

peer reviewed ORIGINAL ARTICLE

## Determination of creatinine level before administration of intravenous iodinated contrast media at two selected hospitals in Ghana

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### Abstract

**Background:** In spite of the development and availability of newer contrast media with reduced and enhanced safety profiles, certain patients remain at risk for serious adverse reactions. Creatinine clearance is widely used to assess at-risk patients. This is an acceptable practice for estimating the glomerular filtration rate.

**Aim:** The aim of the study was to find out whether creatinine clearance is determined before administration of intravenous iodinated contrast medium (IICM) in some selected contrast-usage hospitals in Ghana.

**Method:** The research was a descriptive survey. The participants were selected through purposive sampling. Fifty-nine (59) questionnaires were sent to radiographers, radiologists and physicians from the respective imaging and urology departments of the selected hospitals. Fifty (n=50) completed questionnaires were received. Descriptive statistics was used to generate the results.

**Results:** The study achieved a response rate of 85%. Most of the respondents (n=41; 82%); did not enquire or determine creatinine clearance of their patients before referring or performing procedures that involved the use of IICM. Reasons given for not doing so were as follows: cost involved (n=16; 32%), delay in booking (n=15; 30%), and booking disruptions (n=4; 8%). The test was considered to be cumbersome by eight (16%) of the respondents, whereas ten (20%) indicated they did not determine it because they relied on other staff (radiographers/radiologists relied on referring physicians and vice versa).

**Conclusion:** Determination of creatinine clearance before IICM examinations by referring clinicians appeared lacking in the selected hospitals in Accra. The imaging departments also do not check their patients' creatinine clearance or levels before performing procedures. It is appropriate that the creatinine status is checked to avoid serious adverse reactions to at-risk patients. However, there are challenges in checking patients' creatinine status, such as delays in booking patients, booking disruptions, high cost, the cumbersome nature of the test and communication gap.

### Keywords

Creatinine clearance; diagnostic imaging; safety profiles

### Introduction

Intravenous iodinated contrast media (IICM) are important water soluble agents administered intravenously to delineate the anatomical structures of interest for image visualisation. In view of the important role of IICM in imaging, it has been mooted that approximately 60 million doses are administered worldwide each year.<sup>[1]</sup> IICM is becoming the most commonly prescribed drug in modern medical practice in view of its regular usage in most imaging examinations.<sup>[2]</sup>

In spite of the crucial role it plays, and the availability of newer contrast media with reduced and enhanced safety profiles, there are idiosyncratic (anaphylactic) and non-idiosyncratic (chemotoxic) adverse effects that may arise from IICM administration.<sup>[3, 4]</sup> These adverse effects result in bradycardia, hypotension, neuropathy, convulsion, cardiovascular reactions and renal failure, a call for haemodialysis, and even mortality.<sup>[5-7]</sup> Studies have shown that

contrast-induced nephropathy is the third most common cause of renal failure, occurring in 1% to 20% of all patients and 25% to 50% of those with baseline renal dysfunction.<sup>[8-10]</sup>

Since an adverse response to contrast media cannot always be predicted, it is internationally recommended that high risk patients should be screened before administration of IICM.<sup>[4, 6]</sup> The most effective and sensitive marker for measuring or predicting those at risk is by taking creatinine clearance.<sup>[11, 12]</sup> Creatinine clearance gives an estimation of patients who are at risk by comparing their creatinine levels in the blood and urine. This is an acceptable practice for estimating glomerular filtration rate. The European Society of Urogenital Radiology (ESUR)<sup>[13]</sup> and the American College of Radiologists (ACR)<sup>[14]</sup> endorse screening of patients with unascertained renal function. They include a list of contrast procedures using questionnaires including measurement of serum

creatinine in patients with high risk factors to rule out significant renal impairment. A study in the United States of America (USA) indicated that out of a 5.6 million civilian population 3.0% had high serum creatinine levels, and 70% were hypertensive.<sup>[15]</sup>

The practice of identifying patients at risk of contrast medium induced nephropathy significantly differs among organisations. It is crucial to recognise such patients in order to put in place required safety measures.<sup>[16]</sup> Although serum creatinine is not a perfect indicator of renal function<sup>[16]</sup>, it is largely utilised in clinical medicine to check the glomerular filtration rate (GFR).<sup>[17]</sup> A current serum creatinine level is required in patients who have had a recent intake of nephrotoxic drugs which predisposes a high likelihood of an elevated serum creatinine level. In addition it is required in patients with renal disease, proteinuria, diabetes mellitus, hypertension, and gout.<sup>[16]</sup> Other risk factors, which

**Table 1: Questionnaire**

SECTION A (Please tick the appropriate box)	DEMOGRAPHIC DATA
Profession	Physician [ ]      Radiologist [ ]      Radiographer [ ]
<b>SECTION B</b> (Please tick and answer appropriately where necessary)	
Do you know patients at risk for undergoing intravenous iodinated contrast medium (ICM) examination?	Yes [ ]      No [ ]
<b>KNOWLEDGE ASSESSMENT</b>	
Has any patient complained of reaction after referral / after performing intravenous ICM examination before?	Yes [ ]      No [ ]
Do you know of any adverse (serious) reaction that results from intravenous ICM administration?	Yes [ ]      No [ ]
Have you heard of creatinine clearance test?	Yes [ ]      No [ ]
If yes, what was your source of information?	Course of practice [ ] Internet [ ]      Books [ ]      Friends [ ] Training [ ]      Conference [ ] Other.....
What is the purpose of creatinine clearance test? (Tick appropriate ones)	Renal function [ ]      Cardiac function [ ] Glomerular filtration rate [ ]      Asthmatic [ ] Contrast-induced nephropathy [ ]
<b>SECTION C: APPLICATION AND ATTITUDE CREATININE CLEARANCE</b> (Please provide appropriate answer)	
<b>PHYSICIAN</b>	
How often do you refer patients for examinations that involve the use of intravenous iodinated contrast medium (ICM)?	Everyday [ ]      Once a week [ ] Twice a week [ ]      Three times a week [ ] Four times a week [ ]      None [ ]
Do you determine creatinine clearance test before referring patients for intravenous iodinated contrast media examination?	Yes [ ]      No [ ]
<b>If NO, then go to the last two questions.</b>	
<b>RESIDENT &amp; CONSULTANT RADIOLOGISTS, RADIOGRAPHERS</b>	
How often do you perform examinations that involve the use of intravenous iodinated contrast medium (ICM)?	Everyday [ ]      Once a week [ ] Twice a week [ ]      Three times a week [ ] Four times a week [ ]      None [ ]
What type of ICM do you use for the examination?	.....
Do you enquire about your patient's clearance test before you perform intravenous iodinated contrast media examination?	Yes [ ]      No [ ]
<b>If NO, go to the last two questions.</b>	
What factors prevent the practice of determining creatinine clearance before administering ICM?	Cost involved [ ]      Cumbersome test [ ] Delays examination [ ]      Disrupt booking [ ] Not necessary [ ]
Should creatinine clearance before administration of intravenous iodinated contrast media be practiced?	Agree [ ]      Disagree [ ] Strongly agree [ ]      Strongly disagree [ ] Neutral [ ]
Is there any other test you prefer in place of creatinine clearance?	Yes [ ]      No [ ]
If yes, what test?	.....

require such checks include dehydration; congestive heart disease; and patients >70 years.<sup>[18]</sup> Patients who have had renal surgery are also considered at-risk.

Identifying or measuring high risk patients through creatinine clearance before administration of IICM at the study sites seemed to be a grey area. Hence this study focused on finding out whether creatinine clearance is determined before administration IICM in some selected contrast-usage hospitals in Ghana.

**Methodology**

A descriptive survey design using a self-administered semi structured questionnaire was adopted for the study. The questionnaire was in three parts: part one collected information on the respondents' status; part two consisted of closed ended questions which gathered information and knowledge of risks associated with IICM and creatinine clearance; part three gathered data on the practice of determining creatinine clearance. Some sections of the questionnaire were for the specific category of the participants based on their various roles in the management of the patients (Table 1).

All of the radiologists (n=14), diagnostic radiographers (n=32), and urology physicians (n=13) from the selected hospitals were invited to participate in the study (n=59). Purposive sampling was used because the study specifically focussed on information from all the professionals who were involved in IICM examinations in the selected hospitals. Data collected were entered into a database and analysed using the statistical package for social scientist (SPSS) version 17.0. Microsoft Excel 2007 was used to draw charts and graphs for pictorial presentation of results. Data are presented in proportions and percentages.

Approval for the study was obtained from the research ethics committee of a higher education institution. The ethics approval was supported by written permission for the study to be conducted at the study sites. The ethical standard of confidentiality was upheld. Permission was also sought and gained from the authorities at the selected hospitals. All gave informed consent prior to the commencement of the study and each data collection activity. A cover letter, that introduced the nature and purpose of the study, was attached to the research tool (questionnaire). The in-

vited participants were guaranteed confidentiality and anonymity. They were assured that the research had no element that would pose any risk or harm to them.

**Results**

Fifty-nine (n=59) questionnaires were administered to the purposively selected potential participants. There was a response rate of 85%. The respondents (n=50) comprised physicians (n=10), diagnostic radiographers (n=29) and radiologists (n=11). Most of them (n=49; 98%) had knowledge of the risk factors of administration of IICM, but some radiographers (2%) did not have such knowledge (Figure 1). The vast majority (n=43; 86%) had knowledge of adverse reaction from IICM administrations.

The majority of the respondents (n=35; 70%), had received complaints of reaction from patients after IICM examinations. The majority of respondents (n=39,

78%) were aware of creatinine clearance and knew it as the most effective test for assessing renal function. However, eleven (n=11; 22%) radiographers did not know about creatinine clearance and its function (Figure 2).

The majority of the radiologists (n=10; 91%) and radiographers (n=25; 85%), who normally administer IICM, indicated that non-ionic and low osmolar contrast media, such as iopamidol (iopamiro of Bracco), iopromide (ultravist of Bayer) and iohexel (omnipaque of GE) are usually administered. Responses from radiographers were that 3.5% of them administer sodium amidotrizoate and meglumine amidotrizoate (urografin of Bayer), which is an ionic contrast agent. One radiologist, and four radiographers did not comment (see Table 2).

The majority of the respondents (n=41; 82%) did not enquire or determine creatinine clearance of their patients before

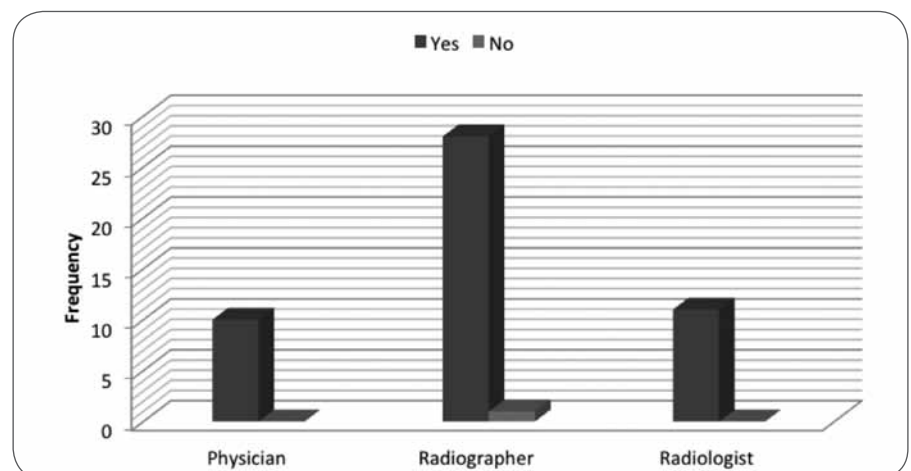


Figure 1. Knowledge of the risk factors for undergoing intravenous iodinated contrast medium (ICM) examination.

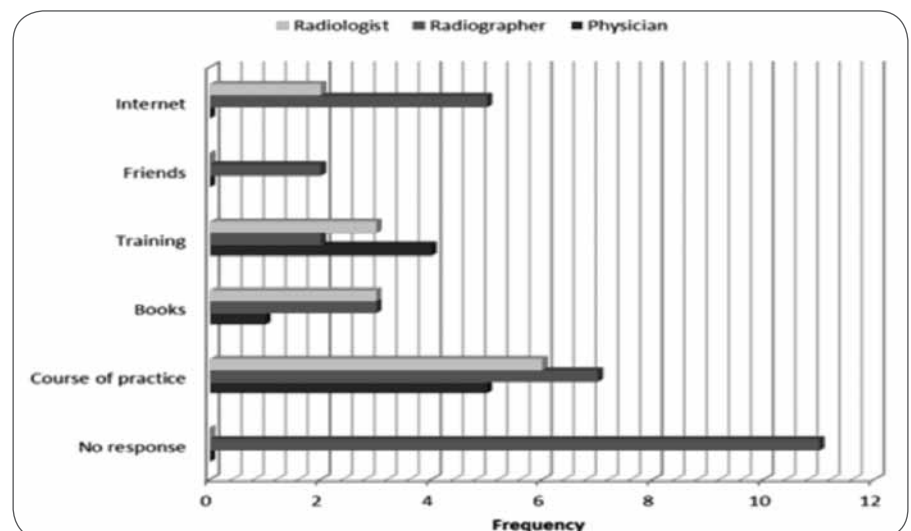


Figure 2. Sources of knowledge on creatinine clearance.

**Table 2: Type of contrast medium used for examination**

	RADIOGRAPHER	%	RADIOLOGIST	%
No response	4	13.8	1	9.1
Iohexol (Omnipaque)	8	27.6	2	18.2
Iopamidol (Iopamirol)	9	31.0	6	54.5
Iopromide (Ultravist)	7	24.1	2	18.2
Sodium amidotrizoate / meglumine amidotrizoate (Urografin)	1	3.5	0	0
<b>Total</b>	<b>29</b>	<b>100</b>	<b>11</b>	<b>100</b>

**Table 3: Alternative tests for intravenous ICM**

	PHYSICIAN	%	RADIOGRAPHER	%	RADIOLOGIST	%
No response	6	60	26	90	7	64
BUE & Creatinine	1	10	0	0	2	18
Creatinine test	2	20	0	0	1	9
Asthmatic test	0	0	1	3	0	0
Urea/nitrogen level	0	0	1	3	0	0
Renal function test	1	10	1	4	1	9
<b>Total</b>	<b>10</b>	<b>100</b>	<b>29</b>	<b>100</b>	<b>11</b>	<b>100</b>

referring or performing procedures that involved the use of IICM; a few (12%) did so (Figure 4). There were several reasons given by respondents for not determining nor enquiring of the creatinine clearance levels of patients before they were referred or administered with IICM: it delays booking 15 (30%); it disrupts booking four (8%), it is costly 16 (32%); it is a cumbersome test (16%); it is not necessary 10 (20%) because others will assess it.

Most respondents (n=36; 72%) agreed that creatinine clearance before administration of IICM should be practiced, whereas 12% disagreed. Other tests were preferred by 22% of the respondents. The suggested alternative tests included BUE and creatinine (18%), urea/nitrogen level (3%), other renal function tests (9%) (Table 3). An asthmatic test was preferred in place of creatinine clearance test by 4% of radiographers.

## Discussion

In view of similar densities of body tissue means that contrast media are required in

imaging to visualise tissues and organs. However, there is no doubt that patients who have low creatinine clearance levels are at high risk of developing nephropathy, among other conditions, when administered with IICM. It is therefore very crucial that creatinine clearance screening should be done to determine patients who could be at a high risk of developing IICM-related complications. The findings of this study revealed that the practitioners who participated were aware of the risks of iodinated contrast media and had received complaints of reaction from patients after administration of IICM. This finding differs from that of Konen et al<sup>[12]</sup>; they reported that half of the respondents in their survey were not fully aware of the risk associated with IICM. The findings in this study revealed that most of the practitioners from the selected hospitals were aware of the creatinine clearance test. This is in accord with Bazari<sup>[11]</sup> who stated that it is the most effective tool for analysing renal function and evaluating at-risk patients for IICM. However, a knowledge gap was identified among 22% of the ra-

diographers about the role of a creatinine test in the administration of IICM. Therefore the radiographic curricula, as well as continuing professional development programmes for radiographers, should give attention to the role of creatinine level assessment. It is acknowledged that the latter is not a definitive test but needs to be considered in terms of patient safety in diagnostic imaging. Practitioners' knowledge of creatinine clearance was gained mostly through training, books, use of the internet and information from colleagues.

The study also revealed that most of the physicians (82%), who referred patients for IICM examinations, do not determine the creatinine clearance levels of their patients before referring them to imaging departments. Similarly, radiographers and radiologists who administered IICM on a daily basis do not ascertain their patients' creatinine clearance during their preparation and before contrast administration.

The worrying part is that some practitioners (3.5%) administer intravenous sodium amidotrizoate/meglumine amidotrizoate



(urografin), which is a high osmolar contrast medium (HOCM) and therefore has higher side effects due to its higher osmolarity. On the other hand non-ionic low osmolar contrast medium (LOCM) was acknowledged to be used mainly in the selected hospitals in the study (Table 2). The administration of ionic iodated contrast agent intravenously has become an outdated practice; it is thus disturbing that at-risk patients' creatinine status is not checked before contrast media is administered. We need to interrogate some reasons for not doing so, such as delays in booking (30%); disruptions in booking (8%), cost (32%); and the cumbersome nature of the test (16%). A fifth of the respondents were of the opinion that it was not necessary for them to determine the test; they relied on other staff to do so. Radiographers and radiologists rely on the referring physicians and vice versa. Cochran<sup>[19]</sup>, Tippins et al<sup>[20]</sup> and Thompsen and Morcos<sup>[21]</sup> reported such reasons as well. Of note is that physicians refer patients to the radiology department with the thinking that the radiology departments will see to the determination of creatinine clearance, whilst the radiology staff assume that patients referred for IICM examinations have been assessed by the referrers, hence no need to check before administering IICM. There was a gap in assessing creatinine clearance; a situation that developed out of communication gap between the referrers and the radiology departments.

However, not all who do not determine creatinine clearance prior to IICM administration totally disregarded the necessity of identifying at-risk patients. Some practitioners (22%) used other methods because of the aforementioned reasons against creatinine clearance test, and for departmental protocol. The most reported alternative test used was the BUE-creatinine test. Others indicated urea/nitrogen level and some renal function tests. Some radiographers preferred an asthmatic test as an alternative for creatinine clearance. It is thus reasonable to assume that these radiographers were not sure of the purpose of creatinine clearance.

## Conclusion

Determination of creatinine clearance before IICM examinations by referring clinicians appeared lacking in the hospitals in this study. Likewise the imaging departments also do not check their patients' creatinine clearance or levels before they

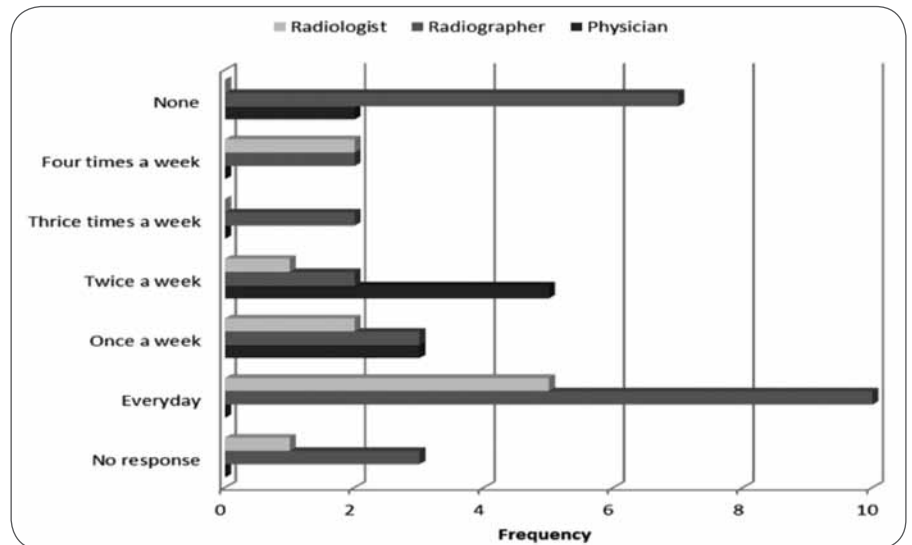


Figure 3. How often physicians refer patients for IICM examinations and how often radiographers and radiologists perform IICM examinations.

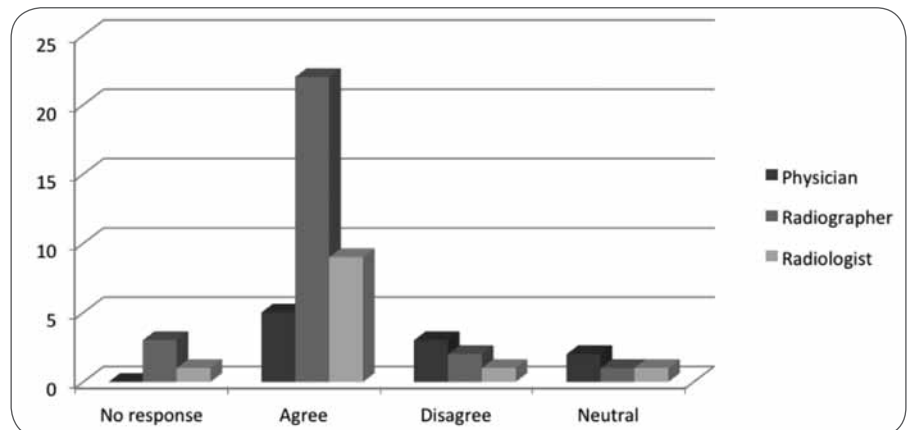


Figure 4. Whether or not practitioners inquire or determine creatinine clearance before intravenous ICM examination.

perform the procedures. Most of the practitioners in this study were aware that it is a more sensitive test for analysing renal function and identifying patients who are at risk for developing nephropathy among other conditions in the presence of IICM.

Delays in booking, booking disruptions, high cost, the cumbersome nature of creatinine clearance test and communication gap between the radiology departments and the referring physicians appear to be the challenges confronting the practice of determining creatinine clearance levels before administration of IICM. There is a need to develop appropriate steps to ensure that at-risk patients are routinely screened before IICM is administered. The practice of administering intravenously IICM agents should be avoided particularly as there are newer non-ionic contrast media with reduced and enhanced safety profiles. A huge gap was observed among the radiographers' knowledge concerning

administration of IICM. As they are members of a diagnostic imaging team it is recommended that radiographic curricula, as well as continuing professional development programmes for radiographers, should include the role of creatinine level.

## References

1. Liistro F, Falsini G, Bolognese L. The clinical burden of contrast media-induced nephropathy. *Italian Heart Journal* 2003; 4(10): 668-676.
2. Goel G, Ravishankar S, Jayakumar P N et al. Intrathecal gadolinium-enhanced magnetic resonance cisternography in cerebrospinal fluid rhinorrhea: road ahead? *Journal Neurotrauma* 2007; 24(10): 1570-1575.
3. Waybill M M, Waybill P.N. Contrast media-induced nephrotoxicity: identification of patients at risk and algorithms for prevention. *J of Vascular Interventional Radiology* 2001; 12(1): 3-9.

4. Cutroneo P, Polimeni G, Curcuruto R, Calapai G, Caputi A P. Adverse reactions to contrast media: an analysis from spontaneous reporting data. *Pharmacological Research* 2007; 56(1): 35-41.
5. Corr P. Contrast media in imaging. In: Corr P, Peh W, Kune SW. et al (Eds). *Pattern recognition in diagnostic imaging*, Geneva: WHO, 2001
6. McCullough PA. Acute kidney injury with iodinated contrast. *Critical Care Medicine* 2008; 36(4): 204-211.
7. Dillman J R, Ellis J H, Cohan R H, Strouse P J, Jan S C. Allergic-like breakthrough reactions to gadolinium contrast agents after corticosteroid and antihistamine premedication. *AJR* 2008; 190(1): 187-190.
8. Bagshaw S.M, Mortis G, Doig C J, Godinez-Luna T, Fick G H, Laupland K B. One-year mortality in critically ill patients by severity of kidney dysfunction: a population-based assessment. *American J Kidney Dis* 2006; 48(3): 402-409.
9. Morcos S K, Thomsen H S, Exley C M. Contrast media: interactions with other drugs and clinical tests. *Eur Radiol* 2005; 15(7): 1463-1468.
10. Lee J K T, Warshauer D M, Bush W H. Determination of serum creatinine level before intravenous administration of iodinated contrast medium. A survey. *Investigative Radiology* 1995; 30(12): 700-705.
11. Bazari H. Approach to the patient with renal disease. In: Goldman L, Ausiello D, eds. *Cecil Medicine*. 23rd ed. Philadelphia, Pa: Saunders Elsevier; 2007; chap 115.
12. Konen E, Konen O, Katz M, Levy Y, Rozenman J, Hertz M. Are referring clinicians aware of patients at risk from intravenous injection of iodinated contrast media? *Clinical Radiology* 2002; 57: 132-135.
13. ESUR guidelines on contrast media, version 7.0, 2009. (Accessed; 22 November 2014). Available from: [http://www.esur.org/ESUR\\_Guidelines.23.0](http://www.esur.org/ESUR_Guidelines.23.0).
14. American College of Radiologists. *ACR manual on contrast media*, version 6. (accessed 22 November 2014). Available from: [http://clinical-mri.com/wpcontent/uploads/textbooks/media\\_updates/contrast\\_manual\\_ACR\\_for\\_web.pdf](http://clinical-mri.com/wpcontent/uploads/textbooks/media_updates/contrast_manual_ACR_for_web.pdf).
15. Coresh J, Wei G L, McQuillan G, et al. Prevalence of high blood pressure and elevated serum creatinine level in the United States: findings from the third national health and nutrition examination survey 1988-1994. *Arch Intern Med* 2001; 161 (9): 1207-1216
16. Thomsen H S, Morcos S K. In which patients should serum creatinine be measured before iodinated contrast medium administration? *Eur Radiol* 2005; 15: 749-754.
17. Jones C P, Jones C A, McQuillan G M et al. Serum creatinine levels in the US population: Third National Health and Nutrition Examination Survey. *Am J of Kidney Diseases* 1998; 32 (6): 992-999.
18. Morcos S K, Thomsen H S, Webb J A, et al. Contrast-media-induced nephrotoxicity: a consensus report. *Eur Radiol* 1999; 9: 1602-1613.
19. Cochran S T. Determination of serum creatinine level prior to administration of radiographic contrast media. *American Medical Association* 1997; 277(1): 517-518.
20. Tippins R B, Torres W E, Baumgartner B R, Baumgarten D A. Are screening serum creatinine levels necessary prior to outpatient CT examinations? *Radiology* 2000; 216 (2): 481-484.
21. Thomsen H S, Morcos S K. Management of acute adverse reactions to contrast media. *Eur Radiol* 2004; 14(3): 476-481.



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