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Assessment of Interventional Radiology Practice and Knowledge in the Democratic Republic of Congo

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Keywords: *interventional radiology, knowledge, practice,-hospital environments in the DRC.*

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Assessment of Interventional Radiology Practice and Knowledge in the Democratic Republic of Congo

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Summary- ***Introduction:*** Interventional radiology procedures are performed at three levels: primary, intermediate and tertiary. They are classified as simple, intermediate and complex procedures. These procedures have become commonplace in Western countries and in certain emerging countries in North and South Africa. However, some of these procedures are still largely unknown and impractical in the Democratic Republic of Congo (DRC), particularly in the hospital environment of Kinshasa. Intermediate and complex procedures are performed in specialized hospitals; they are time-consuming and involve a high risk of exposure to ionizing radiation.

Objective: To assess practices and knowledge of interventional radiology in DRC hospitals. Methods: descriptive cross-sectional study conducted from 15/Aug/2023 to 15/Jan/2024, organized in the form of an anonymous electronic questionnaire evolving knowledge and practices of IR in hospital settings in DR Congo was sent electronically to healthcare providers (radiologists and non-radiologists) practicing in the Democratic Republic of Congo. The socio-demographic profile of respondents, radioprotection in IR, radiology equipment available, IR procedures performed and level of competence in radioprotection and IR were recorded.

Results: The participation rate in the present series was 35.6% for radiologists and radiology assistants, and 64.4% for non-radiologists. There was a predominance of males (77.5%) and females (22.5%). The age range 32 - 41 was predominant in both groups; 19.5% for radiologists/radiology assistants and 25.4% for non-radiologists. The average age was 38.9 ± 7.3 years for radiologists/radiology assistants and 38.8 ± 9.1 years for non-radiologists. The provincial city of Kinshasa was the most represented province in the present series with 67.4%, followed by North Kivu with 5.5%.91.9% of participants had heard of IR, while 8.1% of respondents had never heard of the discipline. In terms of knowledge of IR procedures, 59.7% gave a positive response, of which only 26.2% had complex knowledge of IR procedures.

Conclusion: The level of knowledge and practice of IR in hospitals in the DRC is generally inadequate. This calls on the health authorities to organize a strategic plan for equipping the various hospitals, not forgetting the ongoing training of radiologists and non-radiologists.

Keywords: interventional radiology, knowledge, practice, hospital environments in the DRC.

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I. Introduction

Interventional Radiology (IR) comprises all invasive medical procedures designed to diagnose and/or treat a medical pathology under the guidance and control of a medical imaging device [1]. IR procedures are performed at three levels: primary, secondary and tertiary. They are classified as simple, intermediate and complex IR procedures. Certain major surgical procedures are now being replaced by treatments guided by medical imaging, with numerous benefits [2]. IR plays a key role in the diagnosis and treatment of non-communicable and cardiovascular diseases. In 2005, Sunshine JH et al noted that 6% of radiologists in the USA devoted more than 70% of their time to IR, and 11.5% had received specialization in IR [3]. In 2006, in China's Jiangsu province, 24.0% of hospitals had set up IR departments independent of diagnostic radiology, and 64.8% of hospitals had wards dedicated to patients having undergone an IR procedure [4]. In France, overall IR activity was estimated at 545,048 procedures in 2009, 42.2% of which were therapeutic [5]. This explosion in the practice of IR is only true in developed countries. These procedures, which have become commonplace in developed countries and in certain emerging countries in North and South Africa, are nevertheless unknown, non-existent and not routinely applicable in the Democratic Republic of Congo (DRC), whether in primary, secondary or tertiary hospitals. It should be noted that radiology departments are under-equipped, as noted by the World Health Organization (WHO) [6], including an insufficient number of radiologists. Human resources and equipment are concentrated in large cities [7,8]. The increase in cardiovascular and non-communicable diseases in the DRC makes it urgent to combat disparities in general radiology and IR in particular [9]. The implementation of IR centers should also help to significantly reduce

mortality from other conditions. The practice of embolization, for example, should drastically reduce deaths from postpartum haemorrhage [10]. A number of initiatives are underway, particularly in English-speaking countries, to reduce this gap in IR. There is little data on IR in low-income countries [11]. In French-speaking sub-Saharan African countries, particularly the DRC. Any action aimed at improvement requires a prior inventory, which is why the present study was initiated with the main objective of assessing IR practices and theoretical knowledge in medical training and national programs in the DRC.

II. Materials and Methods

This was a descriptive cross-sectional study conducted over a 5-month period from August 15, 2023 to January 15, 2024, in the twenty-six provinces of the DRC, using an electronic questionnaire sent to all healthcare providers. The study population consisted of radiologists, medical specialists in other disciplines (surgeons, internists, an atom oathologists, pediatricians, ophthalmologists, dentists), physician assistants in training, pharmacists, hospital and health program administrators, radiology technicians, laboratory technicians and nurses practicing in the DRC. Data collection was organized in the form of an anonymous electronic questionnaire consisting of multiple-choice questions (MCQs) and short open-ended questions (SOQs) containing the variables under study. The questionnaire was designed using the "Google forms" web application. It was sent by e-mail and by pre-selected social networks. A reminder was sent every 72 hours. Data collection was carried out in a single phase. Respondents' anonymity and free and informed consent were respected. Once the data had been collected, they were entered into Excel and analyzed using SPSS version 21 software. Results are presented in tables and figures.

III. Results

Of the 236 participants, 84 (35.6%) were radiologists and radiology assistants, and 152 (64.4%) were non-radiologists. The study showed a predominance of males (77.5%) versus females (22.5%). The 32 - 41 age group was the most represented in both groups, with 19.5% among radiologists/radiology assistants and 25.4% among non-radiologists. The average age was 38.9±7.3 years for radiologists/ radiology assistants and 38.8 ± 9.1 years for non-radiologists (Table 1). With regard to the distribution of respondents by province: the city-province of Kinshasa was the most represented with 159 responses or 67.4%, followed by North Kivu with 13 responses or 5.5% and 12 responses or 5.1% for the province of Kongo Central. *Figure 1:* Distribution of respondents by specialty and number of years in the profession: we received 84 electronic responses (19.82%) from radiologists and radiology assistants who took part in this study. Forty-six responses or 54.8% for general imaging; 10 responses or 11.9% for pediatric radiology; and finally 10.7%. For women's imaging. In terms of number of years of professional experience: 46.4% of radiologists and radiology assistants had 2 to 3 years' experience, and 42.9% 0 - 1 year. (Table 1). With regard to the distribution of respondents according to their status as non-radiologists, we noted: 31.5% of assistant physicians belonging to specialties other than radiology, 28.9% of general practitioners and 6.6% of physicians specializing in internal medicine. Figure 2: Distribution of respondents according to whether or not they had heard of IR; 217 respondents (91.9%) gave a positive answer, and 19 respondents (8.1%) gave a negative answer. Regarding the source of IR knowledge, medical school teaching was cited as the first source with 45.2%, followed by reading about the subject and continuing education with 35.0% and 25.8% respectively. Other sources were conferences (18.0%), television programs (13.4%) and internships in foreign hospitals (3.7%) Table 2. Concerning knowledge of IR procedures: 141 out of 236 respondents (59.7%) gave a positive answer; Based on the above, 26.2% of respondents had advanced knowledge of IR procedures (Table 2). Concerning the possession of medical imaging equipment and the haemostasis check-up carried out before any IR procedure; 179 out of 236 respondents gave a positive answer regarding the possession of medical imaging equipment in their institutions. Of the above, Doppler ultrasound equipment was the most common with 55.3%, followed by X-ray and CT equipment with 23.5 and 11.7% respectively. One hundred and fifty-eight respondents gave a positive answer to the question of whether they owned radiation protection equipment. The leaded apron was the most common, at 41.8%, followed by the leaded room at 39.2%, the leaded screen at 29.1% and the leaded gloves at 27.8. The leaded thyroid cover and the personal dosimeter were reported in 13.9% each. As for the question of whether the institution had a catheterization room, 4 positive responses were reported, of which 3 were positive (75.0%) in relation to three catheterization rooms in the provincial city of Kinshasa, one of which was operational and two others in the process of being installed. When an approved supplier of IR equipment was involved, only one response (25.0%) was reported. This was the Chinese company ECO, supplier of antennas and microwave generators. Concerning the hemostasis check-up prior to any IR procedure, 54 respondents gave a positive answer, all of whom (100.0%) reported the bleeding time, 96.3% the coagulation time, 74.1% the hemoglobin level, 50.0% the hematocrit level and 33.3% the active partial thromboplastin time, Table 2. Concerning referral to IR for consultation before any IR procedure, premedication

before any IR procedure, administration of analgesics before, during or after the IR procedure, and administration of antibiotics before, during or after any IR procedure likely to cause an infection: 68.6% of respondents said they did not refer the patient to IR for consultation before any procedure. As for the question of whether the hospital carries out premedication before any IR procedure, 84.7% of respondents answered in the negative. As for the administration of analgesics before, during or after the IR procedure, and the administration of antibiotics before, during or after the IR procedure likely to cause an infection, the predominance of negative answers to the 2 questions was 79.7% and 72.5% respectively. Table 3. Type of anesthesia most commonly used: With regard to the type of anesthesia most commonly used, we obtained 65 responses out of a total of 236 participants. From the above, it can be seen that 73.8% of respondents cited local anesthesia, 23.1% general anesthesia and 3.1% reported diazanalgesia. Table 3. Does your interventional radiology unit work in collaboration with other specialties? Concerning collaboration between IR units and other services and departments, 60 positive responses out of 236 were given, of which collaboration between IR units and the Departments of Internal Medicine accounted for 36.7%; collaboration between IR units and the Department of Surgery 26.7%; collaboration between IR units and the Department of Pediatrics 20.0%; collaboration between IR units and the Department of Gyneco-obstetrics and collaboration between IR units and the pathology department accounted for 16.7%. Table 3. Concerning patient follow-up after the IR procedure: 21.2% of respondents gave a positive answer. However, we note that 90.0% of them carry out follow-up as a team. Table 3. Diagnostic and therapeutic procedures performed during IR: over half the participants (50.8%) reported exploratory puncture, followed by breast biopsy (41.9%). Other diagnostic procedures included microbiopsy of nodules and masses (37.7%), liver biopsy (34.3%) and cytopuncture of nodules and lymph nodes (30.5%). Therapeutic procedures included radio-guided percutaneous drainage of hepatic abscesses (27.9%), radio-guided evacuation of intra-peritoneal or parietal abscess collections (23.3%) and sclerotherapy (20.8%), with thyroid (73.5%), liver (14.3%) and spleen (6.1%) leading the way. Table 4. Procedures performed in IR: In relation to therapeutic procedures performed in IR, radio-guided spinal infiltration and radio-guided therapeutic intra-articular injection predominated among osteoarticular procedures performed in IR, with 20.3% and 18.6% of cases respectively, followed by radio-guided nerve root infiltration with 14.4%. In urology, percutaneous renal tumor removal was the 1st procedure performed with 16.9% of cases, followed by hemodialysis catheterization and suprapubic catheterization with 15.7% and 10.2% respectively. In the hepatobiliary field, percutaneous ablation was the most common procedure with 32.2% of cases, followed by external biliary drainage and cholecystotomy with 11.4% and 6.8% respectively. Amniocentesis, craniocentesis and fetal blood sampling were the most frequently cited gyneco-obstetric procedures, with 7.4%, 4.2% and 1.7% of cases respectively. Table 4. Availability of percutaneous ablation devices and techniques: With regard to the availability of percutaneous ablation devices and techniques, microwave and radiofrequency generators were the only percutaneous ablation devices and techniques available in only 0.4% of cases each. The only vascular procedure available was arteriography in 13.9% of cases. The vascular procedures performed were venous access for central catheter, selective venous sampling and arterial access with implantable chamber in 11.4%, 3.8% and 1.7% respectively. Table 4.

IV. Discussion

With regard to the participation rate, the present study noted a predominance of healthcare providers from the provincial city of Kinshasa (67.4%). This predominance can be explained by the fact that the largest radiology school is in the provincial city of Kinshasa, and the largest number of specialist physicians and specialization assistants are in Kinshasa. Males predominated among radiologists/ radiology assistants, at 65.5% versus 35.5%, and among non-radiologists, at 84.2% versus 15.8% in the present study. The low representation of women in the medical sector, and specifically in radiology, has already been highlighted by several studies [12,13]. This gap is even more marked in interventional imaging [14]. Studies carried out in developed countries highlight the obstacles faced by women: sexist prejudice, discrimination and sexual harassment [14]. Although we have not found similar studies carried out in French-speaking sub-Saharan Africa, these obstacles appear to be identical. In addition, the risk of radiation exposure in the event of pregnancy would be a further obstacle, even if, according to several authors, the strict application of radiation protection rules would provide sufficient protection [15]. Radiation protection is an important issue in IR, and efforts must be made in this area in low-income countries, particularly in Africa [10]. As for the age of respondents, this study noted a high participation of young people, with a mean age of 38.9±7.3 years for radiology physicians/assistants and 38.8±9.1 years for non-radiologists. The mean ages in both groups in this study are close to those found by Adigo et al [16] in Togo (37.8 years), but are lower than those found by Sunshine JH et al [3] in 2005; in the USA (51 years) in their study of the portrait of interventional radiologists in the USA. In terms of having heard of IR, almost all respondents (91.9%) admitted to having heard of IR before. As for the source, 54.8% cited

sources other than university teaching, notably: personal reading on the subject, continuing medical education, scientific conference or congress and others. Despite the high level of awareness of IR in the DRC, it is sad to note that the practice of IR in the DRC, as defined by the Fédération de Radiologie Interventionnelle (FRI) and the Société Française de Radiologie (SFR), seems less satisfactory (talk about the fact that the university should be involved in popularizing or integrating new subjects, in this case the course on IR for a full and clear understanding of the situation, or other ideas relating to how to go about acquiring this knowledge). With regard to the presence of one or more medical physicists in radiology facilities in the DRC, no positive response was given. This reflects not only the shortage of medical physicists, but also the lack of collaboration with existing medical physicists. With regard to knowledge of IR procedures, 59.7% of respondents admitted to having such knowledge, 47.5% of whom had knowledge of simple IR procedures. Intermediate and complex IR procedures are not well known in DRC hospitals, and only 26.2% were familiar with them. This can be explained by the fact that the majority of IR procedures performed in hospitals in the DRC, and Kinshasa in particular, are simple. However, taking into account the fact that with the evolution of IR, in practice only complex procedures, particularly therapeutic vascular procedures, are considered as “true” IR procedures, proves that the practice of IR in the DRC is largely insufficient. With regard to the availability of catheterization rooms, the study noted only 3 positive responses, i.e. 1.3%. Of the three available rooms, two are in the process of being installed, and only one is operational and used much more for IR procedures. This indicates a very low rate of intermediate and complex IR procedures in the DRC. No positive response concerning the availability of an IR unit meeting international standards was given in the present study. This reflects the lack of cooperation with international manufacturers and suppliers of IR equipment. The contrast with developed countries is striking: as early as 2007, O'brien et al [20] reported that 87% of Canadian radiologists had at least one angiography room, and Teng et al [4] in China in 2008 estimated the number of angiography rooms at between 1,000 and 1,500. The available technical platform also determines the approach and the sites where IR procedures are performed. The lack of suppliers of IR equipment in the present study (1.6%) may justify the lack of biplane angiography equipment and the absence of IR blocks equipped to international standards. As for the availability of percutaneous ablation equipment, the study noted only one microwave device (0.4%) currently available in the DRC. The availability of the only microwave generator is due to a public-private partnership between our team and the Chinese company ECO-Médical based in the city of Nanjing. This state of affairs bears witness to the lack of collaboration between the supervisory ministry, interventional radiologists and hospital institutions in the DRC, and the various interventional suppliers of IR equipment around the world. Regarding IR consultation, we recorded 74 positive responses (31.4%). The low rate of pre-operative IR consultations can be explained by the fact that knowledge and practice of this promising discipline are still at an embryonic stage in DRC hospitals. The pre-medication rate prior to any IR procedure remains low, at 20.3%. Hemostasis testing prior to any IR procedure also remains low, with a rate of 22.9%. The young age of this discipline in the DRC is one of the main reasons for this. Among the tests performed, we noted 54 positive responses for bleeding time (100.0%); 52 positive responses for coagulation time (96.3%); 40 positive responses (74.1%) for hemoglobin level; 27 positive responses (50.0%) for hematocrit level; and 18 positive responses (33.3%) for active partial thromboplastin time. Regarding the administration of antibiotics before, during or after the IR procedure, we recorded 27.5% positive responses. This low rate can be explained by the fact that the majority of procedures performed were biopsies, particularly breast biopsies, which did not require the administration of antibiotics. Local anesthesia was the most frequently used type of anesthesia, with 48 responses (73.8%) out of 65 positive responses. The predominance of simple IR procedures is probably the reason for this in the present study. Regarding patient follow-up after IR procedures, we received 50 positive responses (21.2%). The lack of follow-up after IR procedures has been performed can be explained by the low rate (31.4%) of pre-procedure radiological consultation recorded in the present study. In terms of examination of the various diagnostic IR procedures performed, the study noted a predominance of breast biopsies (41.9%), liver biopsies (34.3%), lymph node biopsies (28.0%) and soft tissue biopsies (25%). The predominance of ultrasound-guided biopsies of breast masses can be explained by a number of factors: the affordability and accessibility of echo-guided breast microbiopsy, the multiplication of breast cancer screening campaigns, the improvement in neo-adjuvant chemotherapy for breast cancer requiring immunohistochemical typing, the availability of the mammo-echo pair in hospitals in the DRC, Kinshasa in particular, not forgetting the sensitivity among clinicians of IR procedures, notably echo-guided breast microbiopsies. Boudghene [21] in France reported that the majority of biopsy punctures were carried out in the breast (42.73%), and that ultrasound was the most commonly used means of guidance (78%). As for the therapeutic IR procedures performed, the present study showed a predominance of radioguided percutaneous drainage of hepatic abscesses with 27.96%, followed by radioguided evacuation of intraperitoneal or parietal abscessed collections with 23.3%, and sclerotherapy

with 20.8%. This can be explained by the predominant use of abdominal Doppler ultrasound, which remains the most widely used means of guidance in the DRC. In this study, radioguided spinal infiltrations, radioguided therapeutic intra-auricular injections and radioguided nerve root infiltrations were the main procedures related to osteoarticular IR procedures, with 20.3, 18.6 and 14.4% respectively. Joffre et al [1] in France in 2010, reported a predominance of intra-auricular infiltrations at 93.4%. The predominance of intra-auricular infiltrations was also reported by Savi De Tove Kofi-Mensa et al [22] in 2020, in their study on the state of IR practice in French-speaking sub-Saharan Africa. In relation to procedures performed in IR: percutaneous renal tumor removal (16.9%), hemodialysis catheterization (15.7%) and suprapubic catheterization (10.2%) were the main procedures performed in urology (Give reasons for the predominance of these main procedures. In the hepatobiliary field, percutaneous ablation and external biliary drainage were the most common procedures, accounting for 32.2% and 11.4% respectively. As for IR procedures performed in gyneco-obstetrics, amniocentesis (7.4%), craniocentesis (4.2%) and fetal blood sampling (1.7%) were found at low rates. With regard to vascular IR procedures performed in neuroradiology, it should be noted that venous access for central catheter was the main procedure in this study with 11.4%, followed by selective venous sampling with 3.8% and arterial access with implantable chamber with 1.7%. With regard to vascular diagnostic procedures that can be performed in the DRC, the study found that 13.9% of patients underwent arteriographic examinations. These results differ from those observed by Sunshine et al [3,4], who reported 11.5% and 7.6% respectively. In terms of guidance modality for IR procedures, Doppler ultrasound was the most widely used radiological guidance modality in the present study (31.8%), followed by CT (7.2%) and scopy (5.1%). Ultrasound remains the most widely available and used imaging modality for IR procedures in the DRC. This justifies the fact that the sites concerned are most often shallow. Breast biopsies account for 41.9%, followed by liver biopsies for 34.3%. Boudghene [21] in France reported that the majority of biopsy punctures were carried out in the breast (42.73%), and that ultrasound was the most commonly used means of guidance (78%). However, some simple procedures that can be performed under ultrasound are performed by few radiologists (treatment of joint calcifications, catheter placement for peritoneal dialysis, chemical tumor ablation). This underscores the need to develop a culture of IR in the DRC.

a) Prospects for IR Development

The development of IR in the DRC requires the availability of the necessary material and human resources. In a study carried out in Canada, the obstacles to the practice of IR were: lack of rooms or equipment (35%), lack of radiologists (33%) and lack of funding or administrative support (28%) [20]. We made a similar finding in the present study. Implementing IR in low-income countries, the DRC in particular, requires the availability of various necessary resources. A checklist of different needs, or tool for assessing readiness to implement IR, has been drawn up in order to take stock of the various needs to be met before IR can be implemented [11]. It is desirable that the political authorities of the DRC underpin the various actions to be taken in order to improve the practice of IR. Improving technical facilities and revising downwards the cost of IR procedures are necessary conditions for the development of IR in the DRC. Significant efforts are required in view of the many shortcomings in radiology equipment in the DRC [6,23,24]. Human resources It is vital to increase the number of interventional radiologists trained to international standards. We therefore need to arouse the interest of radiology trainees in IR. According to a study carried out in Spain, the organization of symposia on IR increases the interest of medical students and helps identify candidates for targeted recruitment [25]. Other authors, such as Tan et al in China, advocate introducing IR into the undergraduate training program for medical students [26]. Efforts led by the RAD-AID organization have helped to highlight disparities in radiology, particularly interventional radiology [27]. Based on these findings, several initiatives in partnership with high-income countries, such as Tanzania [28], have been launched to help implement IR in low-income countries.

b) Strength of the Study

This study is the first of its kind to be carried out in hospitals in the DRC, covering all the provinces. For the very first time, it gave us an idea of the practice of IR in the twenty-six provinces of the DRC.

V. Conclusion

IR remains a little-known discipline among healthcare providers in the DRC. Almost all the medical facilities that took part in the study are either poorly equipped or under-equipped with IR equipment. No international-standard IR unit is currently available in the DRC. The practice of IR in the DRC is still at an embryonic stage, and the procedures most frequently performed are essentially diagnostic and non-vascular. The development of IR practice, especially in its vascular and non-vascular therapeutic aspects, is vital in view of the role these techniques now play in the efficient management of several thoracic and cardiovascular, neuro-vascular, tumoral, urological and, of course, gyneco-obstetrical pathologies. The popularization of the discipline, the training of interventional radiologists, the equipping of various university and provincial referral hospitals with IR equipment, the improvement of existing

technical platforms without forgetting the facilitation of accessibility to IR procedures should be taken into account at all levels.

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