



Assessment of the workload and financial burden of Bosniak IIF renal cyst surveillance in a tertiary referral hospital

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Abstract

Background The Bosniak classification is a CT classification which stratifies renal cysts based on imaging appearances and therefore associated risk of malignancy. Bosniak IIF cysts are renal which have complex features and therefore require surveillance.

Aims The aim of this study is to assess the economic and workload burden of diagnosing and following up Bosniak IIF cysts on the urology service in a tertiary hospital in the West of Ireland.

Methods All patients with a diagnosis of Bosniak IIF renal cysts attending our urology service between 1st of January 2012 and 31st December 2020 were analysed. The following data were collected: number and modality of follow up scans, number of MDT discussions, number and type of outpatient appointments, surgical intervention, and length of follow up. Financial data were provided by the hospital finance department.

Results One hundred and sixty-two patients were included. Total cost of follow up was €164,056, costing €1,012.7 per patient. Cost of outpatient visits was €77,850. Follow-up length ranged from 1 to 109 months, median follow up time 17.5 months. Overall cost of imaging was €74,518. There were a total of 80 MDT discussions at an overall cost of €11,688.

Conclusions This study demonstrates that surveillance of patients with Bosniak IIF renal cysts represents a significant burden upon both radiology and urology services. Surveillance for these patients could be streamlined in the future through a number of initiatives such as virtual OPDs and dedicated MDTs.

Keywords Bosniak IIF · Bosniak 2f · Burden · Cost · Economic impact · Follow-up · Imaging · Surveillance

Introduction

Renal cysts are a common phenomenon, with approximately 50% of individuals over the age of 50 having at least one renal cyst [1]. Simple cysts are entirely benign and require no follow up. Complex cysts, however, can be benign, indeterminate, or malignant, and therefore represent a conundrum for the clinician.

In 1986, M.A. Bosniak proposed a classification system for renal cysts based on computed tomography (CT) imaging appearances [2]. This stratified cysts into different categories

to determine the risk of malignancy. This system has endured to this day albeit with periodic updates. The term Bosniak IIF was introduced later, to enable the identification of cystic lesions which had more complex features but were not overtly malignant. The “F” stands for follow-up, as such cysts require surveillance to determine whether they remain stable, indicating a benign lesion, or progress, indicating potential malignancy [3]. A 2005 version of this system, by Warren and McFarlane [4], defines a Bosniak IIF cyst as follows:

These cysts might contain more hairline thin septa. Minimal enhancement of a hairline thin septum or wall can be seen and there might be minimal thickening of the septa or wall. The cyst might contain calcification that might be nodular and thick but there is no contrast enhancement. There are no enhancing soft-tissue elements. Totally intrarenal non-enhancing high-attenuation renal lesions of ≥ 3 cm are also included in this category. These lesions are generally well marginated.

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This is the current definition used by the 2021 European Association of Urology Guidelines on Renal Cell Carcinoma [5]. Bosniak I and II cysts are considered benign and therefore do not require follow up. On the other hand, Bosniak III and IV cysts are considered to have a high likelihood of malignancy, and therefore, surgical resection is advised [6].

The necessity for follow up of Bosniak IIf cysts is due to their malignant potential. The progression rate of Bosniak IIf cysts in two separate studies was found to be 4.6% [7, 8]. Malignancy rates of Bosniak IIf cysts are determined by surgical resection, and in one systematic review, the malignancy rate was calculated at 6.7% [9]. While it is certain that Bosniak IIf cysts require follow up, there remains no consensus on the appropriate length of follow up or the intervals for repeat imaging. In a 2003 paper, Israel and Bosniak recommend surveillance of these cysts for 5 years, with the first follow up scan to be performed 6 months from time of diagnosis [10]. In a 2014 study by Hindman et al. [11] the recommended total length of follow up for such cysts was 4 years, while noting that some cysts may require longer or shorter periods of follow up. An updated Bosniak classification was proposed in 2019, with the aim of reducing inter-reporter variability, formally including magnetic resonance imaging (MRI) in the classification, and reducing the overdiagnosis and overtreatment of cystic renal masses by clarifying definitions [12]. However it does not include follow up recommendations and its use has yet to be adopted on a broader scale.

The Bosniak classification was originally described for CT imaging. However, in recent years, its use has extended to MRI. Thus, either modality may be used to follow up cystic renal lesions. Grey-scale ultrasound (US) may play a role in assessing these lesions, and the accuracy of contrast-enhanced ultrasound (CEUS) is currently being investigated [13]. A 2014 study found that while US could diagnose cystic renal masses, when compared with CEUS, it identified less septa and lacked the ability to identify important features such as enhancement [14].

Multidisciplinary Team Meetings (MDTs) are a common feature in modern healthcare. While their importance in the context of oncology cases has been well established, their use for benign conditions has also been recognised [15]. The importance of MDT meetings in the management of Bosniak IIf lesions has been demonstrated, as they facilitate re-evaluation and therefore potentially re-classification of these cysts. In one such study, 15.6% of Bosniak IIf cysts were re-classified following MDT discussion [16]. Additionally, this re-evaluation can aid decision-making regarding further follow up, need for intervention, or suitability for discharge.

Given the prevalence of renal cysts in general and the importance of follow up of Bosniak IIf cysts in particular, one can conclude that the follow up of such lesions can generate a significant workload for healthcare services. The aim

of this study is to assess the economic and workload burden of diagnosing and following up Bosniak IIf cysts on the urology service in a tertiary hospital in the West of Ireland.

Methods

All patients with a diagnosis of Bosniak IIf renal cysts who attended the urology services in the hospital between the 1st of January 2012 and the 31st of December 2020 were included. The key words of “Bosniak 2F” and “Bosniak IIf” were applied to both radiology and dictation databases to generate a patient list. In some instances, the label Bosniak IIf was not explicitly reported on imaging, but rather the description of a Bosniak IIf cyst was used. These cases were included as the description of the cysts was appropriate to the classification system, and the label Bosniak IIf was used in subsequent imaging reports and correspondence. Patients from private and external hospitals were excluded, as were patients who had never been referred to urology services. A small number of patients had a diagnosis of Bosniak II cysts or simple cysts, as opposed to Bosniak IIf, and these patients were also excluded. Data including number and modality of follow up scans (including the initial scan at diagnosis), number of MDT discussions, number and type of outpatient appointments (physical and virtual), whether patients had any surgical intervention and total length of follow up in months were recorded. Financial data including the cost of imaging, clinic appointments and MDT meetings were calculated and provided by the hospital finance department. The cost of MDT discussion was calculated as outlined below, with input from the MDT coordinator as to the number of personnel involved in the meetings and their respective estimated working hours pertaining to each meeting (Table 1).

Results

A total of 349 patients were identified as having Bosniak IIf cysts during this time period. Of these, 162 were included, as they were referred to the urology services. The length of follow up ranged from 1 to 109 months, with a median follow up time of 17.5 months. Variation in the length of follow up was due to a number of factors such as patient mortality during the follow up period, re-classification of cysts after MDT discussion or on follow up imaging and the proximity of cyst diagnosis to the timeframe cut-off of the study. A total of 8 (5%) patients had their IIf cysts reclassified to Bosniak III or higher during the period; 4 (2.5%) were reclassified as Bosniak III, while 4 (2.5%) were reclassified as having image appearances suspicious for a renal neoplasm. Of this cohort, 4

Table 1 Estimated cost for MDT slot per patient

Quantity	Job	MDM time	Total MDM hours	Prep time	Total hours	Rate	Total cost
14	Consultants	1.5	21	6	27	101	2740
7	Reg	1.5	10.5		10.5	39	410
2	SHO	1.5	3		3	30	89
1	Grade V (coordinator)	1.5	1.5	3	4.5	26	118
1	IT Support Outside vendor	N/a	1		1	150	150
Total cost per MDM							€3506
Cost per patient							€146.10

had surgical resection, with all 4 having malignancy on histology. Regarding the remaining patients, 3 remain on surveillance and 1 patient had their cyst subsequently downgraded.

Regarding follow up imaging, a total of 224 CT scans, 33 MRIs and 299 US scans were performed over the period. There were a total of 80 MDT discussions for this cohort, with 13 (8%) of these patients discussed at MDT on more than one occasion. The total cost of MDT discussions was €11,688, calculated as €146.10 per patient. Only 1 (0.6%) patient underwent a surgical procedure, initially undergoing cyst drainage, followed by nephrectomy. Histology in this instance demonstrated cystic nephroma.

The total cost of follow up over the 9 year period was calculated at €164,056, with the cost per patient calculated at €1012.7. The total cost of follow up imaging was estimated at €74,518. However, the calculated cost of imaging represents a commercial rather than true cost, as aspects such as scanner running costs, service contracts and depreciation are not factored in. The total cost of outpatient visits was €77,850. While there was no formal price comparison between physical and virtual outpatient clinic appointments for our department, the cost of a virtual review would be equivalent to a physical review, as virtual reviews take place in a fully staffed outpatient setting. Cost summary is outlined in Table 2.

Table 2 Cost summary

Intervention	Cost per unit	Total number of units	Total cost
CT	€170	224	€38080
MRI	€180	33	€5940
USS	€102	299	€30498
OPD	€150	519	€77850
MDT	€146.1	80	€11688
Total cost			€164056
Cost per patient			€1012.7

Discussion

The prevalence of Bosniak IIf cysts and the workload and financial burden that is required for their surveillance is evident in the findings of this study. The potential for malignant transformation of these cysts, estimated at 6.7%, necessitates their surveillance [9]. Surveillance comprises various imaging modalities, outpatient appointments, and, in some instances, MDT discussion. The total cost of follow up of 162 patients with Bosniak IIf cysts over a 9-year period in our institution was €164,056 and averaged €1,012.7 per patient. Regarding the burden of surveying such patients on the staff, this can be extrapolated from the multidisciplinary input needed for MDT discussions, image acquisition and interpretation, as well as the workload required for the running of outpatient clinics.

A total of 556 follow up scans consisting of 224 CTs, 33 MRIs and 299 US at a total cost of €74,518 were required for surveillance of these patients. Twenty-three patients (14.2%) had neither CT nor MRI during their surveillance. Given that the original Bosniak classification was based specifically on CT findings, and in later years has been adopted for MRI, this represents a deficiency in our imaging pathway for assessing and surveying Bosniak IIf cysts. Certainly, while US can play a role in the assessment of Bosniak IIf cysts, it is less sensitive than MRI, CT and CEUS, and therefore to ensure complete assessment of these cysts, one of these other imaging modalities should be used, at least in the initial characterisation of the cyst [13, 14]. From an economic perspective, in our institution, the price of US is approximately 60% of that of a CT scan, and MRI is approximately 105% of that of a CT scan. Financially then, it may be reasonable to follow up Bosniak IIf cysts with US, provided initial characterisation with CT or MRI has been undertaken.

A total of 80 MDT discussions at an overall cost of €11,688 were had for these patients. Thirteen (8%) of patients were discussed at MDT on more than one occasion. MDT meetings come at a large financial and workload burden, as is demonstrated in Table 1. There may be a role

for MDT discussions for patients with Bosniak IIf cysts, as these forums provide the team with the opportunity to reassess imaging and therefore the potential to reclassify cysts, determine appropriate follow up schedules per patient, or even to deem patients fit for discharge from surveillance [16]. In the future, the MDT could be used as a tool to effectively streamline patients into those fit for discharge from surveillance, those who require ongoing surveillance and the means of this, and those who may require intervention due to progression on imaging.

As a response to the COVID-19 pandemic, many outpatient appointments moved from the traditional face-to-face setup to a virtual domain [17]. This was also the case in our institution. While the finance department in our hospital was of the impression that there would not be a significant cost difference between virtual and physical consultations, a cost difference has been demonstrated elsewhere [18]. Nevertheless, while there may be no evident cost difference for implementation of virtual outpatient clinics from the perspective of our health service, virtual consultations can have the advantage of removing the expense and effort of travel for patients [19]. A total of 519 outpatient appointments at an overall cost of €77,850 were required for follow up of the 162 patients concerned in this study. Moving forward, transferring some, if not all, of these appointments to a virtual environment could have the outcome of reducing both the financial burden on patients and also potentially that of the health service.

Interestingly, only 1 patient underwent surgical resection of their stable Bosniak IIf cyst, which revealed benign histology. Of the eight patients who reclassified to a higher grade during the period, the 4 who underwent surgical resection all had malignant pathology. This gives a malignancy rate of 2.5% for the 162 patients. In contrast, the progression and malignancy rates for Bosniak IIf cysts were quoted as 4.6% and 6.7% respectively in the literature [7–9].

It is worth noting that only 162 (46.4%) of the 349 patients diagnosed with Bosniak IIf cysts during the study period were referred to and followed up by urology. Clearly, this represents deficiencies in the referral and surveillance pathways for such patients at our institution. Israel and Bosniak [10] state that when a patient is diagnosed with Bosniak IIf cyst the...

...radiologist must be certain that the referring physician clearly understands that the lesion in question is likely benign but that it does have some worrisome features and that follow-up examinations are necessary to prove stability and, therefore, benignity.

It is possible that in the context of these patients, the attending clinician was not aware of the requirement for follow up of these individuals, or that follow up was undertaken by a specialty other than urology. A potential future direction for study could be to investigate what, if any, follow up this cohort had and what the outcomes were. Moving forward,

one way to ensure that all such patients are followed up is to formally assign a Bosniak score to all identified renal cysts on imaging and to recommend urology referral and surveillance for Bosniak IIf cysts and above.

In this study, we have focused solely on the economic burden that follow up of these patients places upon the health service. If patient factors such as days lost at work and the financial implications of travel for surveillance scans and outpatient clinics were included, it is likely that the total figure would be much higher. It is worth bearing in mind that the true cost of follow up imaging when additional factors such as staffing and utilities are factored would be higher than the figure we have provided. Additionally, while we endeavoured to capture all patients with Bosniak IIf cysts who were referred to our services using our search methods, it is possible that some cases were missed.

Conclusion

This study demonstrates that the surveillance of patients with Bosniak IIf renal cysts represents a significant financial and workload burden upon both the radiology and urology services in our institution. Additionally, the intervention rates for Bosniak IIf cysts in our institution were relatively low at 0.6%. Moving forward, there is the potential for surveillance of these patients to be streamlined via the inclusion of follow up recommendations in radiology reports diagnosing such cysts, the introduction of dedicated MDT meetings to determine follow up regimens for these patients, and implementing a virtual outpatient setup.

Author contribution O. Cullivan: Data collection, data analysis, manuscript writing. R. Wong: data collection, data analysis. C. Albu: data collection, data analysis. F. D'Arcy: project development, manuscript editing. E. O'Malley: project development, manuscript editing. P. McCarthy: project development, manuscript editing. C.M Dowling: data collection, project development, manuscript writing and editing. All the authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by Orla Cullivan, Ruby Wong and Cristian Albu. The first draft of the manuscript was written by Orla Cullivan, and all the authors commented on previous versions of the manuscript. All the authors read and approved the final manuscript.

Declarations

Conflict of interest The authors declare no competing interests.

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