg étaient respectivement de 9,2 mGy, 88,3 μGy.m^2 et 3,2 μGy.m^2/kg. Les facteurs de risques associés à un taux élevé de PDS étaient : un âge plus élevé à la fermeture, une CIA ou un dispositif de fermeture large, la calibration au ballonnet, la survenue de complications et l'utilisation d'une cadence-image élevée. La réduction de la cadence image à 7,5 images/seconde à elle seule a permis de réduire par facteur d'au moins 2 la médiane du DAP, DAP/kg et l'air Kerma (99 vs 43 μGy.m^2, 3,5 vs 1,7 μGy.m^2/kg and 11 vs 4,8 mGy, respectivement ; $p < 0,001$).

Conclusions. — Une irradiation faible est possible lors de la fermeture percutanée des communications inter-auriculaires, y compris pour les communications complexes sous réserve d'appliquer les recommandations suivantes : réduire de la cadence-image, éviter les projections de profil et l'acquisition en mode ciné, limiter le temps de scopie en utilisant au maximum le guidage échocardiographique.

Background

In recent years, it has been proved that cancer induced by radiation exists, and is related to the doses delivered and the stochastic effect [1—3]. This phenomenon is of particular importance in children, who will live longer, and are sometimes exposed to multiple sources of iatrogenic radiation, including multiple cardiac catheterizations, X-rays and computed tomography scans, in cases of complex congenital malformations [4]. This has led to the principle of reducing exposure to ionizing radiation (for both the patient and laboratory personnel) to ''as low as reasonably achievable'' — the so-called ALARA principle [5,6]. Minimizing radiation exposure has thus become a major topic in the field of interventional cardiology for patients with congenital heart diseases [6,7]. Some benchmarks for the most common procedures performed on children have been published recently. In these papers and a recent review, authors report the benchmarks, but also the ways in which radiation exposure can be reduced [8—11].

Length of exposure is not the only issue. The authors emphasize optimizing operator techniques by wise use of the equipment: reducing cineangiography; reducing zoom use; lowering the image intensifier; use of collimation; optimizing the use of equipment by reducing the frame rate; and, by close collaboration with the manufacturer, defining good settings that are a compromise between radiation dose and image quality [12].

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