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Effect Of Fluoroscopic Exposure During Interventional Cardiology, Risk and Benefits During the Procedure

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Abstract: Advanced angiographic techniques in interventional radiation have gained importance in the treatment of many life-threatening diseases, especially stroke and aortic injury, and have become increasingly used. In recent years, technology has led to more invasive and complex surgeries and longer fluoroscopy times. This includes the risk of overdose, which may in some cases lead to radiological findings such as erythema in patients undergoing angiographic examinations. In this context, this process has recently started to be implemented in accordance with national and international regulations regarding radiation protection. At the same time, the risk of stochastic effects must be evaluated for each patient against the expected benefits of the treatment itself. The dangers of drug use are not limited to the patient but can also affect radiologists and medical staff. Cataracts are a growing problem, especially among doctors. Additionally, the long-term effects of repeated and long-term exposure to X-rays have long been ignored by radiologists but have emerged in the past few years. Various efforts use individual, individual, and organizational measures to improve outcomes for patients and health professionals.

***keywords - radiation exposure, neuro interventional procedures, radioprotection*.**

1.INTRODUCTION

Angiographic techniques in interventional radiation (IR) have become increasingly used in recent years, including new treatments and often for many diseases. For example, in the treatment of ischemic stroke and ruptured brain aneurysms, interventional procedures represent an important and often superior method of treatment compared to surgical treatment. In addition, interventional procedures are recommended as standard in many cases in the care of post-traumatic patients such as splenic rupture or aortic dissection. It is therefore not surprising that the number of surgeries performed in Germany, the United States, and other countries has increased over the years. More intervention often results in a greater burden for the patient, along with fluoroscopically specific services for patients and medical staff. Doses used in angiographic procedures range from very low doses (e.g., treatment of peripheral artery occlusion) to very high doses (e.g., endovascular aortic repair (EVAR)) and can reach even higher doses in special cases. As a result, it was reported that good decisions were made such as skin damage and cataracts. Practitioners therefore need to carry out a good risk assessment before any intervention and pay attention to the ALARA principles and the strength of fire safety measures. At the same time, the doctor's exposure to radiation should also be taken into account when it comes to the intervention process. With this in mind, in recent years significant efforts have been made not only in economic development but also in organizational measures and stricter regulations to improve radiation protection and reduce doses during interventional procedures. In this review, we summarize the potential effects of radiation exposure on patients and healthcare professionals, define exposure levels for various interventions, and discuss various techniques and practices to reduce infrared radiation.

Region	Dose limit
Total body dose mSv	20 mSv per year (50 mSv per year; in 5 successive years not >100
Eye lens	20 mSv per year
Local skin dose	500 mSv per year
Hands, lower arms, feet, ankles	500 mSv per year
Lifetime occupational dose (exceptions possible)	400 mSv Current dose limits of occupational exposure in Germany

Table 1. Region Dose limit (selection)

2.INTERVENTIONAL FLUOROSCOPY AS HIGH-DOSE PROCEDURE

The terms "high dose" and "low dose" are often associated with radiation protection to the environment or the use of radiation, from radiation therapy to X-ray testing. However, these terms are sometimes associated with different doses, causing confusion when talking about "high" or "low dose" bursts. In the field of radiation, interventional angiography and computed tomography are often referred to as advanced procedures. At the same time, the doses used in IR depend on the area of interest and the complexity of the intervention, as well as abdominal and neuro interventional procedures, etc. depending on the patient, usually requiring more injections. For example, in the German national hierarchy, the dose of angiographic interventions varies between 10 times the intracranial aneurysm treated with 25,000 cGyÏcm (during percutaneous transluminal angiography the dose is 2500 cGyÏcm2 area product (DAP)). in the middle and lower extremities).

3.RADIATION EFFECTS

Since the first warning about the harmful effects of X-rays on humans (Frieden 1902), knowledge about radiation protection has increased. Despite technological advances and reductions in doses, the complexity of today's interventional procedures can still affect rare cases. In this field, radiation damage to the skin has been described several times after angiographic procedures with skin doses greater than 2 Gy·cm2. The extent of this disadvantage is explained by the recent amendment of the German electronic protection law according to European regulations (EU Directive 2013/59 EURATOM). In particular, the dose exceeds > 50,000 cGy·cm2 DAP when the process involved causes skin damage reported by a physician within 21 days of exposure. Evidence of cataract induction in interventionists, another organization with deterministic effects, alarmed the medical community. A starting dose for induction of lens opacification of more than 2 Gy·cm2 was initially considered, but this was challenged by analysis of data from bombing survivors. There therefore appears to be no clear starting dose for lens damage and resulting cataracts below 100 mSv. For this reason, new ICRP and European Essential Safety Standard recommendations were created, which were also transferred to national legislation with an annual dose limit of 20 mSv (Table 1). Unfortunately, accurate estimation of lens dose during fluoroscopy is hampered by many problems, and new technologies for dosimetry purposes are not yet widespread.

In terms of stochastic effects, X-ray exposure is known to induce many malignancies, including neuronal tumors. Data from the Lifetime Study Group of Atomic Bomb Survivors indicate that the threshold for developing brain damage is below 1 Sv. Concern has also been expressed by physicians regarding reports that brain tumors are more common in the left hemisphere. However, full assessment and adequate monitoring of exposure, especially to low doses, is difficult. Klein et al. He reviewed many studies and reports on the subject and concluded that this link implicated workers in creating brain tumors by performing fluoroscopic procedures such as “it says but it is not true”. Cytogenetic analysis showed that chromosomal abnormalities and the frequency of micronuclei in lymphocytes increased in patients after fluoroscopic surgery, increased DNA damage, and significant changes in genetics. Despite this finding, the truth about the possibility of radiation exposure due to stochastic effects is still unresolved (European Society of Radiology, 2011). Personal risk assessment in this context is limited not only by lack of understanding of other radiological guidelines, especially the lack of regular reference standards but also by complex features. Dosage structure. for related processes.

4.PATIENT DOSE LEVELS IN COMPLEX INTERVENTIONS

Complex interventions that are expected to be more burdensome include various procedures such as trans jugular intrahepatic portosystemic stent shunt (TIPSS), liver chemoembolization, thoracic or abdominal aortic endovascular repair ((T-)EVAR), mechanical thrombectomy, percutaneous certebroplastions, and kyphopelas. . EVAR and neurointerventional embolization are discussed in more detail below. Procedures with higher skin doses up to 5 Gycm2 for 6 months. Interestingly, recent data show a lower dose in EVAR (mean DAP 14,700 cGycm2, mean dose plus specific kinetic energy of air for skin penetration which suggests the possibility of reducing the dose. . with the development of modern equipment and electrical protection. At the same time, the intervention of medical personnel in cases where aortic repair is not yet recommended also affects the work.

Measure	Dose reduction
Shielding	
Table	<64%
Ceiling mounted	50–96.7%
Personal protection equipment	70–89.3% Operational
Pulse rate (10 to >5 p/s)	50%
Filtering þ collimator þ low-dose protocol	<95%

Table 2. Dose reduction measures (selection).

As an example of how true it is The maximum calculated operator dose in complicated surgeries or bifurcated EVAR has been reported to be up to 0.345 mSv (0.235-0.757 mSv) , can also perform complex neurointerventions with a high level of patient and physician accuracy. Patients' skin, hair, brain and eye lenses are particularly susceptible to radiation damage due to the area examined. In this case, studies have been reported in which brain doses were calculated in the range of 500 mGycm2 to 45 Gycm2 and up to 5 Gycm2 to the skin causes skin tearing after intracranial AVM embolization. In addition to damaging the eyes of medical workers and patients during neurointerventional procedures, 16% of neurointerventional procedures involve increased exposure to the highest dose with lens doses > 500 mGycm2. as high as 2 Gycm2.

5.RADIATION PROTECTION MEASURES

The easiest way to reduce patients' and doctors' exposure to x-rays is to skip unnecessary surgeries. Therefore, radiologists always need to consider other possible methods (e.g., interventional ultrasound). General principles of radiation protection must also be observed, which must be agreed upon by all parties involved. The exposure time should be as short as possible, the patient should be kept at a distance since the radiation is the greatest part of the exposed person, the radiation dose should be equal to the square of the distance, and appropriate protection should be used. Additionally, using state-of-the-art electronic devices is beneficial in terms of saving money. These precautions and conditions should be complemented by continuing education and training in radiation protection to reduce the dose and maintain the knowledge of those performing clinical work, as recommended by the European Society of Radiology.

6.PROTECTION EQUIPMENT

The stability and routine use of various protective equipment during the response process designed to reduce worker exposure. They include personal protective clothing as well as mobile and desktop protection. Protective aprons and vests contain lead equal to 0.35 mm, and shields contain lead equal to 0.5 mm, reducing the dose from 72.4% to 80%. There is also an extension vest that will protect the humeral head and chest In addition to improving protection of the body, other Xray shielding materials (such as gadolinium or other metals) can provide greater protection as well as greater comfort at a given power level based on evidence of radiation induced cataracts in interventionists, protective goggles or shields have emerged in recent year and have also been used to incorporate government guideline and regulation. The use of this protective device can reduce the dose to the lens by up to 89%due to negative radiation or interference from outsiders. To overcome use outer google with a protective helmet. The lead thickness of many helmet is 0.5 mm, which is effective in preventing radiation (Karatag et al.,2017). The Doctor's hand, another frequently exposed part of the body, absorb a higher dose, especially during complex procedures such as EVAR. Aluminium or steel gloves have been used to provide protection for many years and have been shown to be effective in reducing the dose to the hands. On the contrary placing protective gloves directly on power lines should be strictly avoided as this may lead to automatic drugs transfer placing greater burden on the patient. Additionally, the tectile deficit must be overcome to gain widespread accepted among effected people. New leadfree system may represents an alternative, at least in term of protection against harmful radiation.

7.TECHNICAL MEASURES

Various dose-reducing measures are used in most infrared devices in today's surgeries. This is included in Table 2 and Figure 1(a). Table-mounted shielding, including extension and rotation features above the table, can reduce patient-emitted radiation by up to 64% . Therefore, ceiling shielding (0.5 mm lead equivalent) and patient-mounted shielding can reduce the impact of radiation on the neck and eyes from 50% to 96.7%, and patient exposure can be as high as 96%. thyroid. Many types of dose reduction are also available in modern infrared suites and should be used as standard. For example, reducing the pulse rate from 10 to 4 beats per second can reduce the radiation dose to patients and staff by 60% without compromising image quality. Additionally, the use of hard beam filters lead-hole components, and an automatic tube power switch during impact can reduce the dose by up to 95% and should definitely be used Image enlargement (zooming) using geometric scaling techniques should be used only when necessary or replaced with digital zoom functions. Today's software and hardware solutions have large-scale, high-resolution computing equipment that provides a variety of image processing and imaging, such as virtual collimators, "career positions" or "image retention", thus eliminating the need to repeat fluoroscopy while increasing dose selection. Additionally, mixing other information such as CT or MRI in the IR package makes fluoroscopic imaging in interventional planning. may render it invalid.

8.DOSIMETRY

In many countries, personal dosimetry for occupational testing is subject to strict regulations, and all members of the healthcare team are required to carry a dosimeter for all interventions. However, since international recommendations are not consistent with national regulations, effective dose calculations and national dosimetry recommendations differ. According to the German electronic protection law, each doctor's prescription is assigned a unique number equivalent to a social security number and is centrally managed. In this way, it is possible to prevent overperformance of the workplace by monitoring and controlling electronic equipment throughout its working life. In terms of dosimeter position recommendation, it is recommended to place it in a protective jacket at chest pocket level, as abnormal position may negatively affect the use of reinforcement. However, some authors recommend installing two or more dosimeters in different places, especially near the eyes. The negative sign dosimeter was introduced in the early 1960s and is still the most widely used dosimeter today. Alternatively, thermalluminescence dosimeters are recommended for routine use with different physical measurements such as crystalline lense. In addition to these devices, electronic dosimeters that can directly read doses and dose rates represent another hope that is an advantage of this technology. In clinical practice, maximum skin level and effective dose can be calculated by directly measuring DAP.

9.ORGANIZATIONAL APPROACHES

Radiation protection should be provided in the infrared room or in the study room, for example, in the study. By instantly displaying the DAP and calculating the maximum dose on the monitor's skin. In this way, the operator can directly read the radiation dose used according to the intervention level during each intervention. Even a small change, such as calling the doctor before the nursing procedure and then interrupting the fluoroscopy examination during the procedure, can reduce the treatment team. Regular use of collimators during the selection and rest process can be converted to natural use in emergency situations. Practical use of the custom operating system was chosen by choosing different C-arm angles to reduce the operator's impact on scattered radiation because workers regularly emit infrared during short-term high-dose applications such as cone beams. Kit CT. Additionally, CA staff need to receive regular training, preferably with real simulator training. National and international regulations, quality assurance programs, operational procedures and processes can help achieve this. The above measures can only reach their full potential if they are fully understood and used routinely by medical personnel. In Germany, the assistance of medical physicists and the use of drug control strategies are needed in many cases when administering high doses. Finally, radiation protection also includes the control of unwanted and unintentional exposure above certain criteria and is currently implemented in national regulations.

10.CONCLUSIONS

Advances in IR have revolutionized the treatment of many diseases. Some studies and reports indicate that exposure to radiation can cause serious side effects. At the same time, the procedures involved often burden patients and doctors. As the number of tests continues to increase, the importance and effectiveness of the intervention process remain unquestioned. Various precautions and tissue protection against radiation can be combined and used to prevent overexposure and keep the dose as low as possible. By making the right decision and using all possible precautions every day, we can use their full potential to reduce the dose. Additionally, continuing education and training of medical personnel and medical equipment and procedures is essential to provide effective radiation protection to patients and physicians. Future measures to reduce radiation dose and protect against radiation include the technological development of X-ray tubes and detectors, electrical protective equipment, and the constant revision of rating agencies to update guidelines and rules; all of which will lead to further reductions in radiation exposure and optimize infrared radiation resistance.

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