

# Protokol za ultraniske doze zračenja od 3,75 sličica u sekundi kao zadan za invazivne kardiovaskularne postupke

## Ultralow Dose Radiation Protocol with 3.75 Frames per Second as a Default Setting for Invasive Cardiovascular Procedures

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Smanjivanje doze zračenja bez ugrožavanja učinkovitosti i sigurnosti kontinuirani je cilj u postupcima kateterizacije srca, jer znače opasnost za zdravlje i bolesnika, a isto tako i liječnika i pomoćnog osoblja. Važna komponenta energije zračenja koja se isporučuje tijekom invazivnih postupaka jest brzina pulsa pri kojoj se generiraju fluoroskopske slike i slike za akviziciju<sup>1</sup>.

Prethodno je istraživanje pokazalo je da su protokoli ultraniskih doza izvedivi u postavkama kateterizacije srca i rezultiraju znatnim smanjenjem izloženosti zračenju. Suvremeni uređaji za fluoroskopiju isporučuju rendgensku energiju u impulsnom rasponu od 1 do 30 sličica u sekundi (FPS, prema engl. *frames per second*); zadana je postavka uglavnom u rasponu od 7,5 do 10 FPS-a. Evolucija isporuke zračenja povezana s kateterizacijom pokazuje smanjenje isporuke. Tako se u ranim godinama rendgenska energija isporučivala kontinuirano, a prvi režimi pulsirane fluoroskopije provodili su se pri 30 FPS-a, a poslije su smanjeni na 15 FPS-a. U posljednjem desetljeću dogovoren je standard od 7,5 FPS-a, što je vrijednost koja pokazuje da se znatno smanjuju prilagođena ukupna rendgenska energija i izloženost zračenju osoblja i bolesnika.<sup>2,3</sup>

Od kraja 2019. uveli smo i rutinski primjenjujemo „protokol zračenja ultraniske doze“ u laboratoriju za kateterizaciju srca, s pulsnom frekvencijom fluoroskopije od 3,75 FPS-a i akvizicijom snimaka filma pri 7,5 FPS-a. Sve perkutane koronarne intervencije (PCI) za akutni koronarni sindrom, uključujući složene PCI poput bifurkacija i kronične totalne okluzije (CTO), provode se pod fluoroskopijom pri 3,75 FPS-a. Nismo primijetili smanjenje kvalitete slike, a cijeli je tim usvojio nižu brzinu kadrova u kratkom vremenu bez štetnih učinaka na učinkovitost/sigurnost: vrijeme postupka, uporaba kontrasta ili vizualizacija

Achieving radiation dose reduction without compromising efficacy and safety is a permanent goal in cardiac catheterization procedures, as they pose a health hazard to both the patients and physicians and support staff. An important component of radiation energy delivered during invasive procedures is the pulse rate at which fluoroscopic and cine-acquisition (CINE) images are generated.<sup>1</sup>

Previous research has shown that ultralow-dose protocols are feasible in a cardiac catheterization setting and result in a significant decrease in radiation exposure. Modern fluoroscopy devices deliver X-ray energy in a pulse range from 1 to 30 frames per second (FPS); the default setting is mostly in the range from 7.5-10.0 FPS. The evolution of catheterization-related radiation delivery has one of decreasing energy values: in the early years X-ray energy was delivered continuously; the first pulsed fluoroscopy regimes were performed at 30 FPS and later reduced to 15 FPS. In the recent decade, the agreed-upon standard has been 7.5 FPS, a value shown to significantly reduce adjusted total X-ray energy and radiation exposure in the staff and patients.<sup>2,3</sup>

Since late 2019, we have introduced and routinely use an “ultralow dose radiation protocol” at the Cardiac Catheterization Laboratory at Čakovec County Hospital, with a fluoroscopy pulse rate of 3.75 FPS and cine-acquisition at 7.5 FPS. All percutaneous coronary interventions (PCI) for acute coronary syndrome, including complex PCI like bifurcations and chronic total occlusion (CTO), are performed under fluoroscopy at 3.75 FPS. We did not notice a reduction in image quality, and the whole team quickly adopted to the lower frame rate without deleterious effects on efficacy/safety: i.e. procedure time, contrast usage, or less-than-optimal visualization. In comparison with the previously used 7.5

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koja je manja od optimalne. U usporedbi s prethodno primjenjivanim protokolom od 7,5 FPS-a, izloženost zračenju prema bolesniku znatno se smanjuje primjenom novoga protokola od 3,75 FPS-a. Da bismo znanstveno istražili predloženi protokol, pridružili smo se vanjskom centru u randomiziranom istraživanju čiji je cilj istražiti smanjenje izloženosti zračenju protokola od 3,75 do 7,5 FPS-a.

Dok očekujemo rezultate spomenutog ispitivanja, pozivamo zajednicu interventnih kardiologa da razmotre novi protokol čak i u najsloženijim slučajevima, poput CTO postupaka, kako bi smanjili izloženost zračenju bolesnika i osoblja, jer naše iskustvo pokazuje da novi protokol ni na koji način ne ugrožava postupak.

FPS protocol, the radiation exposure on part of the patient has been significantly reduced using the novel 3.75 FPS protocol. To scrutinize the proposed protocol scientifically, we have joined an outside center in conducting a randomized study aimed at investigating the radiation exposure reduction from the 3.75 FPS vs. the 7.5 FPS protocol.

While awaiting the results of said trial, we urge the community of interventional cardiologists to consider the new protocol even in the most complex cases, such as CTO procedures, to minimize radiation exposure for the patients and staff, since our experience shows that the new protocol does not compromise the procedure in any way.

#### LITERATURE

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