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Research Article

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Dose Reduction in Operating Theatre: Experience Outcome

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Abstract

The risk deriving from the use of ionizing radiation is now well known. In particular environments such as operating theatres, it takes on a particularly important aspect, involving not only the patients, but also the operators.

The purpose of this work is to describe the strategy employed and perfected in 8 years of activity thanks to the introduction of a new C arm and, in particular, to the joint team work between the Radiographer operating in the Operating Theatre and the Surgeons of different specialties.

The technical-professional approach, not separated from the relational one, has allowed to reflect on the deep, albeit subtle, difference between the concept of "diagnostic image" and "high-definition image" and so obtain a concrete result from the point of view radioprotection, both for the patient and for the operators.

A fundamental point, but also a weakness, is that the new strategy must be shared and applied by all technicians and surgeons, since radiation protection is a team result.

Keywords
dose, reduction, operating theatre

Introduction

Currently, the risk deriving from the use of ionizing radiation is well known both at high doses and also at low doses, albeit in a lesser form and still not completely [1-12]. This risk does not only involve patients, but also operators, especially those who work closest to the primary beam and the patient, as happens in operating theatres.

In this context, the ethical concept of dose reduction assumes a further and significant importance linked to the protection not only of the patient's health, but also of that of the operators who, much more likely, will be exposed to the risk more frequently than the patient. It should also be emphasized that very often the operators belong to the female gender and are young, and therefore particularly sensitive from a radiation protection point of view.

It thus becomes essential to study and implement strategies aimed at minimizing the delivered dose without in any way decreasing the diagnostic capacity of the radiological imaging produced.

The purpose of this work is to describe the strategy and the results obtained within the Operating Block, over the course of 8 years.

Methods

The experience that will be described begins in 2016 with the introduction of a new C arm characterized by considerable flexibility in dose modulation even during the course of surgery.

The cornerstone of the thought strategy is based on a very simple concept: the difference between a well-defined image and a diagnostic image.

Although the two concepts may seem equivalent, it is important to recall the concept of "*diagnostic image*" because it constitutes that subtle gap that makes the two concepts deeply different, especially from the point of view of radiation protection.

A "*diagnostic image*" is commonly defined as that image capable of completely satisfying the proposed clinical question. Starting from this assumption, it is evident how one can easily disengage from the concept of "*high resolution image*". An example will better clarify the idea: suppose that the clinical question consists of understanding whether a guide wire is inside a kidney, or whether the cephalic screw of an intramedullary nail in the synthesis of a femoral fracture is correctly sunk into the femoral neck. The intrinsic high contrast of the structures to be visualized (guide wire/kidney and bone/screw) is such that even a low resolution image is able to respond effectively and completely.

The advantage is immediate: the low resolution image has a much lower dose commitment and this must be multiplied by all the images produced in the single surgery which can also be of the order of several dozen depending on the type of surgery and the complexity meet.

Naturally, the gap to overcome for those who, like surgeons, do not have specific training in this sense, such as the Radiographer working in the Operating Theatre, is the ability to "*trust*" even the low resolution image and be able to touch with as his doubts, represented by the implicit clinical question present in every request for an X-ray during surgery, can also be fully resolved by it. Added to this is the imponderability of each intervention and the fear that the choice of a low resolution could become a "*lethal trap*" if the intervention were to become complicated as objectively it can happen.

Here the skills and abilities of the Radiographer working in the Operating Theatre constitute the solution to the problem, especially when one can count on a C arm capable of rapidly changing the dose modulation in real time.

Thanks therefore to a relational type of work, but in any case always based on the professional skills demonstrated by the Radiographer working in the Operating Theatre, the Surgeons were able to personally and objectively ascertain that low-resolution images can normally be taken with complete safety in every intervention, with the additional safety that, thanks to the technological characteristics of the C arm used and the professionalism of the Radiographer working in the Operating Theatre, even in a situation of complication it is always possible to increase the definition of the image, even just for a single run, to still have a diagnostic image and then return again to images with lower definition and therefore lower dose. And this whenever the intervention requires it.

Results

Since it was not possible to provide data on various interventions as they were burdened by too many variables such as complexity, the patient's habits, the presence or absence of complications and their complexity, it was preferred to measure the difference in dose between two runs (and therefore parity of body segment, patient, complexity) of the same intervention.

Figure.1 shows the guide wire of the cephalic screw in a femoral fracture synthesis performed with the Low Dose protocol at 4fr/s (left) and the cephalic screw positioned performed with the High-Quality protocol at 15fr/s (right).

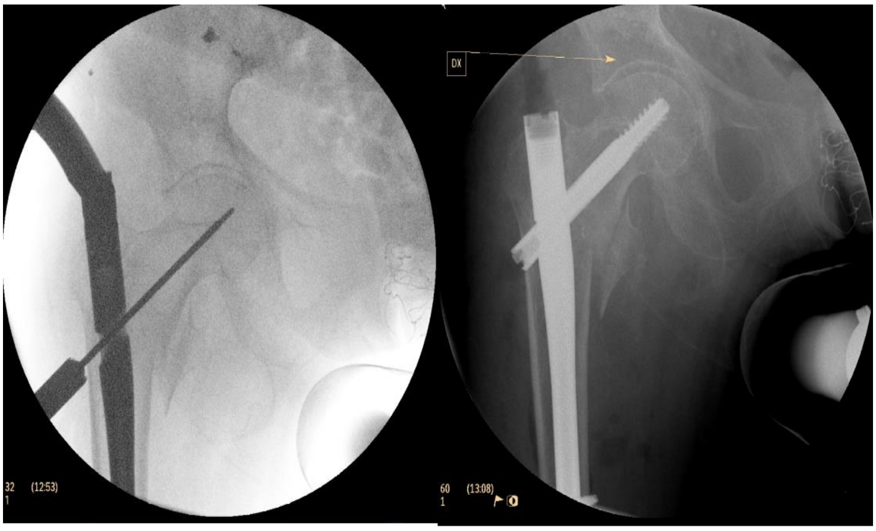

Fig. 1 : guide wire for cephalic screw at Low Dose 4fr/s (left) and cephalic screw at High Quality dose 15fr/s (right)

Figure. 2 instead shows the example of the image of a guide wire inside a kidney, performed with the Low Dose protocol at 4fr/s (left) and the same image performed with the High-Quality protocol at 15fr/s s (right).

Fig. 2 : guide wire in kidney at Low Dose 4fr/s (left) and the same image at High Quality dose 15fr/s (right)

Figure. 3 similarly shows the example of the image of the percutaneous and retrograde access during a combined intra-renal surgery technique inside a kidney, performed with the Low Dose protocol at 4fr/s (left) and the same image performed with High Quality protocol at 15fr/s (right).

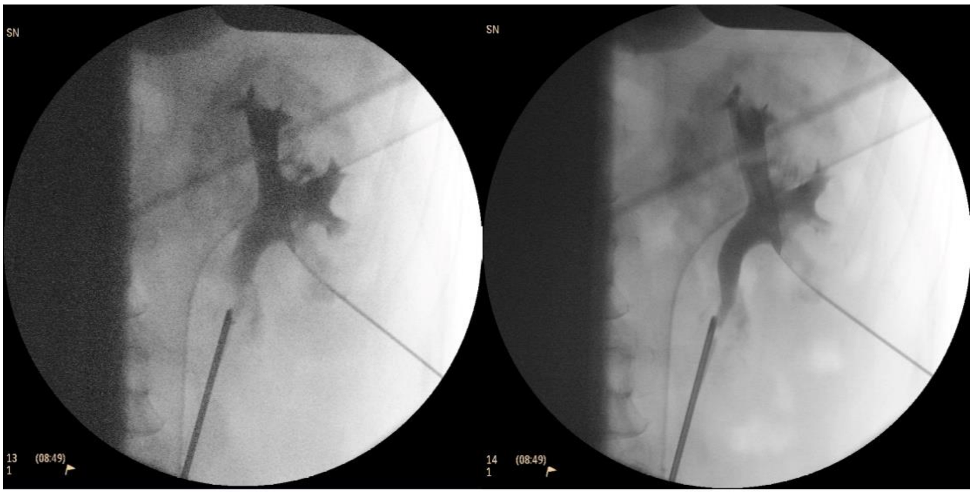

Fig. 3 : percutaneous and retrogade access in combined intrarenal surgery at Low Dose 4fr/s (left) and the ssame image at High Quality dose 15fr/s (right)

Finally, Fig. 4 shows other similar examples relating to a synthesis of a femoral fracture (top) and an intraoperative cholangiography (bottom).

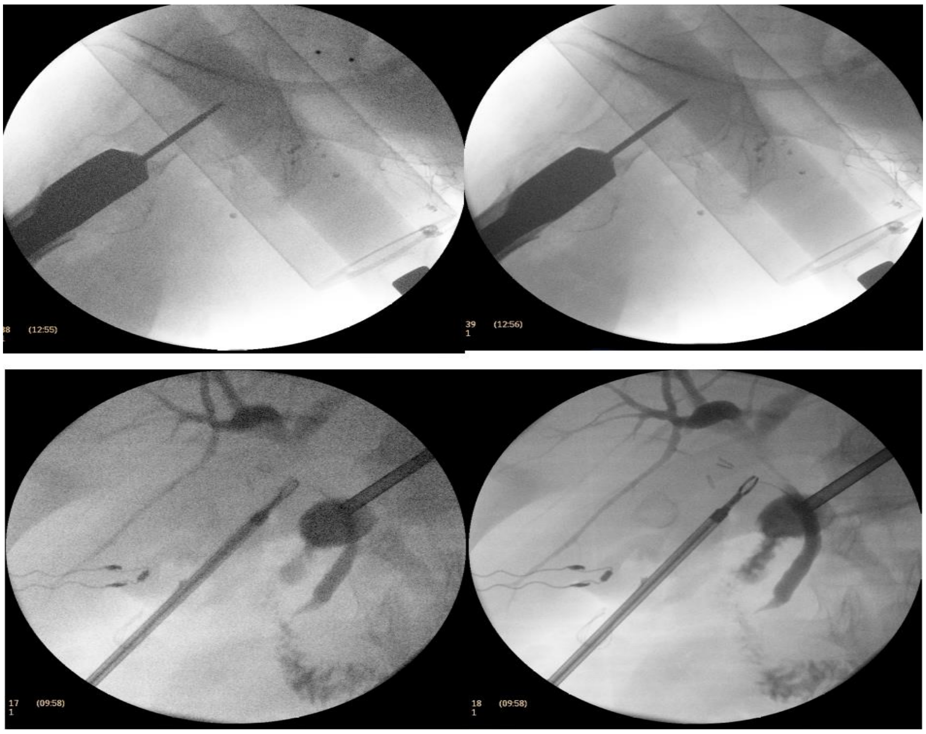

Fig. 4 :other analogue examples: guide wire in cephalic screw (top) and colangiography (bottom)

Table 1: shows a summary with the evident measured dose differences.

Reference	Dose at LD 4fr/s (on the left) [mGy]	Doese at HQ 15fr/s (on the right) [mGy]
Fig.1	0,02	0,20
Fig.2	0,009	0,073
Fig.3	0,016	0,091

It should be emphasized that the values shown are to be intended for a given patient and for a given single run. The eloquence of the images does not require further explanations: the implicit clinical question is already perfectly satisfied by the low-resolution images.

It is only highlighted how the image of Fig.1 on the right, also constitutes the final post-intervention check and, reported by the Radiologist in agreement, avoid the patient further exposures before discharge.

Discussion

The results initially obtained were encouraging and were subsequently perfected and stabilized over time thanks to the growing experience in daily life, even by the Surgeons themselves who increasingly find themselves in this new strategy based on "*seeing with different eyes*" proposed by the Radiographer working in the Operating Theatre

However, it may be useful to remember, in order to have a more practical term of comparison in the evaluation of the reported data, that a chest X-ray in posterior-anterior view is indicated as a reference unit and is equal to about 0.4mGy (update of ISTISAN report 17/ 33 – 2020/2022).

It is important to underline how, despite the positive results obtained, there are still problems in optimizing the dose in the Operating Theatre, due to a lack of training of Operators, both Technicians and Doctors, who are not yet sufficiently aware and prepared on the subject.

Conclusions

The optimization of the dose in the Operating Theatre is an absolutely achievable goal with reasonable simplicity. However, the involvement and active participation of the entire operating team is fundamental and essential, an involvement that is up to the Radiographer working in the Operating Theatre to promote and support with her or his training and professionalism.

Declarations

Conflicts of interet

The Author declare that he have no conflicts of interest

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