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Lumen Balloon Microcatheter

Gastrointestinal Stromal Tumors

Highlights

Onyx Embolization, Anchoring

Academic & Clinical Radiographers

Discovering Thoughts, Inventing Future

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Gastrointestinal Stromal Tumors: Response Evaluation Criteria of CHOI through Computed Tomography

By Elizabeth Blanco Sixtos-Elizabeth, Benjamin Conde-Castro, Adriana Cacho-González, Blanca María Jaime-Suárez & Jazmin Lizeth Martínez-Sánchez

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Abstract- A CT scan is a tool that has been demonstrated to be optimal for response evaluation in gastrointestinal stroma tumors that undergo targeted therapy. In this study, response and evaluation of gastrointestinal stroma tumors were compared with the use of targeted therapy according to CHOI criteria in Oncology Siglo XXI Hospital patients.

Materials and Methods: A retrospective study from January 2009 to January 2014 in patients with a confirmed diagnosis with access to CT scan; a response to the treatment was observed according to CHOI criteria.

Results: A total of 31 patients were enrolled in this study, 61% received targeted therapy with Imatinib and 38% received second-line Imatinib and Sunitinib treatment, with a minimum follow up of 6 months and a maximum of one year. According to CHOI criteria, 45.2% of the patients reached CR, 19.4% had SD, 19.4% reached PR, and 16.1% had PD.

Keywords: GIST (gastrointestinal stromal tumor), RECIST 1.1, response evaluation choi criteria, computed tomography.

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Gastrointestinal Stromal Tumors: Response Evaluation Criteria of CHOI through Computed Tomography

Elizabeth Blanco Sixtos-Elizabeth [α], Benjamin Conde-Castro [σ], Adriana Cacho-González [ρ], Blanca María Jaime-Suárez [ω] & Jazmin Lizeth Martínez-Sánchez [¥]

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Conclusions: Tumor response assessment according to CHOI criteria was useful for the evaluation of molecular targeted therapy in patients with GIST tumor.

Keywords: GIST (gastrointestinal stromal tumor), RECIST 1.1, response evaluation choi criteria, computed tomography.

I. Introduction

Treatment responses for the assesment of tumors performed with CT scans were initially assesed only according to RECIST criteria; however, it was not useful for the evaluation of gastrointestinal stroma tumors because the size of the tumor was not the only characteristic.

The biggest correlation in response is based on a reduction in density measured in Housfield units. This measurement is correlated with the tumoral necrosis and cistic or myxoid deterioration. [1]

Initially, Choi et. al proposed a response criteria, in which size and density were the elements for assessing the responses to treatment. In some cases, the size of the tumor can increase due to a side effect of the development of an intratumoral hemorrhage or myxoid deterioration. [2,3]

II. Targeted Therapies

Selective inhibitor tyrosine kinase agents are employed for the treatment of GIST (molecular targeted therapy) that specifically acts in biomolecular changes that onset the disease and that exclusively targets the tumural cells. The use of this treatment has allowed a 5 year increase in up to 43% of the patients with this metastatic disease. [4,5]

The protocol for GIST treatment at IMSS (Mexican Social Security Institute) UMAE CMN Siglo XXI is based on the histological grading of malignancy according to its mitotic index. The first-line medication treatment used post-surgery is Imatinib Mesylate, which acts through specific inhibition of the ennzyme tyrosine kinase. A 400mg to 800mg dose is administered; depending in the histological grade, there is a one year follow-up for mild cases and up to three years for severe cases. If there are any indications of progression of the disease observed through imaging methods, or clinically observed side effects due to the medication, second-line Sunitinib is then administered.

III. Assesment through Imaging

Computed tomography (CT), is the imaging method of choice for the diagnosis, staging, monitoring and assessment to treatment response of the GIST; 5 cm tumors are identified as large tumors, well-defined, heterogeneous, and exophytic component or with a polypoid intraluminal. . The central portion may contain tumor areas of lower attenuation secondary to necrosis, hemorrhage and cystic degeneration; the presence of calcifications is unusual. [6,7,8]

Malignant GISTs are large and well defined (86 %), with heterogeneous soft tissue of low density and necrotic center. They frequently come from the wall of the stomach or small intestine. The attenuation by liquid or central necrosis occurs in approximately 67% of the cases. [9,10]

The period for follow-up in patients who have GIST may be modified by variables such as if received surgical treatment (neoadjuvant or adjuvant), [11]

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presences of metastatic disease (liver, peritoneum and other sites) and changes in treatment (for adverse effects to the medication or the progression of the disease). High-risk patients are evaluated from 1 to 2 years at the end of the adjuvant therapy and low-risk patients can have greater intervals of evaluation.[12] The group of sarcomas in Europe suggested to routinely assess every 3-6 months during adjuvant therapy in the first year and on an annual basis in the following 5 years. Patients with GIST of low risk can be evaluated every 6-12 months by for a period of five years.[13]

Table 1 : Comparative table between RECIST and CHOI criteria

Criteria	CHOI	RESIST 1.1
Complete Response	Disappearance of all target lesions No new lesions	Disappearance of all target lesions No new lesions
Partial Response	Decrease ≥10% in the sumof the LD or shrinkage ≥15% in Hounsfield Units (tumoral density). No evidence of new lesions	Decrease ≥ 30% in the sum of the LD of target lesions
Stable Disease	Neither sufficient shrinkage to qualify for PR nor sufficient Increase to qualify for PD	Neither PRnor PD
Progressive Disease	Increase in size≥10% with no criteria in Partial Response of the tumor density Appearance of new lesions, intramural nodules, increase in existing nodules or tiissue increase in a hypodense lesion	Increase ≥ 20% in the sum of the LD of target lesions

There are no studies reported in the literature on the experience of the Oncology Hospital Siglo XXI that include criteria CHOI as a basis for monitoring response to molecular targeted therapy. Some authors include in their studies specific criteria such as tumor size, histological grade and track interval once white therapy has begun.

It is therefore important for the Medical Oncologist to know the significance of the tomographic reportfor follow-up of patients with gastrointestinal tumors. The objective of this study was to describe with CTs the response to the treatment of GIST in patients from the Oncology Hospital of twenty-first century, using the criteria of CHOI.

IV. Materials and Methods

A retrospective study from January 2009 to January 2014. The patients included in the study had to have a confirmed diagnosis of GIST by histopathology; a CT scan performed in the oncology service at the IMSS, with realization of three-phase protocol (arterial, venous and portal); treatment of white therapy (Imatinib or Sunitinib) and a baseline and follow-up CT. Simple frequency and dispersion measurements were taken through the program SPSS.

V. Results

From 2009 to 2014 31 cases were obtained with the inclusion criteria mentioned, of whom 54.8 % were women and 45.2 % were men with a median age of 57 years (range 36 to 84 years); all with a study of abdominal computed tomography. The organs affected by GIST were 51.6 % (16) stomach, 22.6 % (7) jejunum, 12.9 % (4) rectum, 6.5 % (2) duodenum, 3.2 % (1) peritoneum and 3.2 % (1) retroperitoneum (Table 2). 32.3 % (10) of the patients were surgically treated before starting with Imatinib. 67.7 % received first-line molecular targeted therapy with Imatinib, and 32.3 % received second line with Sunitinib. We assessed the response to treatment with a CT scan in an average of 1 to 24 months. According to the criteria of CHOI, we observed 45.2 % (14) complete response, 19.4 (5) stable disease, 19.4 (6) partial response and 16.1 % (5) disease progression (Table 3) Figures 1,2, 3. During that time, metastatic activity was observed in 14 patients representing a 45.1 %, with predominant involvement in the liver with a percentage of 35.5 % of the total (Table 4) Figure 4.

Table 2 : Organs affected by GIST

Affected Organ	Number of Patients	Percentage
Stomach	16	51.6
Jejunum	7	22.6
Rectum	4	12.9
Duodenum	2	6.5
Peritoneum	1	3.2
Retroperitoneum	1	3.2
Total	31	100%

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Table 3 : Patient responses to targeted therapy treatment in patients with GIST according to CHOI criteria

Responses according to CHOI criteria	Number of Patients	Percentage
SD	6	19.4
PD	5	16.1
PR	6	19.4
CR	14	45.2
Total	31	100 %

Table 4 : Follow-up of GIST patients with metastasis treated with targeted therapy SD (Stable Disease). PD (Progressive Disease). PR (Partial Response). CR (Complete Response)

Site of metastases	Number	Percentage
Peritoneum	1	3.2
Liver	11	35.5
Retroperitoneum	1	3.2
Uterus	1	3.2
Total	14	45.1



Figure 1: Partial Response to treatment. 2a. Retroperitoneal tumor with density of 49 UH, predominantly hypodense aspect. 2b. Control tomographic study with decrease in greatest diameter to 10% in maximum diameters, heterogeneous density, peripheral enhancement. 2c. 6 month follow-up with decrease greater than 10 % of diameters, increased vascular enhancement not more than 15 % at 2 years of treatment with an interval of 6 months between the assessments.

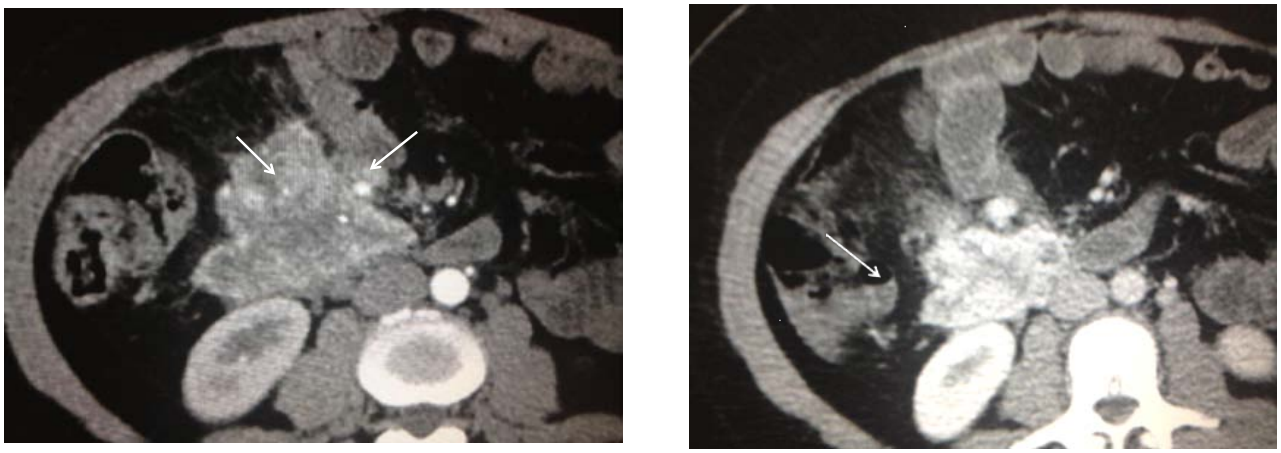


Figure 2 : Progression of the disease. 3a. Peritoneal implants and nodular ascites fluid. 3b. Ascites fluid in peritoneal cavity.

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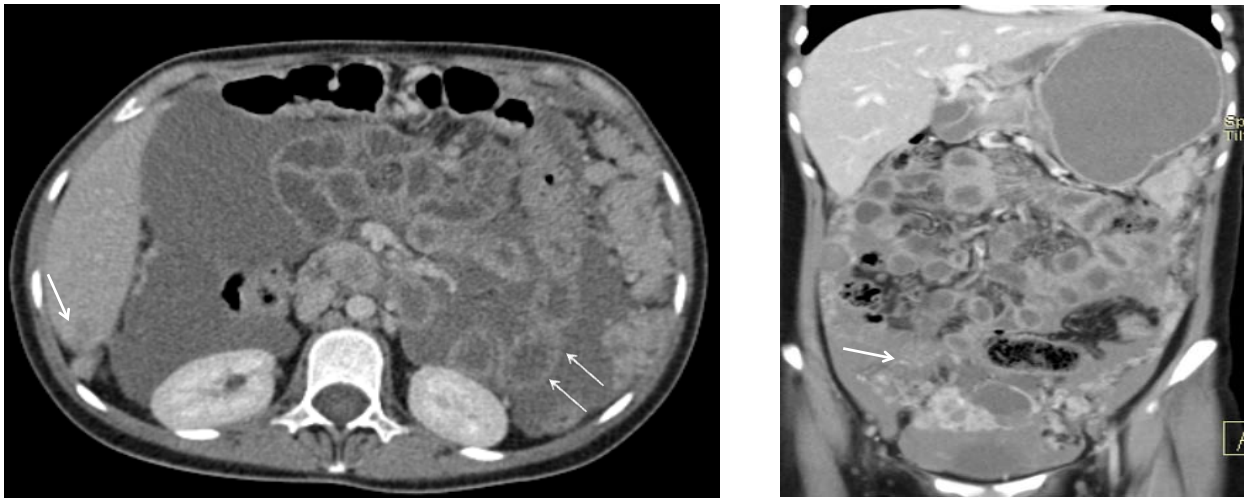


Figure 3 : Total Response to treatment.4a. GIST tumor in greater curvature aspect of hypodense, extraluminal, lobed, before the surgery. 4b. Postsurgical control where no lesions in the gastric wall are observed.



Figure 4 : Liver metastases.1a. Hepatic metastases by gastric GIST. Hypodense aspect, without enhancement after contrast administration. 1b. Liver metastasis of heterogeneous aspect, with peripheral vascular enhancement and focal zones hypodense probably linked to necrosis. 1c. Hypodense hepatic metastases in simple and arterial phase.

VI. Discussion

Neither the time of survival nor the histologic grade of malignancy was considered in our review as Toyokawa et al recommends.[12] A prospective study would consider the survival. In recent publications the partial answer is the predominant result when evaluating with criteria of CHOI, which does not differ with the gains of the study. [12,13.]

The length of time of follow-up was from 6 months. In patients undergoing surgery, the period of follow-up was one year. It was noted that the progression of the disease was determined by the stage at the time of diagnosis and the location that made the unresectable tumor. The molecular targeted therapy in patients with liver hypovascular metastases areas remained as stable disease or partial response to treatment, with a similar percentage to what is reported in the literature. The follow-up every 4-6 months the first two years and annual the following years were a period of time made on average.

The organy most frequently affected (stomach) and the most frequent metastatic disease (liver) is similar to that reported in the literature.

VII. Conclusions

It is necessary as radiologists to become familiar with the existence of white therapies and criteria for evaluation of response, to achieve the appropriate integration in the multidisciplinary management. CT scans allows us to evaluate the response to white therapy in patients with GIST using the criteria of CHOI. It also allows us to identify the primary tumor, stage of the disease and detect metastatic diseases. The criteria of CHOI reported by CT help the clinician with the patient management, decision for surgical treatment, grant white therapy, to change white therapy line and prognosis. GIST requires a tomographic assessment using criteria of CHOI, with a period of time as a minimum of 6 months.

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Peripheral uses of a Double Lumen Balloon Microcatheter: Onyx Embolization, Anchoring and other Techniques

By Mario Martinez-Galdamez, Ernesto Santos Martin & Eduardo Crespo Vallejo

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Abstract- *Purpose:* To evaluate the technical feasibility and safety of dual lumen balloon microcatheter Onyx embolization in peripheral interventions.

Material and methods: Between January 2013 and September 2014, seven patients underwent Onyx embolization through a double lumen balloon microcatheter. Onyx was injected as solely agent in three patients with chronic hemoptysis, two patients with life threatening organ bleeding and one with a rejected kidney graft. In one patient with a liver arterioportal fistula, a combination of coils and onyx was used through the same system. In addition to this technical implementation, we also describe three cases where an anchoring tecnhique were used in tortuous arterial anatomies in order to place micro and guide catheters in a stable position.

Results: All the Onyx embolizations were completed and well tolerated. During the Onyx embolization, no reflux was noted and inmediate forward flow was identified. Technical success was 100%. The clinical outcome of the patients was satisfactory with no (peri/postprocedural) complications.

Conclusion: Double-lumen balloon microcatheter Onyx embolization is feasible and safe in peripheral interventions, lowering the potential complications related to reflux or Onyx migration.

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Peripheral uses of a Double Lumen Balloon Microcatheter: Onyx Embolization, Anchoring and other Techniques

Mario Martinez-Galdamez [α], Ernesto Santos Martin [σ] & Eduardo Crespo Vallejo [ρ]

Abstract- *Purpose:* To evaluate the technical feasibility and safety of dual lumen balloon microcatheter Onyx embolization in peripheral interventions.

Material and methods: Between January 2013 and September 2014, seven patients underwent Onyx embolization through a double lumen balloon microcatheter. Onyx was injected as solely agent in three patients with chronic hemoptysis, two patients with life threatening organ bleeding and one with a rejected kidney graft. In one patient with a liver arterioportal fistula, a combination of coils and onyx was used through the same system. In addition to this technical implementation, we also describe three cases where an anchoring tecnhique were used in tortuous arterial anatomies in order to place micro and guide catheters in a stable position.

Results: All the Onyx embolizations were completed and well tolerated. During the Onyx embolization, no reflux was noted and inmediate forward flow was identified. Technical success was 100%. The clinical outcome of the patients was satisfactory with no (peri/postprocedural) complications.

Conclusion: Double-lumen balloon microcatheter Onyx embolization is feasible and safe in peripheral interventions, lowering the potential complications related to reflux or Onyx migration.

I. Introduction

Ethylene vinyl alcohol copolymer, otherwise known as Onyx (ev3,Irvine, California) is a popular liquid widely used in neurointerventional procedures (1,2) and since 2012 distributed specifically for peripheral use (3,4).

In the present report we present our initial experience with transarterial Onyx injections through a coaxial dual-lumen balloon microcatheter (Ascent, Codman Neurovascular, Raynham, Massachusetts, USA). This compliant, Onyx-compatible balloon 2,3 Fr microcatheter has 2 lumens, one for balloon inflation and the other acting as a regular microcatheter for microwire insertion, infusion of liquid embolic agents, contrast medium or coils deployment. This microcatheter is compatible with 0.014" or smaller guidewires and there is a 0.017" inner diameter. The balloon increases the proximal resistance in the feeder, encouraging Onyx to penetrate more distally into the lesion (5).

Also, the anchoring technique basically consists on the inflation of a compliant ballon in a distal vessel in order to advance coaxially a larger catheter [6]. The Ascent microcatheter balloon came in handy in a critical scenario and was perfectly suitable for its perfomance.

Our objective was to assess the safety and feasibility of double lumen balloon microcatheters in peripheral embolizations.

II. Material and Methods

We retrospectively analyzed our database of all vascular peripheral interventional radiology procedures for cases in which Onyx was administered through the Ascent coaxial dual-lumen balloon microcatheter between January 2013 and September 2014. Our institutional review board approved this analysis and all the patients gave informed consent.

A group of seven separate embolization sessions were performed on seven patients by using this technique (Table). Three of these patients had hemoptysis secondary to lung infections, one had a bleeding renal angiomyolipoma, one patient suffered hypovolemic shock due to a liver mass biopsy, one patient was scheduled to undergo a HCC chemoembolization and a severe hepatoportal shunting was identified and finally, the last patient needed embolization of a kidney graft due to rejection.

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Table : Details of patients's pathology and procedures.

Pt. No.	Age(y)/Sex	Pathology	Indication	Amount of Onyx (ml)	Onyx injection duration	Technical procedure
1	48/F	Renal Angiomyolipoma	Spontaneous rupture	3	3 min	Onyx injection
2	79/M	Renal transplant	Rejection	6	5 min	Onyx injection
3	57/M	Tuberculosis	Hemoptysis	2	2 min	Onyx injection
4	60/M	Necrotizing pneumonia	Hemoptysis	2	2 min	Onyx injection Anchoring
5	80/M	Post-Biopsy hepatic bleeding	Hipovolemic shock	2	2 min	Onyx injection
6	61/M	Actynomycosis	Hemoptysis	2	1 min	Onyx injection Anchoring
7	62/M	Arterioportal fistula Hepatocellular carcinoma	Chemoembolization	0,6	6 sec	Onyx and coils embolization

Our criteria to choose this technique instead of conventional approaches were: difficult distal navigation due to proximal elongation, proximity to main non-target arteries and high flow fistula.

a) Procedure Technique

The procedure was carried out in the vascular angiography room under deep sedation or general anesthesia. In all cases, vascular access was established in the common femoral artery with a 6-Fr sheath. A 6Fr-guiding catheter and/or a 5 Fr diagnostic catheter (which is the minimum recommmended catheter size needed to accommodate the balloon microcatheter) was then positioned within afferent artery from which the pathology arose. Due to the diameter and tortusity of the afferent artery, we thought that the conventional Onyx (ethylene vinyl alcohol copolymer; ev3-covidien) embolization technique with a single microcatheter involved the risk of reflux into non target arteries as the creation of a 'plug' would be difficult and could cause retention of it. Thereafter, a compliant Ascent balloon 4x7 mm (Codman Neurovascular, Raynham, Massachusetts, USA), which is a dual lumen balloon, dimethly sulfoxide compatible, with a deadspace of 0.4 ml, was prepared with a mixture of 30% saline solution and 70% Visipaque 320 (GEHealthcare, Princeton, NewJersey).

The balloon microcatheter was then introduced into the guide catheter, and navigated over a 0.014-inch microwire (Traxcess, Terumo) into the arterial feeder vessel until its tip was as close as possible to the site of embolization. Pre and postinflation superselective runs were then performed through the balloon microcatheter, and changes in flow rate with balloon inflation were evaluated. Onyx18 was chosen as the embolic agent in six of the seven cases because the objetive was an embolization as distal as possible. Onyx34 was employed in a high flow hepatic arterioportal fistula considering that closure of the fistula point was our aim. The balloon was then deflated and the dead space of the balloon catheter (0.4 mL) was filled with dimethyl sulfoxide (DMSO). Injection of Onyx18 or 34 was then initiated in roder to fill the dead space during 1 minute. Then, the balloon was reinflated and Onyx injection was continued. The balloon was not deflated during the procedure, as reflux of Onyx can occur at any time following initial antegrade flow. The speed rate for injection of Onyx was much faster than with typical embolizations performed without balloon microcatheter considering that a safe plug is already performed. After Onyx injection, the balloon was deflated and withdrawn slowly under fluoroscopy.

Anchoring technique was performed in three of the procedures in order to ahieve a more stable position of the guiding catheter. First, the balloon was navigated beyond the tortuous anatomy over a 0.014-inch microwire with a distal J configuration. This microwire–microcatheter navigation through the tortuous segment creates significantly less stress on the vessel wall than a 0.035-inch wire. These smaller wires are far less likely to create any kind of traumatic injury or vasospasm, even in the setting of severe tortuosity or dysplasia. Next, when the balloon is inflated, it creates friction against the vessel wall distally, providing a distal anchor for the entire guiding catheter system. Advancing the guiding catheter system while applying gentle counter tension to the balloon catheter functions to add a distal 'pulling' force to the proximal 'pushing' force. The counter tension also functions to center the guiding catheter system within the parent artery, pulling it away from the outer curvature of the vessel and eliminating or diminishing the forces applied by the guiding catheter

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system to the vessel wall. During this maneuver, no inner transitional catheter is used.

In one patient, case 7, additional coils embolization was performed so that a high flow fistula could be sealed without risk. The Ascent ballon was kept inflated and two 0,010" coils (Axium, Covidien) plus 0,06 ml of Onyx34 were introduced sequentially through the main lumen.

III. Representative Cases

a) Case 1

A 48-year-old female patient had a sudden rupture of a 6 cm-angiomyolipoma within her right kidney. A large retroperitoneal hematoma was identified in the contrast CT. In the emergent angiography we identified the vascularized tumor as well as the bleeding point. Due to reflux and non-target embolization risk a double lumen microcatheter was used for the Onyx embolization from the only arterial feeder vessel (Fig.1). After embolization, there was a complete devascularization of the vascular bed without non-target embolization.

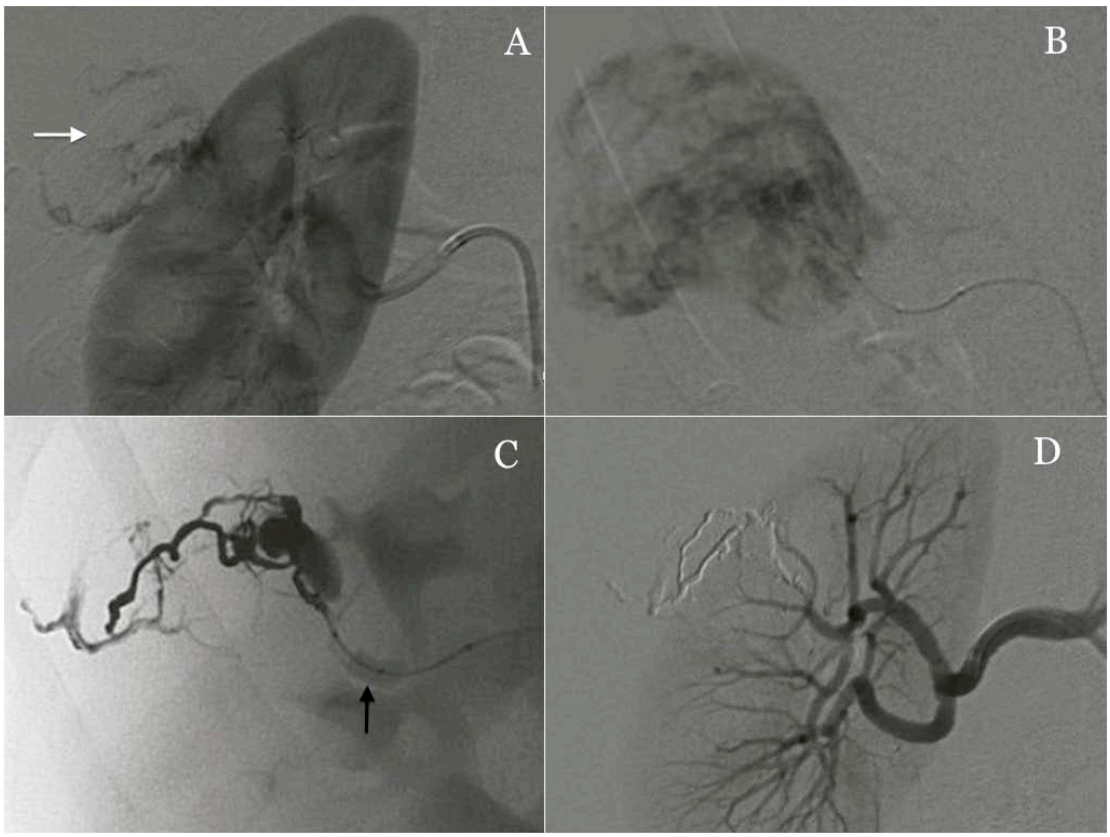


Figure 1 : A-D. Patient 1. A. Selective right renal artery angiogram demonstrates a vascularized round shaped renal tumor corresponding to a bleeding angiomyolipoma (arrow). B. Distal superselective injection through the Ascent microcatheter shows tumor vascularization. C Inflation of the ballon (black arrow) and Onyx progresion without reflux. D Final run showing normal renal vasculature and no tumor blush.

b) Case 2

A 79-year-old male patient had a rejection of a kidney graft transplanted 6 years before. Embolization was requested from nephrologists. Complete devascularization of the graft vascular bed was demanded and Onyx injection through a double lumen microcatheter was thought to associate good result. No reflux was noted and distal stuffing of the vessels was achieved (Fig.2). Additionally we embolized with a mixture of coils plus Onyx a superficial circumflex artery also involved in the graft arterial vascularization.

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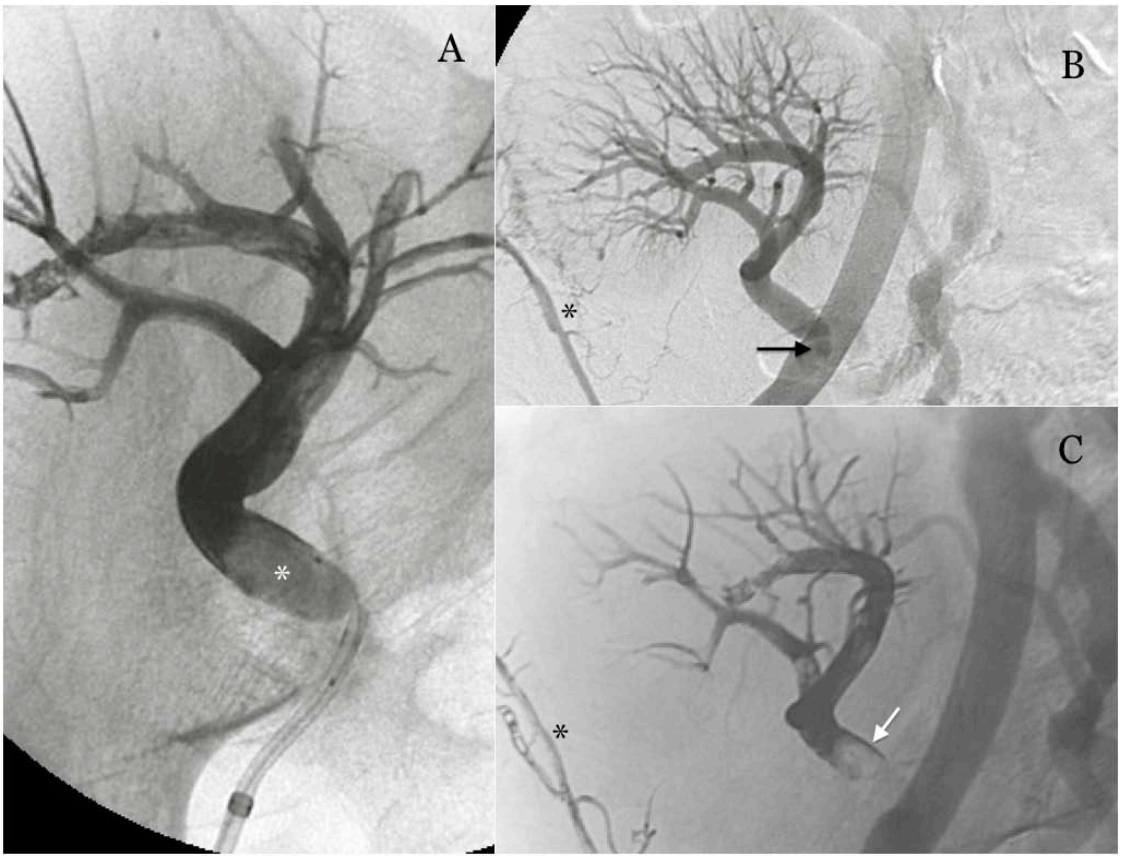


Figure 2 : Patient 2. A. Proximal Onyx injection through a double lumen balloon microcatheter during inflation (white asterisk) in a renal graft. Extreme distal reach of the liquid agent without reflux. B. The goal in the present case was to avoid reflux into external iliac artery (arrow) as well as distal embolization. Vascularization from cicumflex iliac artery is also seen (asterisk). C Withdrawal of the balloon microcatheter showing minimal reflux around the distal part of the balloon (arrow) and non-target embolization. Posteriously, we occluded the circumflex iliac artery as well (black asterisk)

c) Case 4

A 60-year-old male patient with an intense hemoptysis episode (1000 ml/24 h) was consulted to IR unit. Angio CT identifed an enlarged single right bronchial artery (4 mm) in addition to aneurysm like formations in the lower right lobe, findings in relation to necrotizing pneumonia.

In one hand, the Ascent ballon microcatheter was employed to help us to achieve a more stable position of the diagnostic catheter. For that reason, the dual lumen ballon catheter with the microwire were tracked into the bronchial artery, a gently inflation of the ballon allowed us to advance the diagnostic catheter over the system, achieving a more stable position (Fig.3).

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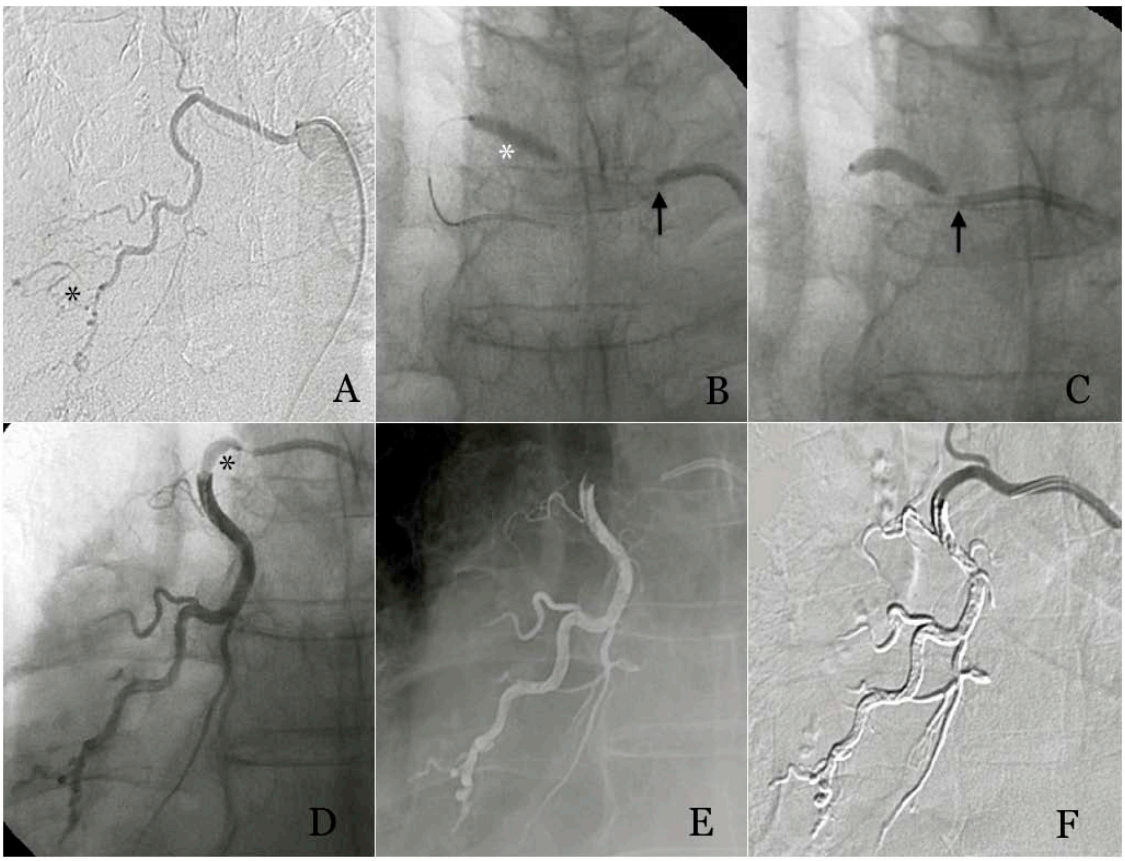


Figure 3 : A-F. Patient 4. A. DSA, selective injection from an enlarged right bronchial artery showing aneurysms-like formations in lower lobe (asterisk). B-C. Anchoring technique: Despite the passage of the glidewire to the artery not enough stability was achieved in the diagnostic catheter (arrow). Gentle inflation of the Ascent ballon (asterisk) in the bronchial artery allowed advancement of the 5Fr catheter over the system. D. Inflation of the ballon created a mechanical plug (asterisk) and Onyx injections was done sucessfully. E. After balloon deflation neither reflux nor adherence of Onyx to the catheter was noted. F. Final angiography showing complete occlusion of the artery and Onyx cast.

On the other hand, inflation of a proximal balloon created a 'mechanical plug', allowing for immediate forward flow of Onyx, reaching the more pathological vessels. No complications were noted.

d) Case 7

A 62-year-old male patient with a 6 cm right lobe hepatocellular carcinoma was scheduled to undergo a transarterial chemoembolization (TACE). During the initial angiography a high flow arterioportal fistula was identified and therfore the procedure was contraindicated. After multidisplinary discussion, an attempt to close the fistula and subsequent TACE was decided. For this purpose, the Ascent ballon was kept inflated in the arterial feeder and two 0,010" coils (Axium, Covidien) plus 0,6 ml of Onyx34 were introduced sequentially through its main lumen (Fig.4). In the final run no fistula was identified and the procedure was preformed as usually. No complications were noted and during a second TACE three months later the arterioportal fistula was still closed.

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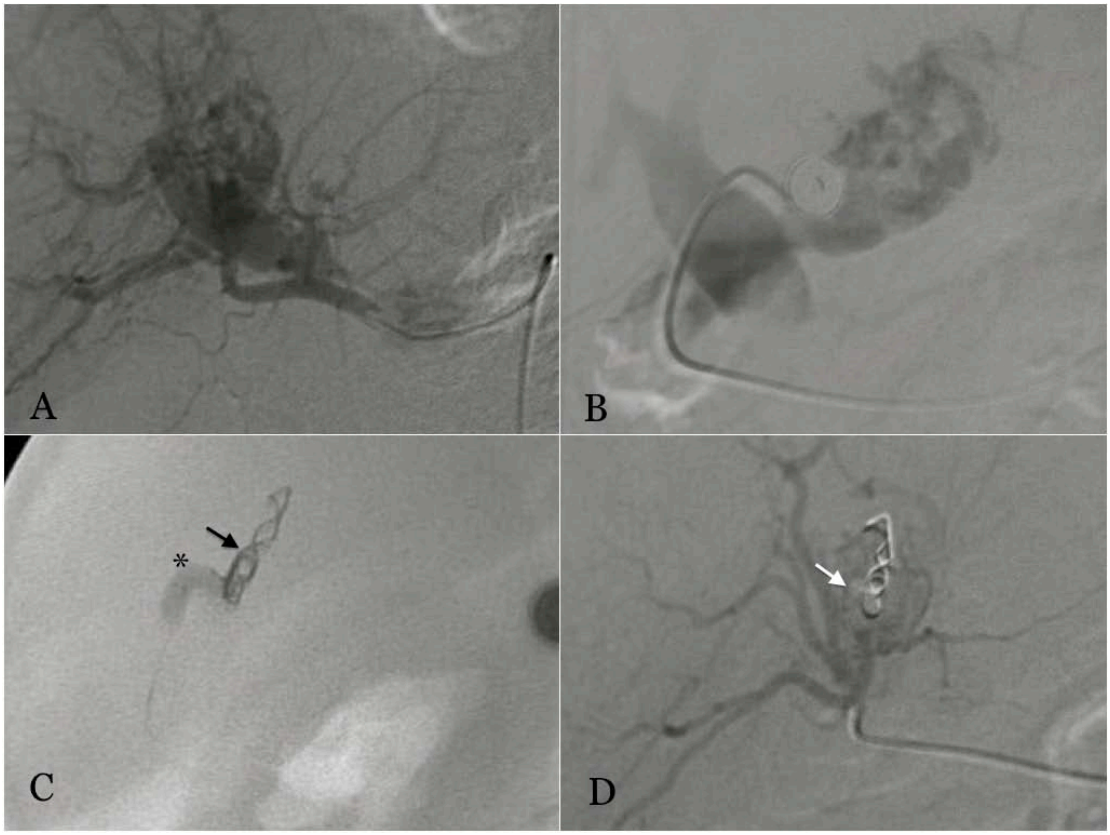


Figure 4 : A-D. Patient 7. A-B. Angiography identified a high-flow arterioportal fistula. A 3mm branch of the right hepatic artery was the single feeder. C-D. Inflation of the double lumen ballon (asterisk) at the fistula point, allows the combination of coils deployment (black arrow) and Onyx (white arrow) injection through the same lumen, decreasing the risk of Onyx migration.

IV. Discussion

Althought Ascent ballon was designed originally for ballon assisted coiling embolization of intracranial aneurysm; DMSO compatibility and Onyx injection through it have been described in the literature (5,7).

Inflation of a proximal balloon creates a 'plug', allowing for immediate forward flow of Onyx. Additionally, the balloon increases the proximal resistance in the feeder, encouraging Onyx to penetrate more distally into the lesion.

The drawbacks of Onyx embolization include the time needed to create a proximal plug that allows forward flow of the agent into the lesion (2) and proximal reflux of Onyx, which can compromise the normal vasculature and cause non-target embolizations and/or retention of the microcatheter. To obviate some of the risks associated with reflux of Onyx, the injection of Onyx through a dual-lumen balloon microcatheter has been described in the management of neurovacular procedures (7,8). In the present small series of embolizations performed by using this technique, there was immediate antegrade flow of Onyx into the pathologic vessel without the need for the initial formation of a plug. The inflated balloon essentially served as the plug, and embolization was achieved without catheter entrapment.

The present case series demonstrates the usefulness of the anchoring technique, a technique designed to allow the efficient and atraumatic positioning of a distal access-guiding catheter in patients with a tortuous anatomy. Hypercompliant balloon catheters can be reliably used to facilitate safe and rapid distal positioning of flexible guiding catheters beyond severe vascular tortuosity or in challenging arterial ostium (6).

Also, Onyx injections can be long, increasing the fluoroscopy times and radiation exposure. As seen in our series, because the use of the dual lumen balloon microcatheter precludes the need for creation of the Onyx plug, facilitates continuous Onyx injection, and there are no delays in microcatheter removal/extraction, the use of these devices may shorten the procedure times and, therefore, reduce radiation exposure.

There are several limitations to the present report. The present case series is small, and a much larger series of cases will be needed to fully document the safety of this technique, particularly in view of risks of vessel rupture during balloon inflation, arterio spasm, and balloon-induced intimal injury or thrombosis of arteries. Our results were also not compared with those in a control group of patients treated by using conventional embolization techniques. Finally, an

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important potential limitation of this technique may be related to difficulties in navigating the balloon microcatheter to very small distal arterial feeder vessel.

V. Conclusion

Double lumen Ballon Onyx embolization is feasible and safe. The described embolizations techniques can be used in peripheral interventions for avoiding complications related to reflux or complex anatomies.

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Assessment of Job Satisfaction among Academic and Clinical Radiographers in Public Institutions in Northern Nigeria

By Prince Ameh Ogenyi, Luntsi Geoffery & Dauda Maikudi
University of Maiduguri, Nigeria

Abstract- *Objectives:* To determine the level of job satisfaction among academic and clinical radiographers and possibly identify areas that requires improvements in the hospitals and radiography teaching institutions.

Methods: A prospective cross-sectional study of 48 radiographers working in tertiary healthcare institutions and universities in northern Nigeria. Semi-structured questionnaires were used to obtain vital information about the working conditions of radiographers and degree of satisfaction they derive from their job.

Data Analysis: Descriptive statistics such as mean, percentages and frequencies were generated using statistical package for social sciences (SPSS) 19.0 and inferential statistics was used to compare the level of job satisfaction of academic and clinical radiographers.

Results: A total of 60 semi-structured questionnaires were distributed among radiographers across northern Nigeria and 48 were retrieved representing a response rate of 80%. There were 33 males (68.8%) and 15 females (31.2%). The age of radiographers ranges from 25-50 years with a mean age of 29 years.

Keywords: *academic radiographer, burnout, clinical radiographer, job satisfaction, workload.*

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Conclusion: The study has shown that radiographers working in the northern part of Nigeria either as academics or clinicians are satisfied with their jobs on a general note and there is no significant difference between the level of job satisfaction among clinical and academic radiographers.

Advances in Knowledge: This research paper has identified lack of training/advancement opportunities, dilapidated infrastructure, incessant equipment breakdown and long equipment down time as major causes of dissatisfaction and frequent industrial strikes among radiographers in the region.

Keywords: academic radiographer, burnout, clinical radiographer, job satisfaction, workload.

I. Introduction

The history of job satisfaction stems back to the early 1900's with the situationist perspective on job satisfaction. This perspective states that satisfaction is determined by certain characteristics of the job and characteristics of the job environment itself. This view has been present in the literature since the first studies by Hauser, Taylor and the various projects at the Western Electric plants in Hawthorne. [1] These studies follow the assumption that when a certain set of job conditions are present a certain level of job satisfaction will follow.

It is noteworthy that, the greatest challenge facing healthcare systems in sub-Saharan Africa is the insufficiency of human resources from both qualitative and quantitative stand points. [2] This implies that every effort must be channelled towards improving the work standards and welfare of healthcare professionals in order to retain the current professionals and possibly attract more persons to the health sector. [3]

Radiographers across the world remain highly vital and highly indispensible as far as the healthcare institution and patient care is concerned. Consequently, the overall condition of the radiographer is paramount to the promotion of excellent well being of the sick patient. It is evident that dissatisfied health workers have compromised efficiency and a direct or indirect negative impact on the well being of the patient. [4, 5]

It is in view of this fact that, several studies have been conducted by diverse intellectuals to evaluate and assess job satisfaction among medical practitioners and other allied health professional across the world. [2] Although studies have been conducted regarding medical practitioners and other health professionals, radiographers have not received considerable attention in this respect. [6]

Okaro reported that radiographers in southeast Nigeria are not satisfied with their jobs and would prefer another job if the opportunity comes. [7] This finding was also supported by David who also observed that radiographers in Northern Nigeria were clearly dissatisfied with their salaries. [9] Now, what are the main causes of strikes among radiographers and other allied health professionals? Has the welfare of radiographers in Nigeria improved over the years? If not, what then is the way forward? These are some of the questions which require urgent answers.

"Job satisfaction" is a multifaceted concept which covers the positive emotional, physical, psychological, moral and social gratification or contentment that individuals derive from their chosen profession. Visser et al., described job satisfaction as the extent to which one is generally fulfilled by or the pleasure derived from one's current job or working

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conditions. [9] Although it is quite difficult to objectively assess job satisfaction, it is still achievable in many respects.

This study collated views of academic and clinical radiographers in some hospitals and universities in Northern Nigeria using job assessment scales and analyzed them in order to ascertain satisfaction. [6]

II. Materials and Methods

The objective of this study was to determine the level of job satisfaction among clinical and academic radiographers and possibly identify areas which require improvements in the tertiary healthcare institutions and universities in northern Nigeria. A prospective cross-sectional survey design was used for this study. It was carried out for a period of 4 months, from December 2014- March 2015.

a) Setting and Subjects

A stratified convenience sampling technique was used for this study as 3 major geo-political zones in Northern Nigeria were considered, these include, the North-east, North-west and North-central. Primary source of data (questionnaires) was used for this study as data was collected from the radiographers working at hospitals and universities in Northern Nigeria. Acceptance to participate in the study after explanation of the study was considered as consent and participation was voluntary. Participants were allowed to withdraw from the study at any point without explanation.

b) Instrument

The data was collected using self-administered 20 item scale structured questionnaires with questions on demographics, Job satisfaction, working conditions and areas requiring developments in radiography.

c) Statistical Analysis

Data was analyzed using Statistical Package for Social Sciences (SPSS) version 19. Descriptive statistics such as mean, standard deviation, percentages and frequency distribution tables were utilized to analyze quantitative data and content analysis was used for semi-structured questions, t-test was used for the inferential statistics and $p \leq 0.05$ was considered.

III. Results

A total of 60 semi-structured questionnaires were distributed across northern Nigeria among academic and clinical radiographers and 48 were retrieved representing a response rate of 80%. There were 33 males (68.8%) and 15 females (31.2%). The age of radiographers ranges from 25 to 50 years with a mean age of 29 years $\pm$ 10.5 years.

A total of 35 clinical radiographers and 13 academic radiographers participated in the study. About 22 radiographers (48.8%) who participated in the study recorded high rate of job satisfaction while 13 radiographers (31.3%) had optimal satisfaction and 11 radiographers (22.9%) were dissatisfied with their job.

Table 1.0 : Demographic Information of Radiographers with Overall Job satisfaction

Demographics		Frequency(%)	Satisfied	Dissatisfied
Category	Clinical Radiographers	35(72.9)	24(68.6)	11(31.4)
	Academic Radiographers	13(27.1)	13(100)	0
	Both (Clinical & Academic)	13(27.1)	13(100)	0
Gender	Male	33(68.8)	25(75.8)	8(24.2)
	Female	15(31.2)	12(80)	3(20)
Age	25-30	29(60.4)	24(82.8)	5(17.2)
	31-35	14(29.1)	9(64.3)	5(35.7)
	36-40	2(4.2)	1(50)	1(50)
	41>	3(6.3)	2(100)	0
Nature of Work	Full-time	43(89.6)	35(81.4)	8(18.6)
	Part-time	5(10.4)	2(40)	3(60)
Years of Experience	0-5	34(70.8)	25(73.5)	9(26.5)
	6-10	9(18.7)	8(88.9)	1(11.1)
	11-15	3(6.2)	3(100)	0
	16>	2(4.2)	1(50)	1(50)
Highest Qualification	DCR	1(2.1)	0	1(100)
	BSc	39(81.3)	29(74.4)	10(25.6)
	Msc and above	8(16.7)	8(100)	0
Institution	UMTH	13(27.1)	8(61.5)	5(38.5)
	FNPH	3(6.3)	3(100)	0
	ATBUTH	4(8.3)	3(75)	1(25)
	UNIMAID	7(14.6)	7(100)	0
	AKTH	10(20.8)	8(80)	2(20)

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NHA	5(10.4)	3(60)	2(40)
BUK	6(12.5)	6(100)	0

Key: DCR: Diploma Certificate Radiography
BSc: Bachelor of Science Radiography
Msc: Masters Degree Radiography
UMTH: University of Maiduguri Teaching Hospital
FNPH: Federal NeuroPschiatry Hospital
ATBUTH: Abubakar Tafawa Teaching Hospital
UNIMAID: University of Maiduguri
AKTH: Aminu Kano Teaching Hospital
NHA: National Hospital Abuja
BUK: Bayero University Kano

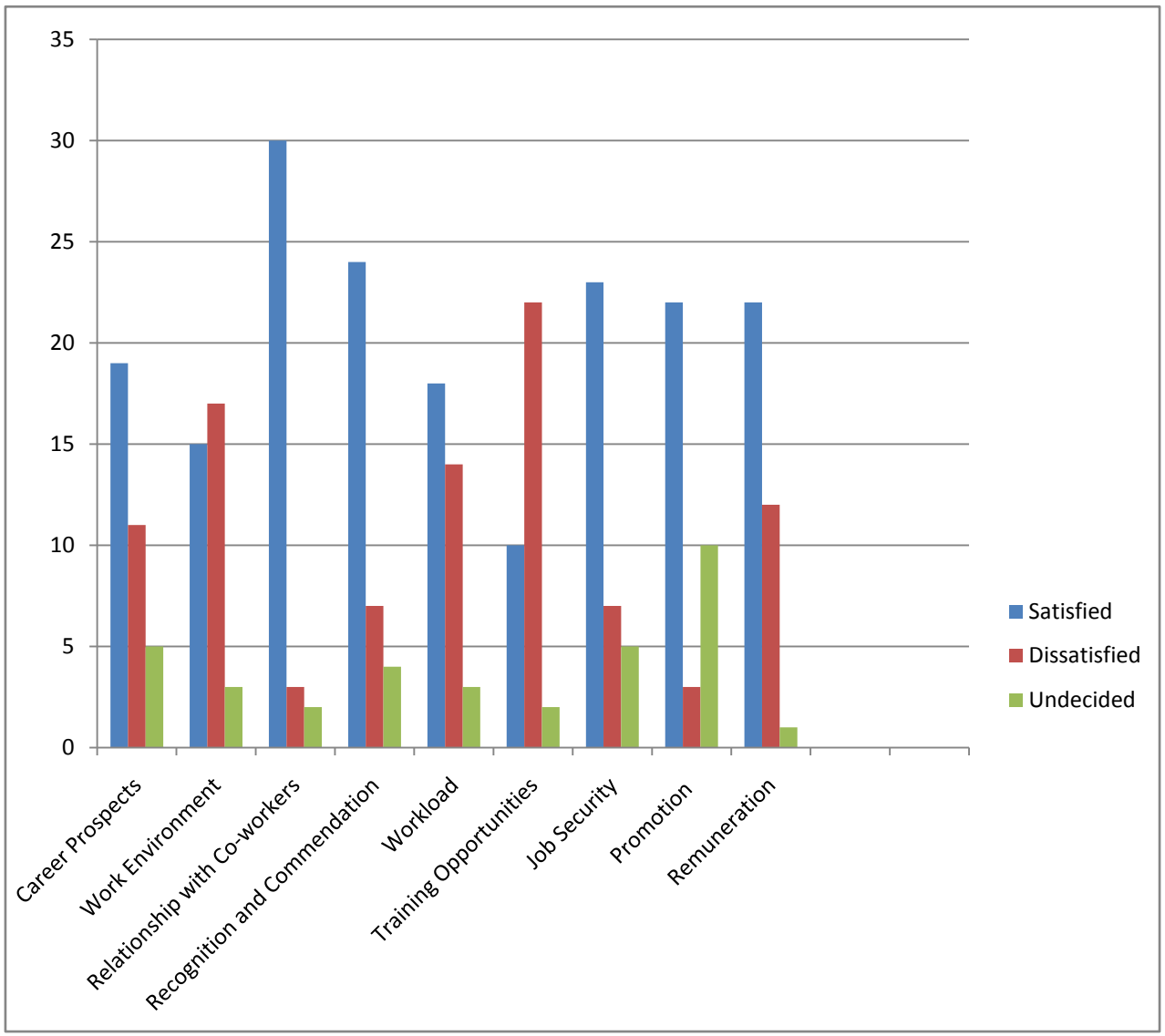


Figure 1.0 : Clinical radiographer's satisfaction with different job facets.

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Table 1.2 : Academic radiographer's views on the different facets of their Jobs

Job facet	Satisfied (%)	Dissatisfied (%)	Undecided (%)
Career Prospects	13(100)	0	0
Work Environments	3(23.1)	10(76.9)	0
Relationship with Co-workers	13(100)	0	0
Recognition	11(84.6)	2(15.4)	0
Workload	0	13(100)	0
Training Opportunities	10(76.9)	3(23.1)	0
Job Security	9(69.2)	2(15.4)	2(15.4)
Promotion	7(53.8)	5(38.5)	1(7.7)
Remuneration	4(30.8)	9(69.2)	0
Total	70(59.8%)	44(37.6%)	3(2.6%)

Table 1.3 : Overall satisfaction among clinical and academic radiographers

Clinical Radiographer			
Strongly Dissatisfied	Dissatisfied	Satisfied	Strongly Satisfied
1	10	10	14
2.9%	28.6%	28.6%	40

Academic Radiographer			
Strongly Dissatisfied	Dissatisfied	Satisfied	Strongly Satisfied
0	0	5	8
0	0	38.5%	61.5%

Table 1.4 : Statistical Analysis of mean satisfaction score using Student t-test out of 10.

Academic Radiographer(X)	Clinical Radiographer(Y)	X^2	Y^2
6	7	36	49
9	3	81	9
7	5	49	25
5	5	25	25
7	6	49	36
5	5	25	25
8	10	64	100
5	7	25	49
5	6	25	36
6	2	36	4
8	5	64	25
8	4	64	16
7	5	49	25
0	4	0	16
0	4	0	16
0	4	0	16
0	8	0	64
0	3	0	9
0	10	0	100
0	4	0	16
0	3	0	9
0	6	0	36
0	3	0	9
0	6	0	36
0	8	0	64
0	7	0	49
0	9	0	81
0	7	0	49
0	7	0	49
0	5	0	25
0	9	0	81

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0	4	0	16
0	10	0	100
0	8	0	64
0	8	0	64
$\sum X=86$	$\sum Y=207$	$\sum X^2=592$	$\sum Y^2=1393$

Standard error (ste-x) = 0.69 Critical value = 2.201 t = 1.10

IV. Discussion

The study evaluated job satisfaction among 48 radiographers working in northern Nigeria either as academic or clinical radiographers. The mean age of respondents was 29 years with a standard deviation of 10.5 and about 33 males and 15 females were involved in the study.

The study considered 10 critical job facets which include, career prospects, work environment, relationship with fellow radiographers, radiologists and other workers in the radiology department, recognition by departmental heads and superiors at work, daily workload, availability of training and advancement opportunities, job security, frequency of promotions, remuneration and other benefits. This is similar to studies conducted some researchers in Europe. [4, 10, 11]

All radiographers who participated in the study provided information about each job facet in their respective institutions and the overall job satisfaction was determined based on responses provided regarding each job facet.

The study indicated that about 68.6% (n=24) clinical radiographers were satisfied with their jobs while 33.5% (n=11) were dissatisfied with their jobs. On the other hand, it was observed that about 100% (n=13) academic radiographers were satisfied with their job. This proved that academic radiographers were more likely satisfied with their job than their counterparts in the clinic. This could be due to the fact that, there are more opportunities for post graduate training (MSc, PhD, and post doctoral training) as well as timely promotions.

These findings of high level satisfaction were at variance with findings by some researchers who found that majority of radiographers (68%) in south east Nigeria were unsatisfied with their jobs. [7] This new trend could be attributed to the fact that over the years the number of radiographers has grown rapidly as more universities now graduate radiographers in Nigeria. This has led to a significant decrease in the daily workload.

The study has also shown that there is a need for more female radiographers in the north as only about 31.2% females were reached in the course of the study. This is especially important considering socio-cultural perspectives of Nigerians residing in the north with most female patients preferring services from female radiographers.

Existing literatures suggest that job satisfaction in the health sector increases with increase in qualification.[12-14] This study also supports this finding as satisfied than those who had only DCR and/or Bsc. This could be because higher qualification provides room for advancement, role extension and better incentives. Similarly, the higher the years of professional practice in radiography, the higher the satisfaction the radiographer derives. This is in agreement with a study by Lehman et al., (2015) who explored the relationship between workers retention and job satisfaction of Swiss Radiographers in Switzerland.

It was also observed that radiographers working part-time were not as satisfied as those working fulltime probably because they had limited benefits, low job security and were excluded from routine promotions.

Previous studies of job satisfaction among Maltese Radiographers observed that salary was the major cause of dissatisfaction, this study identified lack of training/ advancement opportunities (62.9% indicating dissatisfaction), dilapidated infrastructure, incessant equipment breakdown and long equipment down time (48.6% indicating dissatisfaction) as the major aspects of dissatisfaction among clinical radiographers. [8, 11]

These views about lack of standard work environment were also identified as a serious challenge in a similar studies of job satisfaction among radiographers in Finland, Tanzania, Malawi and South Africa. [6, 10] It is important to note that, the provision of essential imaging technologies such as Computed tomography, automated ultrasound imaging systems, digital breast tomosynthesis, PET scanners, Magnetic Resonance imaging among others in all Tertiary Healthcare institutions in Northern Nigeria will not only contribute to enhancing job satisfaction among radiographers, it will also check upsurge in the number of Nigerians travelling abroad for medical diagnosis and treatment.

Even though the academic radiographers appeared more satisfied, with all of them attaining high overall satisfaction scores, they expressed deep concerns about their remuneration (69.2% indicating dissatisfaction) and work environment (76.9% indicating dissatisfaction). They strongly emphasized the need for autonomy, respect and value for both academic and clinical radiographers especially with advancement. This agrees with findings from studies of factors influencing job satisfaction, burnout and stress in public healthcare sector in Pakistan, Australia and New Zealand. [13, 14]

One critical job facet which has been an issue over the years is remuneration and benefits resulting in frequent strikes (industrial action) among the allied However aspects such as work environments, dilapidated infrastructure, long equipment downtime, lack of training/ advancement opportunities and

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inadequate remuneration have been identified as major job facets which have negative impacts on overall job satisfaction of radiographers as most of the radiographers were dissatisfied with these aspects of their job. The study also revealed that, autonomy, respect and value for radiographers would enhance career satisfaction among radiographer.

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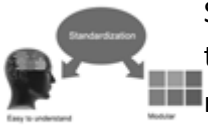


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(f) Results should be presented concisely, by well-designed tables and/or figures; the same data may not be used in both; suitable statistical data should be given. All data must be obtained with attention to numerical detail in the planning stage. As reproduced design has been recognized to be important to experiments for a considerable time, the Editor has decided that any paper that appears not to have adequate numerical treatments of the data will be returned un-refereed;

(g) Discussion should cover the implications and consequences, not just recapitulating the results; conclusions should be summarizing.

(h) Brief Acknowledgements.

(i) References in the proper form.

Authors should very cautiously consider the preparation of papers to ensure that they communicate efficiently. Papers are much more likely to be accepted, if they are cautiously designed and laid out, contain few or no errors, are summarizing, and be conventional to the approach and instructions. They will in addition, be published with much less delays than those that require much technical and editorial correction.

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Standard Usage, Abbreviations, and Units: Spelling and hyphenation should be conventional to The Concise Oxford English Dictionary. Statistics and measurements should at all times be given in figures, e.g. 16 min, except for when the number begins a sentence. When the number does not refer to a unit of measurement it should be spelt in full unless, it is 160 or greater.

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References

References follow the Harvard scheme of referencing. References in the text should cite the authors' names followed by the time of their publication, unless there are three or more authors when simply the first author's name is quoted followed by et al. unpublished work has to only be cited where necessary, and only in the text. Copies of references in press in other journals have to be supplied with submitted typescripts. It is necessary that all citations and references be carefully checked before submission, as mistakes or omissions will cause delays.

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28. Make colleagues: Always try to make colleagues. No matter how sharper or intelligent you are, if you make colleagues you can have several ideas, which will be helpful for your research.

29. Think technically: Always think technically. If anything happens, then search its reasons, its benefits, and demerits.

30. Think and then print: When you will go to print your paper, notice that tables are not be split, headings are not detached from their descriptions, and page sequence is maintained.

31. Adding unnecessary information: Do not add unnecessary information, like, I have used MS Excel to draw graph. Do not add irrelevant and inappropriate material. These all will create superfluous. Foreign terminology and phrases are not apropos. One should NEVER take a broad view. Analogy in script is like feathers on a snake. Not at all use a large word when a very small one would be sufficient. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Amplification is a billion times of inferior quality than sarcasm.

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33. Report concluded results: Use concluded results. From raw data, filter the results and then conclude your studies based on measurements and observations taken. Significant figures and appropriate number of decimal places should be used. Parenthetical remarks are prohibitive. Proofread carefully at final stage. In the end give outline to your arguments. Spot out perspectives of further study of this subject. Justify your conclusion by at the bottom of them with sufficient justifications and examples.

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- Significant conclusions or questions that track from the research(es)

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Content

- Sum up your conclusion in text and demonstrate them, if suitable, with figures and tables.
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- Present a background, such as by describing the question that was addressed by creation an exacting study.
- Explain results of control experiments and comprise remarks that are not accessible in a prescribed figure or table, if appropriate.
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Approach

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- Give details all of your remarks as much as possible, focus on mechanisms.
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- Try to present substitute explanations if sensible alternatives be present.
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Topics	Grades		
	A-B	**C-D**	**E-F**
Abstract	Clear and concise with appropriate content, Correct format. 200 words or below	Unclear summary and no specific data, Incorrect form Above 200 words	No specific data with ambiguous information Above 250 words
Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

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