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Multi-detector computed tomography (MDCT) evaluation of synchronous renal cell carcinoma and other solid malignancies

Adel El-Badrawy*

Abstract

Background: Multiple primary malignant neoplasms (MPMNs) became more prevalent as the population aged and medical technology progressed. The purpose of this research was to review the findings of multidetector computed tomography (MDCT) in synchronous renal cell carcinoma and other solid tumors.

Results: 31 individuals with synchronous renal cell carcinoma and additional solid cancers were included in this retrospective analysis. CT scanning was carried out using 64 MDCT scanners. All sixty-two malignancies were undergoing pathological assessment. Out of 685 patients with renal cell carcinoma, 31 individuals were identified with another primary solid cancer that occurred concurrently. All of our instances were pathologically verified. In all 31 individuals, clear renal cell carcinoma was found. The most frequent extra-renal malignancies were hepatocellular carcinoma (10/31), followed by breast carcinoma (4/31), non-Hodgkin lymphoma (4/31), bronchogenic carcinoma (3/31), colonic carcinoma (3/31), prostatic carcinoma (2/31), urinary bladder carcinoma (1/31), periampullary carcinoma (1/31), mucoepidermoid carcinoma (1/31) and skin squamous cell carcinoma (1/31) as well as m*alignant hemangioendothelioma* (1/31).

Conclusion: MDCT scanning was an accurate imaging method for diagnosing synchronous renal cell carcinoma and other solid tumors. Even in the face of numerous cancers, the goal of therapy in cancer patients must always be curative. During the pretreatment examination, the potential of synchronous double malignancies with renal cell carcinoma should be explored.

Keywords: Multidetector computed tomography, Renal cell carcinoma, Synchronous malignancy

Background

Renal cell carcinoma (RCC) was the 17th most prevalent malignancy, accounting for 2.2% of all malignancies diagnosed worldwide in 2018 [1]. The number of people diagnosed with second primary cancer has risen due to newly established diagnostic imaging technologies and advances in the treatment of common cancer [2]. Warren and Gates established the diagnostic criteria for numerous primary malignancies. At the current moment, these conditions are still approved [3]. A single patient with several primary cancers accounts for 0.7%–11% of all carcinomas [4]. Renal cell carcinoma patients are at risk of developing additional synchronous primary cancers. Few case reports of synchronous renal cell carcinoma and other malignancies [5–7]. Up to our knowledge, this is the most extensive study in the MDCT examination of synchronous renal cell carcinoma and other solid cancers in the literature. To enhance the prognosis of renal cell cancer patients, a careful preoperative examination is suggested. In this retrospective analysis, we reviewed the multidetector computed tomography (MDCT) results of 31 patients with synchronous renal cell carcinoma and other solid tumors.

*Correspondence: adelelbadrawy@hotmail.com
Radiology Department, Mansoura Faculty of Medicine, Mansoura University, 1 Omar Ben Abdel-Aziz From Gehan Street, Mansoura, Egypt

Methods

Patients

The institutional research ethics review committee authorized the present study. Due to the retrospective nature of this investigation, the patient's informed permission was not obtained. All consecutive patients with renal cell carcinoma were included in this retrospective research treated at our institution from November 2006 to September 2019. Patients' files were reviewed, and 31 patients identified with double primary malignancies as per Warren and Gates criteria were further analyzed. All thirty-one patients had ultrasonography. Pathological diagnoses of all sixty-two malignancies were confirmed in all 31 cases. Although; characteristic CT findings were detected on all 31 patients, a needle biopsy was done to exclude the possibility of metastases and confirm the histopathological diagnosis. During a metastatic workup for other cancers, twenty individuals with RCC were discovered by chance. Sixteen patients with stage T1a and four patients with stage T1b.

Except for case number 21, all primary renal cell carcinomas and other synchronous cancers were discovered simultaneously. This patient underwent a right nephrectomy two years before. During follow-up CT scanning, there was a local mass at the operative bed of the right kidney with malignant para-aortic lymphadenopathy and pulmonary mass with malignant mediastinal lymphadenopathy. Needle biopsies were taken from local recurrent mass and lung mass. Both biopsies underwent immune histochemical staining and revealed local clear renal cell and bronchogenic carcinomas. The existence of two malignant tumors, proven histopathological, with distinct histology in the two sites, was the inclusion criterion for our patients. Individuals who did not have definitive histopathological confirmation of each tumor were excluded, as were patients whose second tumor was thought to be a metastasis of the first. Table 1 contains patient age at the time of each tumor diagnosis, gender, location of origin, histology, and clinical stage. Tumor node metastasis (TNM) staging by the American Joint Committee on Cancer (AJCC) was the most often used cancer staging method. The AJCC has undergone several revisions, and its 8th version is already in use by practicing physicians [8]. As a result, it has become the staging system in the present study. The Barcelona Clinic Liver Cancer (BCLC) staging system is the most often utilized for hepatocellular carcinoma (HCC) therapy [9]. As a result, our research has become the HCC staging method. Warren and Gates' criteria for synchronous double primary cancers were now widely recognized [3].

CT technique

The 64 MDCT scanner was used to do whole-body and triphasic abdominal CT scanning (Brilliance 64; Philips Healthcare, Best, The Netherlands). The unenhanced and contrast-enhanced triphasic investigations were obtained with a slice thickness of 3 mm. For the abdominal examination, arterial and delayed phases were used. The portal phase was completed for the whole body. The contrast-enhanced investigation used 100 ml of non-ionic contrast medium (ioversol, Optiray 350, Mallinckrodt) at a flow rate of 5 ml/sec. During all stages of the computed tomography test, patients were asked to hold their breath. Automated bolus monitoring at the lower thoracic aorta level to guarantee proper timing in an arterial phase. The whole-body portal venous phase was done with a 55–60 s effective delay following the commencement of the contrast injection. The abdominal examination was done in the delayed phase, with an effective delay of 3–6 min. Post-processing was carried out on all images using the workstation [Extended Brilliance Workspace V3.5.0.2254] (EBW). The images were seen in three different settings: lung, soft tissue, and bone. Ten individuals had their CT results confirmed by an MRI.

Image interpretation

The images were looked at the density, size, and the number of lesions, as well as vascular encasement, lymph node involvement, and other organ involvement in the abdomen, as well as metastatic spread. The whole body was scanned with a CT scanner to check for any lymph node groupings, organs, bone, or lung metastases that may have occurred. All renal cell carcinomas and other synchronous solid malignancies were assessed for local, lymphatic, hematogenous, and transcoelomic spread if suspected according to the primary site of the tumor. Size, organ origin, internal architecture, local invasion, vascular encasement, calcifications as well as the presence of metastases were all analyzed. All 62 cancers were assessed for tumor staging (Table 1).

Results

To detect extra-renal primary tumors, we used the Warren and Gates criteria. Thirty-one instances (4.5%) of the 685 patients with renal cell carcinoma satisfied the inclusion criteria for synchronous extra-renal original malignancy [3]. There were 21 males and ten women (mean age, 63 year; range, 36–80 years). Hepatitis C virus was found in 17 of the individuals. Hepatitis C and B viruses were found in six cases.

All sixty-two tumors were accurately characterized, evaluated, and staged. MDCT accurately predicted the second primary vs. metastases in all patients. Clear renal

Table 1 Characteristics of 31 patients with synchronous RCC and other solid malignancies

Case No	Age/sex	Renal cell carcinoma				Extra-renal malignancy				
		TNM staging				Site	TNM staging			
		T	N	M	Stage		T	N	M	Stage
1	58/M	T1a	N0	M0	I	HCC	B (BCLC)			
2	67/M	T1b	N0	M0	I	HCC	B (BCLC)			
3	58/M	T1b	N0	M0	I	HCC	B (BCLC)			
4	65/M	T3a	N0	M0	III	HCC	C (BCLC)			
5	55/F	T1a	N0	M0	I	HCC	A (BCLC)			
6	56/F	T1a	N0	M0	I	HCC	A (BCLC)			
7	58/F	T1a	N0	M0	I	HCC	A (BCLC)			
8	73/M	T1a	N0	M0	I	HCC	A (BCLC)			
9	64/M	T3a	N0	M0	III	HCC	A (BCLC)			
10	68/M	T1a	N0	M0	I	HCC	A (BCLC)			
11	45/F	T1a	N0	M0	I	Breast	T2	N0	M0	IIA
12	55/F	T1b	N0	M0	I	Breast	T4b	N1	M0	IIIC
13	63/F	T1b	N0	M0	I	Breast	T1c	N0	M0	I
14	65/F	T1b	N0	M0	I	Breast	T2	N0	M0	IIA
15	60/F	T1b	N0	M0	I	NHL	I (Ann Arbor staging)			
16	65/F	T3a	N0	M0	III	NHL	III (Ann Arbor staging)			
17	53/M	T1b	N0	M0	I	NHL	II (Ann Arbor staging)			
18	62/M	T1a	N0	M0	I	NHL	III (Ann Arbor staging)			
19	63/M	T1a	N0	M0	I	Lung	T1b	N2	M0	IIIA
20	70/M	T1a	N0	M0	I	Lung	T4	N0	M0	IIIA
21	52/M	Local recurrent with para-aortic malignant LN				Lung	T4	N2	M0	IIIB
22	68/F	T1a	N0	M0	I	Colon	T4a	N1b	M0	IIIB
23	68/M	T1b	N0	M0	I	Colon	T4a	N1b	M0	IIIB
24	58/M	T1a	N0	M0	I	Colon	T4a	N2b	M0	IIIC
25	73/M	T1a	N0	M0	I	Prostate	T3b	N1	M1a	IV
26	80/M	T1b	N0	M0	I	Prostate	T2b	N0	M0	IIA
27	75/M	T1a	N0	M0	I	U.B	T3b	N2	M0	IV
28	74/M	T1a	N0	M0	I	Peri-ampullary	T1	N0	M0	IA
29	73/M	T1b	N0	M0	I	Mucoepidermoid*	T0	N2	M0	IVA
30	75/M	T1a	N0	M0	I	Skin Sq.C.C	T1	N0	M0	I
31	36/M	T3a	N0	M0	III	M.H.E*	Locally advanced			

BCLC; Barcelona Clinic Liver Cancer staging classification, HCC; Hepatocellular carcinoma, NHL; Non-Hodgkin lymphoma, M.H.E*; Malignant hemangioendothelioma, Mucoepidermoid*; Mucoepidermoid carcinoma of left upper cervical region. RCC; Renal cell carcinoma, Sq.C.C.; Squamous cell carcinoma, U.B.; Urinary bladder

cell carcinoma was detected in all 31 patients. The most frequent extra-renal primary sites were hepatocellular carcinoma (10/31) (Fig. 1), followed by breast carcinoma (4/31) (Fig. 2), non-Hodgkin lymphoma (4/31), bronchogenic carcinoma (3/31), colonic carcinoma (3/31), prostatic carcinoma (2/31), urinary bladder transitional cell carcinoma (1/31), peri-ampullary carcinoma (1/31), mucoepidermoid carcinoma (1/31), squamous cell carcinoma of the skin (1/31) and malignant hemangioendothelioma (1/31) (Fig. 3). Twenty-two of the 31 extra-renal tumors were intra-abdominal (ten hepatocellular carcinomas, four lymphomas, three colonic carcinomas, two prostatic carcinomas, and one for each urinary bladder carcinoma, periampullary carcinoma, and malignant hemangioendothelioma).

The American Joint Committee on Cancer (AJCC) tumor-node-metastasis (TNM) staging; the renal cell carcinoma was stage I (26 patients), III (4 patients), and local tumor recurrent with para-aortic malignant lymphadenopathy (1 patient).

The BCLC staging method classified the HCC as stage A (6 patients), B (3 patients), and C (1 patient). Breast

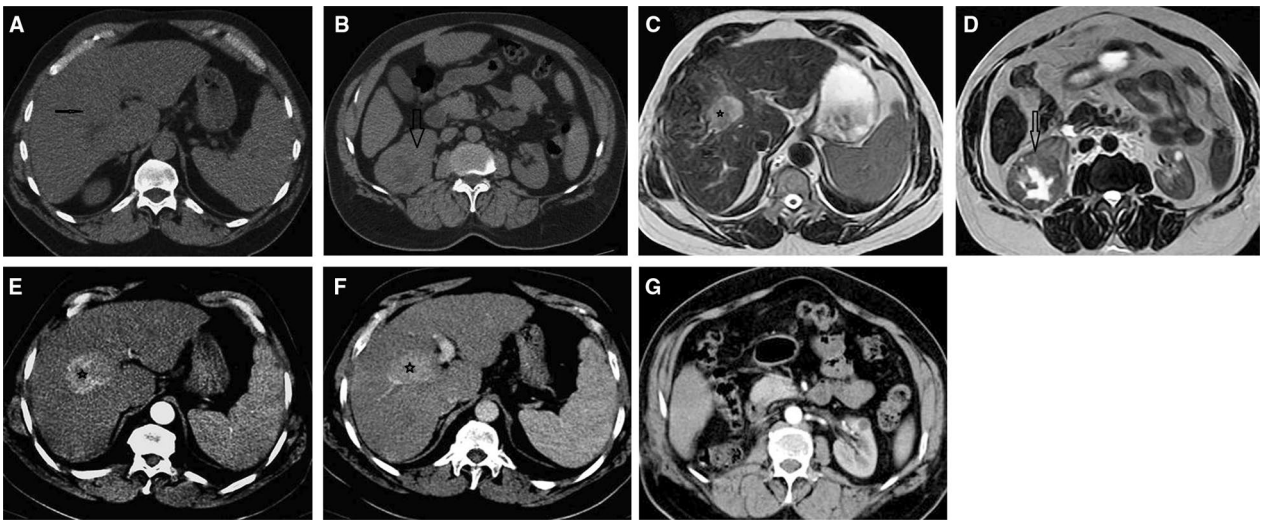

Fig. 1 64-year-old male patient with a history of chronic liver disease presented with hematuria. **a, b** Initially, an unenhanced MDCT scan due to high serum creatinine (contra-indication for contrast study) revealed an ill-defined right liver lobe (thin arrow) and right renal mass (arrow). **c, d** T2 magnetic resonance image revealed hepatic focal lesion (star) (pathologically proved HCC) and right renal mass (arrow) (pathologically proved RCC). The patient underwent a right nephrectomy. **e–g** MDCT scan after nephrectomy showed right liver lobe mass (asterisk) with enhancement on arterial phase and washout in portal phase (characteristic of HCC) with right nephrectomy

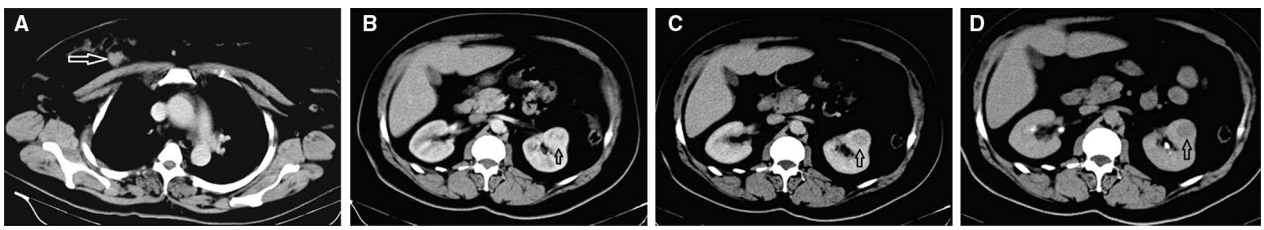

Fig. 2 45-year-old female presented with a right breast mass. **a** MDCT scan revealed right breast mass (arrow) with speculated inferior margin (Pathologically proved breast carcinoma). **b-d** arterial, portal and delayed phases revealed left renal mass (arrow) with a characteristic pattern of renal cell carcinoma (Pathologically proved RCC)

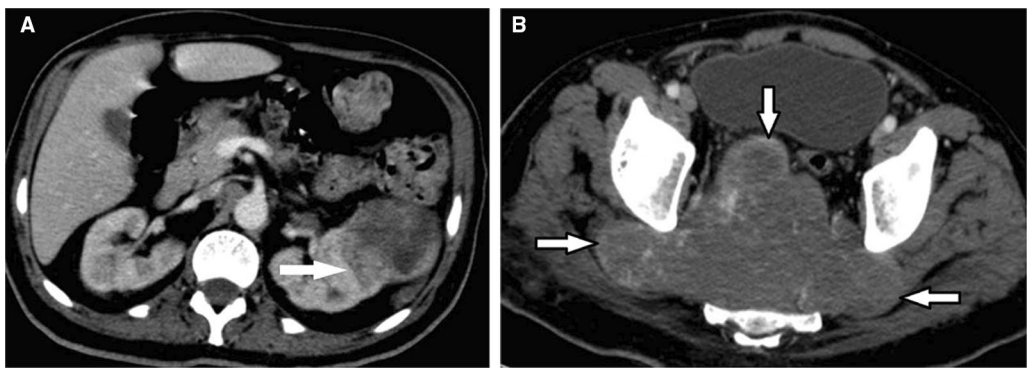

Fig. 3 36-year-old male presented with bilateral sciatica. **a** MDCT scan revealed left renal mass (arrow) (pathologically proved renal cell carcinoma) and **b** locally advanced presacral mass invading sacrum (arrows) (pathologically proved malignant hemangioendothelioma)

cancer staging was I (1 patient), IIA (2 individuals), and IIIC (1 patient). All four individuals had non-Hodgkin lymphoma, dispense sizeable B-cell type. Ann Arbor lymphoma staging was I (1 patient), II (1 patient), and III (2 patients). Bronchogenic carcinoma staging was IIIA (2 patients) and IIIB (1 patient). Colonic carcinoma staging was IIIB (2 patients) and IIIC (1 patient). Prostatic carcinoma staging was IV (1 patient) and IIA (1 patient). Transitional cell carcinoma of the urinary bladder was stage IV. One patient with periampullary carcinoma was stage IA. Mucoepidermoid of the left upper neck was stage IVA. One patient with skin squamous cell carcinoma was stage I. Malignant hemangioendothelioma was detected as locally advanced without an available TNM staging system.

Discussion

Synchronous primary multiple cancers were tumors that coincide or within six months of one another [10]. Warren and Gates presented the diagnostic criteria for multiple primary cancers [3]. These criteria are: (a) each cancer was malignant; (b) Each tumor has its unique set of pathological characteristics; (c) Each tumor must be unique; and (d) the chance of one tumor becoming a metastasis of another must be ruled out. The development of improved diagnostic techniques and the aging of the population has contributed to the increased occurrence of several primary malignant neoplasms (MPMNs) [11]. Early detection of synchronous secondary tumors in malignant patients is critical for appropriate therapy.

Renal cell carcinoma (RCC) was the majority fatal of all urologic tumors, accounting for 90% of adult renal cancers. [12]. Clear renal cell carcinoma is about 70% of RCC [13]. All our 31 renal cell carcinomas were clear cell subtypes. The biopsy is recommended to characterize renal tumor histology and other solid malignancies to validate the initial tumor's histology origin [14, 15]. Our study's sixty-two cancers were all histopathological evaluated.

In the present study, the median age was 63 years. This is consistent with earlier findings indicating that elderly age is a risk factor for the development of primary, secondary cancers [16]. According to Motzer et al. [2011], the average age at diagnosis of RCC is 65 years, with the majority of patients in their sixth to eighth decade of life, and men are two to three times more affected than females [17]. This coincides with our result as the male gender was (21/31).

Renal cell carcinoma (RCC) incidence has significantly raised in recent decades as a result of the increased usage of modern and accurate abdominal imaging methods [18]. In general, incidentally discovered renal cell cancers were smaller in size [19]. Upon the increased use of imaging modalities for various medical conditions, an increasing proportion of incidental renal cell carcinomas were being identified [14, 18]. This is consistent with our findings since renal cell carcinoma was discovered by chance in 20 of 31 individuals. There were 16 T1a (stage I) patients and 4 T1b individuals (stage I).

Most synchronous cancers were discovered during the preoperative workup, and the majority were found in the intra-abdominal cavity [20]. This is consistent with our findings since synchronous extra-renal primary cancers were abdominal malignancy (22/31 patients).

MDCT is a noninvasive and reliable imaging technology that is extensively used in ordinary clinical practice to identify, characterize, and stage renal masses. [21, 22]. MDCT is an excellent tool for evaluating synchronous primary solid double cancers [23–29]. This is consistent with our findings since MDCT properly identified all sixty-two cancers. The radiological findings of renal cell carcinoma in the multiple primary malignancies were similar to that of RCC-alone patients.

The frequency of the second extra-renal primary malignancy site in RCC patients differs depending on the geographical distribution of the study [30–32]. The incidence of renal cell carcinoma was detected during whole-body CT, monitoring for lung cancer, colorectal cancer, and coronary artery disease was 0.21% [30]. RCC is associated with various primary cancers, including prostate, bladder, lung, breast, colon, and rectal cancers, malignant melanomas, and non-lymphomas Hodgkin's (NHL) [31]. Piccinini et al. discovered six cases of RCC that were discovered by chance during the first staging workup of a rhinopharyngeal carcinoma, stomach cancer, Waldenström's disease, NHL, and breast cancer [32]. According to our findings, the most prevalent extra-renal malignancy is HCC (10/31). The second most common extra-renal malignancies are breast carcinoma (4/31) and lymphoma (4/31). Of these eighteen patients, fourteen patients have hepatitis C, and four patients have hepatitis C and B viruses. This is consistent with earlier research that linked hepatitis virus to an increase in the incidence of HCC, breast cancer, and lymphoma. [33–35]. The next extra-renal malignancies are bronchogenic carcinoma (3/31) and colonic carcinoma (3/31). This difference may be due to the relatively small number of cases and due to the geographical setting.

Renal cell carcinoma should be evaluated thoroughly. Detection of synchronous second primary malignancy with renal cell carcinoma is crucial for patient management. Early proper diagnosis of this condition is essential to avoid erroneous disease progression and subsequent palliative treatment rather than curative therapy differentiating a synchronous second primary malignancy from metastatic disease by MDCT seems to be a novel idea for both radiologists and clinicians.

Conclusions

MDCT monitoring was a reliable imaging method for the diagnosis of synchronous renal cell carcinoma and other solid tumors. When a distant deposit is identified at an unusual position, the likelihood of synchronous double malignancies with renal cell carcinoma should always be addressed during pretreatment examination. In the future, novel staging for synchronous RCC and other solid tumors may be created to help in the development of new treatment regimens. Even in the face of multiple primary cancers, the objective of treatment in cancer patients may be curative.

Abbreviations

MPMNs: Multiple primary malignant neoplasms; MDCT: Multi-detector computed tomography; RCC: Renal cell carcinoma; AJCC: American joint committee on cancer; TNM: Tumor node-metastasis; BCLC: Barcelona clinic liver cancer; HCC: Hepatocellular carcinoma; NHL: Non-Hodgkin lymphoma.

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Authors' contributions

A. E.: Conception and design; analysis and interpretation of the data; drafting of the article; critical revision of the article for important intellectual content and final approval of the article. Author reads and approves the final manuscript.

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Availability of data and materials

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Declarations

Ethics approval and consent to participate

The study was approved by the institutional research ethics review committee (Mansoura University/Faculty of Medicine/ Egypt). IRB reference number is "R.19.05.517 ". Informed consent from the patient was waived due to the retrospective design of this study.

Consent for publication

Written informed consent was waived.

Competing interests

None of the contributing authors have any conflict of interest, including specific financial interests or relationships and affiliations relevant to the subject matter or materials discussed in the manuscript.

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References

1. Bray F, Ferlay J, Soerjomataram I, Siegel RL, Torre LA, Jemal A (2018) Global cancer statistics 2018: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. CA Cancer J Clin 68:394–424
2. Bagri PK, Singh D, Singhal MK, Singh G, Mathur G, Jakhar SL, Beniwal S, Sharma N, Kumar HS, Sharma A, Bardia MR (2014) Double primary malignancies: a clinical & pathological analysis report from a regional cancer institute in India. Iran J Cancer Prev 7(2):66–72
3. Warren S, Gates O (1932) Multiple primary malignant tumors. Am J Cancer 16:1358–1414
4. Demandante CG, Troyer DA, Miles TP (2003) Multiple primary malignant neoplasms: case report and a comprehensive review of the literature. Am J Clin Oncol 26(1):79–83
5. Wong C, Plante M, Eltabbakh G (2003) Synchronous renal cell carcinoma and gynecologic malignancies. Gynecol Oncol 88(1):66–68. https://doi.org/10.1006/gyno.2002.6856 (**PMID: 12504630**)
6. Dafashy TJ, Ghaffary CK, Keyes KT, Sonstein J (2016) Synchronous renal cell carcinoma and gastrointestinal malignancies. Case Rep Urol 2016:7329463. https://doi.org/10.1155/2016/7329463.PMID:26904353; PMCID:PMC4745328
7. Sahsamanis G, Katikaridis I, Mikros G, Tzelepis V, Pinialidis D, Deverakis T, Dimitrakopoulos G (2017) Chromophobe Renal Cell carcinoma and the synchronous presence of primary colon malignancies. Is There a Relation? Urol Case Rep. 14:5–7
8. Shao N, Wang HK, Zhu Y, Ye DW (2018) Modification of American joint committee on prognostic cancer groups for renal cell carcinoma. Cancer Med 7:5431–5438
9. Forner A, Reig ME, de Lope CR, Bruix J (2010) Current strategy for staging and treatment: the BCLC update and future prospects. Semin Liver Dis 30:61–74
10. Yun HR, Yi LJ, Cho YK, Park JH, Cho YB, Yun SH, Kim HC, Chun HK, Lee WY (2009) Double primary malignancy in colorectal cancer patients - MSI is the useful marker for predicting double primary tumors. Int J Colorectal Dis 24:369–375
11. Xu LL, Gu KS (2014) Clinical retrospective analysis of cases with multiple primary malignant neoplasms. Genet Mol Res 12(13):9271–9284
12. Siegel RL, Miller KD, Jemal A (2015) Cancer statistics, 2015. CA Cancer J Clin 65:5–29
13. Eble JN, Sauter G, Epstein JI, Sesterhenn IA (2004) World Health organization classification of tumours. pathology and genetics of tumours of the urinary system and male genital organs. IARC Press, Lyon
14. Volpe A (2016) The role of active surveillance of small renal masses. Int J Surg 36:518–524. https://doi.org/10.1016/j.ijsu.2016.06.007
15. Maida M, Macaluso FS, Galia M, Cabibbo G (2013) Hepatocellular carcinoma and synchronous liver metastases from colorectal cancer in cirrhosis: a case report. World J Hepatol. 5(12): 696–700
16. Mariotto AB, Rowland JH, Ries LA, Scoppa S, Feuer EJ (2007) Multiple cancer prevalence: a growing challenge in long-term survivorship. Cancer Epidemiol Biomarkers Prev 16(3):566–571
17. Motzer RJ, Agarwal N, Beard C, Bhayani S, Bolger GB, Carducci MA, Chang SS, Choueiri TK, Hancock SL, Hudes GR, Jonasch E, Josephson D, Kuzel TM, Levine EG, Lin DW, Margolin KA, Michaelson MD, Olencki T, Pili R, Ratliff TW, Redman BG, Robertson CN, Ryan CJ, Sheinfeld J, Spiess PE, Wang J, Wilder RB (2011) Kidney cancer. J Natl Compr Canc Netw 9:960–977
18. Znaor A, Lortet-Tieulent J, Laversanne M, Jemal F (2015) International variations and trends in renal cell carcinoma incidence and mortality. Eur Urol. 67(3):519–530
19. Kane CJ, Mallin K, Ritchey J, Cooperberg MR, Carroll PR (2008) Renal cell cancer stage migration: analysis of the National Cancer Data Base. Cancer 113:78–83
20. Eom BW, Lee HJ, Yoo MW, Cho JJ, Kim WH, Yang HK, Lee KU (2008) Synchronous and metachronous cancers in patients with gastric cancer. J Surg Oncol 98:106–110
21. Sahni VA, Silverman SG (2014) Imaging management of incidentally detected small renal masses. Semin Interv Radiol 31(1):9–19
22. Bradley AJ, MacDonald L, Whiteside S, Johnson RJ, Ramani VA (2015) Accuracy of preoperative CT T staging of renal cell carcinoma: which features predict advanced stage? Clin Radiol 70(8):822–829. https://doi.org/10.1016/j.crad.2015.03.013
23. El-Badrawy A (2014) Multidetector computed tomography (MDCT) evaluation of twenty-two cases with synchronous primary solid double malignancies. J Cancer Sci Ther 7:10. https://doi.org/10.4172/1948-5956.C1.060
24. El-Badrawy A (2016) MDCT evaluation of synchronous primary gynecological and other solid malignancies. Int J Gynecol Cancer 26:33–34

25. El-Badrawy A (2019) Multidetector computed tomography evaluation of synchronous bronchogenic carcinoma and other solid malignancies. Chest 155(6):A356. https://doi.org/10.1016/j.chest.2019.04.054
26. El-Badrawy A (2019) MDCT evaluation of synchronous primary prostatic carcinoma and other solid malignancies. Presented at the 26th European society of urogenital radiology symposium. Dublin Castle, Ireland, September 19th to 22nd.
27. El-Badrawy A (2019) MDCT evaluation of synchronous primary vesical carcinoma and other solid malignancies. Presented at the 26th European society of urogenital radiology symposium. Dublin Castle, Ireland, September 19th to 22nd.
28. El-Badrawy A, Gadelhak B, Helmy EM, Farouk O, Fady T, Refky B, Elzaafarany M, Emarah Z, Taalab MM, Eisa N, El-Etreby SA, Bahgat MH, El-Badrawy MK, Elalfy H, Besheer T, El-Mesery A, Akl MF, Megahed N, Khashaba EO (2020) Multidetector computed tomography evaluation of synchronous lymphoma and other solid malignancies. J Cancer Res Ther 16(1):60–65. https://doi.org/10.4103/just.JCRT_325_17 (**PMID: 32362610**)
29. El-Badrawy A (2021) MDCT evaluation of synchronous breast carcinoma and other solid malignancies. Breast Dis 40(4):275–281. https://doi.org/10.3233/BD-201065 (**PMID: 34120894**)
30. Fenton JJ, Weiss NS (2004) Screening computed tomography: will it result in overdiagnosis of renal carcinoma? Cancer. 100(5):986–990
31. Beisland C, Talleraas O, Bakke A, Norstein J (2006) Multiple primary malignancies in patients with renal cell carcinoma: a national population-based cohort study. BJU Int 97:698–702. https://doi.org/10.1111/j.1464-410X.2006.06004.x
32. Piccinini L, Luppi G, Zoboli A, Torricelli P (1996) Occasional diagnosis of synchronous renal cell carcinoma during the staging of other primary tumors. Tumori 82:488–490. https://doi.org/10.1177/030089169608200516
33. Mahale P, Torres HA, Kramer JR, Hwang LY, Li R, Brown EL, Engels EA (2017) Hepatitis C virus infection and the risk of cancer among elderly US adults: A registry-based case-control study. Cancer 123(7):1202–1211. https://doi.org/10.1002/cncr.30559
34. Lu LJ, Adhikari VP, Zhao CX, Wu H, Dai W, Li X, Li HY, Ren GS, Wu KN, Kong LQ (2017) Clinical study on the relationship between hepatitis B virus infection and risk of breast cancer: a large-sized case-control and single-center study in the southwest of China. Oncotarget 8:72044–72053
35. Ringelhan M, McKeating JA, Protzer U (2017) Viral hepatitis and liver cancer. Philos Trans R Soc Lond B Biol Sci. https://doi.org/10.1098/rstb.2016.0274.

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