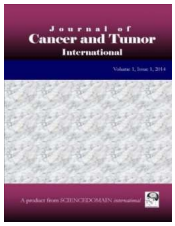

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Squamous Cell Carcinoma of the Kidney and Renal Pelvis: A Review of the Literature

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Author's contribution

The sole author designed, analyzed and interpreted and prepared the manuscript.

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Review Article

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ABSTRACT

Background: Primary squamous cell carcinoma of renal pelvis/kidney (PSCCRP/K) is rare with controversies regarding its histogenesis.
Aim: To review the literature.
Methods: Various internet data bases were searched.
Literature Review: Few cases of PSCCRP/K have been reported with only three cases of PSCC of the renal parenchyma without involvement of renal pelvis. Some PSCCRP/Ks have been associated with renal calculi, chronic infections, vesicoureteric reflux. Some cases had developed many years after successful percutaneous nephrolithotomy; a case was reported many years after curative radiotherapy for testicular tumour. The tumours are initially diagnosed in advanced stages; generally the prognosis has been poor following nephrectomy/nephrouretectomy. Conventional radiological features of the disease are non-specific and cannot differentiate the lesion from other tumours or xanthogranulomatous pyelonephritis. Diagnosis is based upon strict histopathological criteria of the microscopic characteristics of the tumour. Primary tumour elsewhere should be excluded with radiological images. PSCCRP/K should be suspected when a renal/renal pelvis mass is found with a history of chronic or past stone disease treatment. Perhaps if patients who have undergone treatment for kidney stones are carefully followed-up with radiological imaging,

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(for example, ultra-sound-scans and/or MRI and when eventually required a CT scan properly indicated and performed) for a long time, PSCCR/Ks may be diagnosed at an early stage of the disease in order to provide early curative treatment.

Conclusions: PSCCRP/Ks have been reported sporadically and a number of them have been associated with renal calculi and chronic infections of the urinary tract. These malignancies on the whole are initially diagnosed in advanced stages and hence associated with poor prognosis. Histopathological examination of the lesion so far is the definite way to confirm the diagnosis. PSCCRP/K should be considered a differential diagnosis when a patient is found to have a renal / renal pelvis mass and a history of treatment for renal pelvis calculi, or chronic inflammations.

Keywords: Primary squamous cell carcinoma of renal pelvis; primary squamous cell carcinoma of kidney; calculi; nephrectomy; metaplasia; chronic irritation; prognosis.

1. INTRODUCTION

Primary squamous cell carcinoma of renal pelvis/kidney is a rare tumour that is reported sporadically. At the time of initial diagnosis the tumour tends to be in an advanced stage and hence the reported prognosis has so far on the whole been poor. Controversies exist regarding the histogenesis of the tumour. Because of rarity of the disease perhaps a number of clinicians would be unfamiliar with its biological behaviour. The ensuing literature review on primary squamous cell carcinoma of renal pelvis / kidney has been divided into two parts. (A) An Overview and (B) Miscellaneous narrations and discussions from some reported cases.

2. AIM

To review the literature of primary squamous cell carcinoma of renal pelvis and kidney

3. METHODS

Various internet data bases were searched including PUB Med, Google, Google Scholar and Educus. The key words which were used included Primary squamous carcinoma of kidney, primary squamous carcinoma of renal pelvis, squamous cell carcinoma of kidney and squamous cell carcinoma of renal pelvis. Thirty references were found suitable for the review article.

4. LITERATURE REVIEW

4.1 Overview

4.1.1 General comments

- It has been stated that Squamous Cell Carcinomas of the kidney tend to be associated with squamous metaplasia of renal pelvis, renal calculi or infection [1,2].
- Cases of squamous cell carcinoma of kidney may be found associated with urothelial carcinoma or urothelial carcinoma in situ; however, it has been recommended that such cases should be classified as urothelial carcinoma with squamous differentiation [3].
- Holmang et al. [2] stated that most often squamous cell carcinomas of the kidney are diagnosed in advanced stages of the disease and they tend to be associated with poor prognosis.
- With regard to the origin of the disease squamous cell carcinoma of the renal pelvis / kidney has been postulated to emanate from squamous metaplasia in response to chronic irritation [3].

4.1.2 Epidemiology

- It had been stated that SCCK tends to present between 50 years and 70 years and about equally in men and women [2].

4.1.3 Presentation

- It had been stated that SCCKs tend to present with haematuria, abdominal pain, and flank pain and that SCCKs may produce para-neoplastic syndrome, similar to squamous cell carcinoma of lung [3]. It may also present with weight loss.

4.1.4 Blood tests

4.1.4.1 Full blood count

- Full blood count is undertaken as part of the general work up assessment of the patients and those patients who are noted to have anaemia could be managed appropriately considering the fact that

some patients may present with haematuria.

4.1.5 Coagulation screen

- Coagulation screen is undertaken as part of the general assessment of the patient and before a fine needle aspiration is performed (for example if the patient presents with a subcutaneous lump).

4.1.6 Serum urea and electrolytes (U/E)

- Serum urea and electrolytes are undertaken as part of the general assessment of the patient and any impairment in renal function is treated accordingly.

4.1.7 Serum glucose

- Serum glucose in carried out as part of the general assessment of patients.

4.1.8 Liver function-tests

- Liver function tests are undertaken as part of the general assessment of the patient.

4.1.9 Urinalysis, urine microscopy and culture

- These tests and undertaken as part of the general assessment of the patient. In the event of the finding of a positive urine culture for urinary tract infection, the infection can be treated accordingly.

4.1.10 Urine cytology

- Urine cytology may show evidence of abnormal cells which may be suggestive of squamous cell carcinoma.

4.1.11 Radiological investigations

- In squamous cell carcinoma of renal pelvis, radiological investigations may reveal a solid mass, +/- hydronephrosis, calcifications, or as a renal pelvis infiltrative lesion without any obvious distinct mass. The differential diagnosis of SCC of renal pelvis based upon radiological investigations include: primary and metastatic malignancies and Xanthogranulomatous pyelonephritis.

4.1.12 Ultra-sound scan

- Ultrasound scan of abdomen and renal tract may be normal but in some cases it may show hydronephrosis plus or minus calculus in the renal pelvis; it may also show a lesion in the renal pelvis or kidney. Ultrasound scan of abdomen and pelvis can be done in the follow-up assessment of patients who had undergone nephrectomy / nephroureterectomy to exclude metastasis. If a patient needs fine needle aspiration biopsy of a subcutaneous lump or a lesion in the kidney the procedure can be undertaken under ultrasound guidance.

4.1.13 Computed tomography (CT) scan

- CT scan of abdomen and renal tract may be normal but in some cases it may show hydronephrosis plus or minus calculus in the renal pelvis; it may also show a lesion in the renal pelvis or kidney. CT scan can provide detailed assessment of the renal pelvis lesion and would show whether or not lymph nodes are enlarged in the abdomen and pelvis. The CT scan can also be used to confirm absence of a primary tumour lesion anywhere else in the abdomen. CT scan of abdomen and pelvis can be undertaken at follow-up of patients following nephrectomy or nephroureterectomy for squamous cell carcinoma of kidney/renal pelvis to exclude subsequent development of metastasis.
- A variety of developments in MDCT and improvements in techniques of CT scanning has contributed to an increase in the capacity to detect abnormalities in the urinary tract.

4.1.14 CT scan of thorax

- CT scan of thorax is undertaken to exclude a metastatic tumour lesion in the thorax and it would also exclude a primary tumour in the thorax. CT scan of thorax can be done in the follow-up of patients who had undergone nephroureterectomy or nephrectomy for squamous cell carcinoma of kidney / renal pelvis to exclude subsequent development of metastasis in the thorax.

4.1.15 18-fludeoxyglucose positron emission tomography (FDP- PET/CT)

- FDP- PET/CT scan can be used for metastatic tumour work-up assessment.

4.1.16 Magnetic resonance imaging (MRI)

- MRI scan of abdomen and renal tract may be normal but in some cases it may show hydronephrosis plus or minus calculus in the renal pelvis; it may also show a lesion in the renal pelvis or kidney. MRI scan can provide detailed assessment of the renal pelvis lesion and would show whether or not lymph nodes are enlarged in the abdomen and pelvis. The MRI scan can also be used to confirm absence of a primary tumour lesion anywhere else in the abdomen. MRI has an additional advantage in that it is not associated with radiation. MRI scan of abdomen and pelvis can also be undertaken in the follow-up of patients who had undergone treatment for squamous cell carcinoma of kidney/renal pelvis to exclude metastasis.
- With regard to patients with impaired renal function it has been stated that MR urography can be helpful in the detection of tumours of the upper urinary tract, especially in obstructed kidneys and that the use of diffusion-weighted imaging (DWI) sequences in association with conventional T1- and T2-weighted sequences increases the accuracy and sensitivity of URO-MRI.

4.1.17 MRI scan of thorax

- MRI scan of thorax is undertaken to exclude a metastatic tumour lesion in the thorax and it would also exclude a primary tumour in the thorax. MRI scan of thorax can be done in the follow-up of patients who had undergone nephroureterectomy or nephrectomy for squamous cell carcinoma of kidney/renal pelvis to exclude subsequent development of metastasis in the thorax.

4.1.18 Isotope bone scan

- Isotope bone scan can be used to exclude or confirm bone metastasis.

4.1.19 Radiological imaging guidance biopsy of lesions in kidney / renal pelvis

- Ultrasound-guided biopsy or CT-scan guided biopsy of renal masses can be undertaken to obtain specimens for histological examinations which could establish a diagnosis of squamous cell carcinoma of kidney/renal pelvis.

4.1.20 Cystoscopy and ureteric urine sample collection

- Cystoscopy and insertion of ureteric catheters by the retrograde approach can be undertaken to obtain urine for cytological examination which could show malignant cells

4.1.21 Ureteroscopy / Ureterorenoscopy and collection of urine as well as biopsy of lesion in renal pelvis / calyx

- Ureteroscopy / Ureterorenoscopy and collection of urine as well as biopsy of a lesion or lesions in the renal pelvis / calyx can be undertaken to obtain specimens of urine for cytology as well as biopsy specimens for histological examination which could be used to establish a diagnosis of squamous cell carcinoma. Ureterorenoscopy can also be used to treat associated renal pelvis stones by means of basket extraction or lithotripsy.

4.1.22 Fine needle aspiration cytology

- Fine needle aspiration of a lump or mass is a useful way of obtaining specimens for cytopathological examination to establish a diagnosis.

4.1.23 Macroscopic features

- Macroscopic examination of SCCPs, tend to show ulcerated tumours that are large and necrotic [3]

4.1.24 Microscopic features of SCCK

- On the whole microscopic examination of specimens of SCCPs, tend to reveal features that mimic squamous cell carcinoma of other organs [3].
- Microscopic examinations of specimens of SCCPs tend to show infiltrating nests of atypical squamous epithelial cells which are associated with or not associated with keratinization and also there tends to be absence of a component of typical urothelial carcinoma [3].

4.1.25 Differential diagnosis of SCCK

- It is important to differentiate SCCK from urothelial carcinoma with squamous differentiation and it should be appreciated that with regard to urothelial carcinoma with squamous differentiation a thorough examination of sections of the tumour would show areas of urothelial carcinoma but in SCCK there would not be any evidence of urothelial carcinoma anywhere in the tumour [3].

4.1.26 Treatment

The surgical treatment options that had been used for squamous cell carcinoma of the renal pelvis / kidney include:

- Nephrectomy
- Radical Nephrectomy
- Nephroureterectomy

4.1.27 Chemotherapy and radiotherapy

- Radiotherapy and chemotherapy (chemo-radiation) or radiotherapy have also, been used in some cases in addition to surgery which has been used in most cases.

4.1.28 Outcome

- On the whole the outcome of SCCKs or SCCRPs have been poor due to the advanced stage of the disease at the time of initial diagnosis but in comparison with transitional cell carcinomas (urothelial carcinomas) of the renal pelvis / upper renal tract of the same stage there has not been any difference between the outcomes. It would therefore appear that if SCCKs/SCCRPs could be diagnosed at less advanced stages, perhaps their prognosis would improve following treatment but this is conjectural and needs to be proven in due course.

4.2 Miscellaneous Narrations and Discussions from Some Reported Cases (See Table 1 for a List of Some Reported Cases)

Vella et al. [4] reported a 73-year-old man, who had presented with visible haematuria. He had ultra-sound scan and computed tomography (CT) scan which revealed a tumour mass in the right kidney associated with lymphadenopathy. He underwent nephrectomy and lymphadenectomy. Histological examination of the surgical specimen revealed squamous cell carcinoma of the renal pelvis which had involved the renal parenchyma and had extended into the peri-renal fat. The tumour had involved the regional lymph nodes and had also invaded the inferior vena cava. The examination also showed squamous carcinoma in situ and squamous metaplasia in the urothelium adjacent to the tumour. He had another ultra-sound scan of abdomen and renal tract 3 months later which had revealed local recurrence of the tumour. He received adjuvant chemotherapy. Vella et al. [4] stated that the aggressive course of the disease is in concordance with the poor outcome of squamous cell carcinoma of the renal pelvis as was reported in the literature earlier.

Talwar et al. [5] in 2006, reported a 69-year-old man who presented with clinical features of pyonephrosis. He underwent nephrectomy. Histological examination of the nephrectomy specimen showed an unsuspected squamous cell carcinoma of renal pelvis with concomitant pyonephrosis. Talwar et al. [5] stated the rarity of squamous cell carcinoma in the absence of renal calculi and highlighted its association with pyonephrosis.

Kayaselçuk et al. [6] reported two patients, one patient had carcinosarcoma and the other patient had squamous cell carcinoma of renal pelvis. The first patient was a 56-year-old man who presented with visible haematuria, left loin pain, fever, and weight loss. He had a history of untreated nephrolithiasis of his left kidney 20 years, earlier. His pre-operative radiological investigations as well as gross examination of the nephrectomy specimen did not reveal the tumour. Histological examination of the nephrectomy specimen showed squamous cell carcinoma. The second patient was an 87-year-old woman who presented with visible haematuria and left loin pain. She also had a long history of nephrolithiasis of her left kidney. Kayaselçuk et al. [6] stated that both patients had undergone left nephrectomy for non-functioning hydronephrotic kidney. In both cases, microscopic examination of the nephrectomy specimens revealed squamous metaplasia and dysplasia in the pelvi-calyceal mucosa, as well as islands of atypical squamous cells in the renal parenchyma. In the second case microscopic examination of the kidney additionally showed sarcomatous changes in the renal pelvis [6].

Ito et al. [7] in 1988 reported a 60-year-old man who presented with multiple bilateral renal calculi and visible haematuria. His radiological investigations had revealed non-functioning right kidney and marked left sided hydronephrosis. He underwent percutaneous nephrolithotomy for his left renal calculi. Squamous cell carcinoma which had involved the treated left kidney was several months subsequently diagnosed. He was treated by means of chemotherapy and radiotherapy but despite this treatment he died of renal failure.

Paonessa et al. [8] in 2011 reported a 70-year-old woman who presented with vague abdominal pain. She had a long-history of renal calculi. She had CT scan and magnetic resonance imaging (MRI) scan which showed a mass in the upper pole of the left kidney. She underwent percutaneous CT guided biopsy of the mass and histological examination of the specimen revealed a poorly differentiated carcinoma but the features of the tumour were considered to be inconsistent with any definite cell type. She subsequently underwent left nephrectomy and histological examination of the specimen had revealed squamous cell carcinoma of the renal collecting system. Paonessa et al. [8] stated the following:

- Chronic calculi of the kidney pose a risk for the development of squamous metaplasia which could lead to the development of squamous cell carcinoma.
- Despite the fact that squamous cell carcinoma of the upper urinary tract is rare, patients with long-standing nephrolithiasis should be monitored.
- The diagnosis of squamous cell carcinoma of the renal pelvis should be included in one's differential diagnoses in the evaluation of a renal mass that is associated with chronic inflammatory conditions.

Mikuriya et al. [9] reported a 49-year-old woman who presented with left sided abdominal pain. She had various investigations which confirmed she had complete bilateral duplication of her upper renal tracts. She also had a tumour in the upper moiety of the left renal pelvis. She underwent a left nephro-ureterectomy for the tumour in the upper part of the renal pelvis and for the tumour which had also involved the upper third of the upper moiety of the left duplex ureter. Histological examination of the specimen showed squamous cell carcinoma. She received 50 Gy of radiotherapy but despite this treatment, she died four months later.

Sivaramakhrishna et al. [10] in 2004 reported a patient who had undergone successful percutaneous nephrolithotomy (PCNL) for a long-standing renal pelvis calculus and who eight months subsequently presented with a large squamous cell carcinoma in the same location in the renal pelvis.

Imbriaco et al. [11] in 2011, reported a 69-year-old man with a past history of renal calculi who presented with left loin pain and fever. He had CT scan and MRI scan of abdomen which revealed a large mass in the left side of his horseshoe kidney with associated large renal stones. He underwent partial nephrectomy with removal of the left side of the horse shoe kidney. Pathological examination of the specimen showed squamous cell carcinoma with associated renal stones.

Holmang et al. [2] in 2007 reported a series of patients who had squamous cell carcinoma of the renal pelvis and ureter and compared them with patients who had had urothelial carcinoma. Holmang et al. [2] reviewed the histopathological records and the clinical records of an initial 808 patients who had carcinomas which had involved the renal pelvis and ureters. Holmang et al. [2] reported that only 2 (4%) out of 65 patients with squamous cell carcinoma had stage pTa/pT1/pT2 tumours and 96% of them had stages higher than T2 in comparison with 460 (62%) out of 743 patients with pTa/pT1/pT2 tumours who had urothelialial carcinoma. Holmang et al. [2] also reported the following:

- The median survival was shorter for patients with squamous cell carcinoma who were treated surgically (7 months) in comparison with patients who had urothelial carcinoma (50 months).
- Nevertheless, there was no significant difference in the disease-specific 5-year survival rate between patients who had squamous cell carcinoma and urothelial carcinomas in the same disease stage.
- Vascular invasion, microscopic solid tumour pattern, and large tumour size had negative prognostic significance in multi-variate analyses.
- The type of tumour based upon histopathology (squamous cell carcinoma or urothelial carcinoma) did not have any prognostic significance.

Holmang et al. [2] made the following conclusions:

- The prognosis for squamous cell carcinoma is poor; nevertheless, with regard to stage for stage comparison between squamous cell carcinoma and urothelial carcinoma, the prognosis is not different for tumours of the renal pelvis and ureter.

O'Daly et al. [12] reported a 71-year-old man who was diagnosed with squamous cell carcinoma in the renal pelvis of a solitary functioning kidney. O'Daly et al. [12] stated that the patient had undergone radical orchidectomy and adjuvant radiotherapy for stage II seminoma 34 years preceding the diagnosis of the squamous cell carcinoma of the renal pelvis and that this rare second carcinoma had occurred within the radiotherapy treatment field. O'Daly et al. [12] further stated the following:

- Second malignancies are uncommon but serious sequels of radiation treatment and they have a potential for the development of significant health problems in patients with complete remission of their primary disease.
- To their knowledge their case was the first reported case of squamous cell carcinoma of renal pelvis which had occurred after radiotherapy.

Funez et al. [13] reported a 68-year-old woman who presented with visible haemauria and right loin pain. She had ultra-sound scan and CT scan of abdomen and pelvis which revealed a tumour in the upper pole of the right kidney with a heterogeneous contrast caption, calcification and no evidence of lymph adenopathy. She underwent right nephrectomy. Macroscopic examination of the specimen revealed a tumour in the upper pole of the right kidney which measured 4.6 cm in its maximum dimension, without involvement of the perinephric tissues or renal vein. Part of the tumour was brown and homogeneous and another part of the tumour was grey coloured with necrotic / haemorrhagic appearance as well as it had calcifications. There was no evidence of calculi in the renal pelvis. The tumour was related to the renal pelvis focally (see Fig. 1). The adrenal gland and two lymph nodes with the tumour looked normal. Microscopic examination of the specimen revealed that the tumour consisted of a typical chromophobe renal cell carcinoma with positive Hale's colloidal iron stain and immune-histochemical staining of the tumour was negative for vimentin (Dakocytomation S. A.) in the areas that had brown, homogeneous appearance (see Fig. 2). There was another zone with necrosis, extensive calcification and solid epithelial nests with some keratin pearls and obvious squamous cell differentiation (see Figs. 3 and 4) close to these areas. The cells exhibited negative staining for Hale's colloidal iron stain and positive staining for cytokeratin 5/6 (Dakocytomation S. A.). Sections which were taken from the area where both tumours were in contact did not show any evidence of collision effect (see Fig. 5). Focal relationship between both tumours and the renal pelvis were observed. Extensive examination of the specimen did not reveal any urothelial malignancy or signs of chronic urinary tract infection or squamous metaplasia to suggest irritation of the renal pelvis or calyceal epithelium. There was no evidence of invasion of the perinephric tissues, adrenal gland, or lymph nodes. The patient was alive after 32 months.

Bindra et al. [14] reported a 50-year-old woman who presented with a history of pain and fever and a lump in her left flank region. She had ultra-sound scan and intravenous pyelogram which revealed left sided hydronephrosis and multiple calculi in the lower calyx of the left kidney. Her urine cytology was positive for malignant cells and the cytomorphological characteristics of the cells were noted to be suggestive of squamous cell carcinoma (see Fig. 6). Fine needle aspiration cytology (FNAC) of the lump under ultra-sound guidance was undertaken and this revealed the following:

- Acute inflammatory cells, a few a-nucleate squames, necrotic cellular material, and a few isolated and groups of occasional epithelial tumour cells.
- The cells exhibited pleomorphism, central hyperchromatic nucleus which had coarse irregular chromatin and nucleoli that were inconspicuous.
- Irregular nuclear outlines and mild to moderate amount of ground glass-like basophilic cytoplasm. Rare tadpole cells were also found in a haemorrhagic background (see Fig. 7).

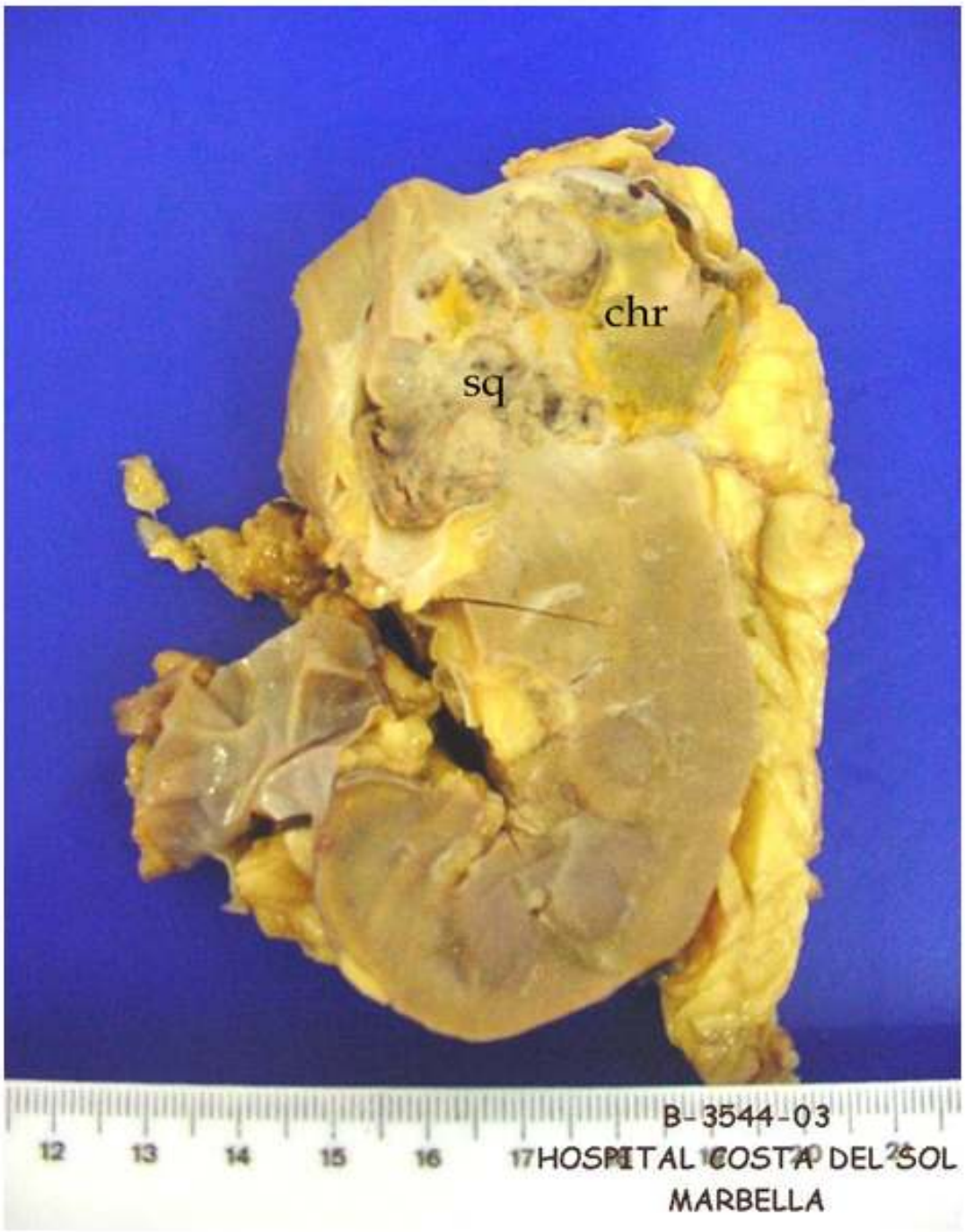


Fig. 1. Macroscopical aspect of the neoplasm. Squamous cell carcinoma (sq) and Chromophobe renal cell carcinoma (chr). Reproduced from: [13]

Fúnez R, Pereda T, Rodrigo I, Robles L, Gonzalez C. Simultaneous chromophobe renal cell carcinoma and squamous renal cell carcinoma. Diagnostic pathology 2007; 2:30 DOI: 10.1186/1746-1596-2-30. URL: http://www.diagosticpathology.org/content/2/1/30

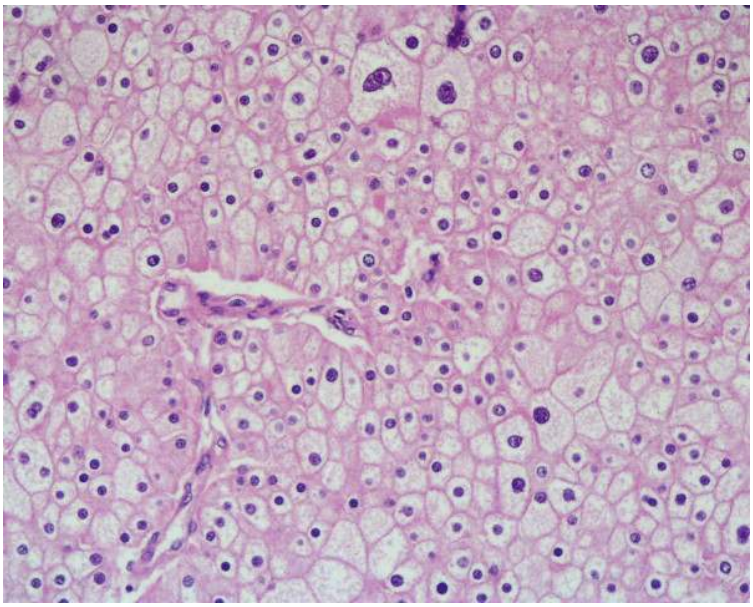


Fig. 2. Areas with typical chromophobe renal cell carcinoma HE x 200

Reproduced from: [13] Fúnez R, Pereda T, Rodrigo I, Robles L, Gonzalez C. Simultaneous chromophobe renal cell carcinoma and squamous renal cell carcinoma. Diagnostic Pathology. 2007;2:30. DOI: 10.1186/1746-1596-2-30. URL: http://www.diagosticpathology.org/content/2/1/30 © Fúnez et al.; licensee Bio Med Central Ltd. this is an open access article distributed under the terms of the creative commons attribution license (http://creativecommons.org/licenses/by/2.0), which permits unrestricted use, distribution and reproduction in any medium, provided the original work is properly cited

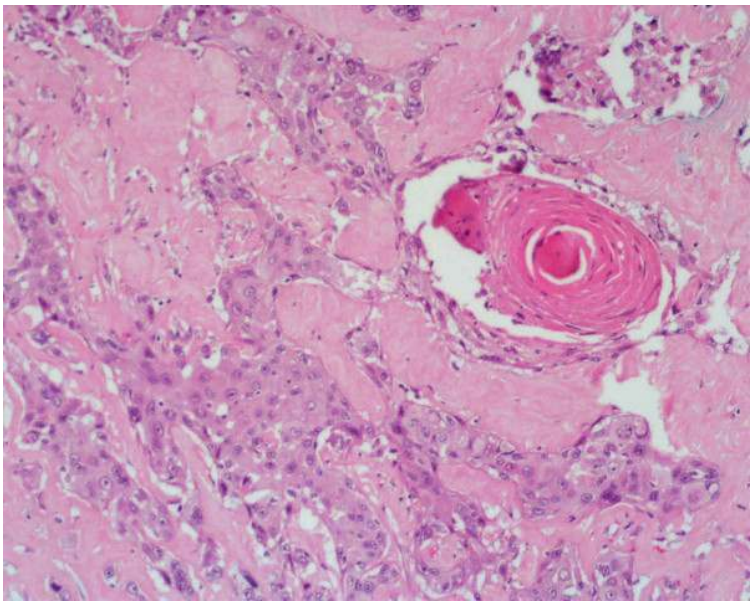


Fig. 3. Zone with squamous cell carcinoma HE x 200

Reproduced from: [13] Fúnez R, Pereda T, Rodrigo I, Robles L, Gonzalez C. Simultaneous chromophobe renal cell carcinoma and squamous renal cell carcinoma. Diagnostic Pathology. 2007;2:30. DOI: 10.1186/1746-1596-2-30. URL: http://www.diagosticpathology.org/content/2/1/30 © Fúnez et al.; licensee Bio Med Central Ltd. this is an Open Access article distributed under the terms of the creative commons attribution license (http://creativecommons.org/licenses/by/2.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited

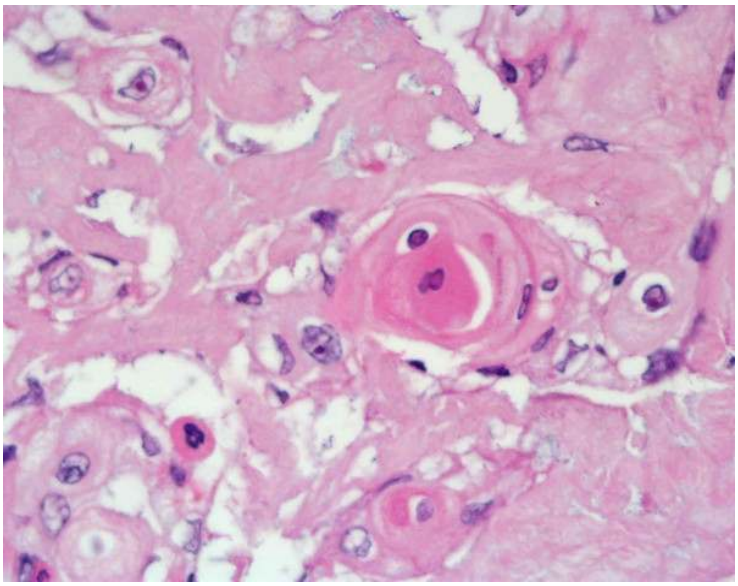


Fig. 4. Zone with squamous cell carcinoma HE x 400. Reproduced from: [13]

Fúnez R, Pereda T, Rodrigo I, Robles L, Gonzalez C. Simultaneous chromophobe renal cell carcinoma and squamous renal cell carcinoma diagnostic pathology. 2007;2:30. DOI: 10.1186/1746-1596-2-30. URL: http://www.diagosticpathology.org/content/2/1/30 © Fúnez et al.; licensee BioMed Central Ltd. this is an open access article distributed under the terms of the creative commons attribution license (http://creativecommons.org/licenses/by/2.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited

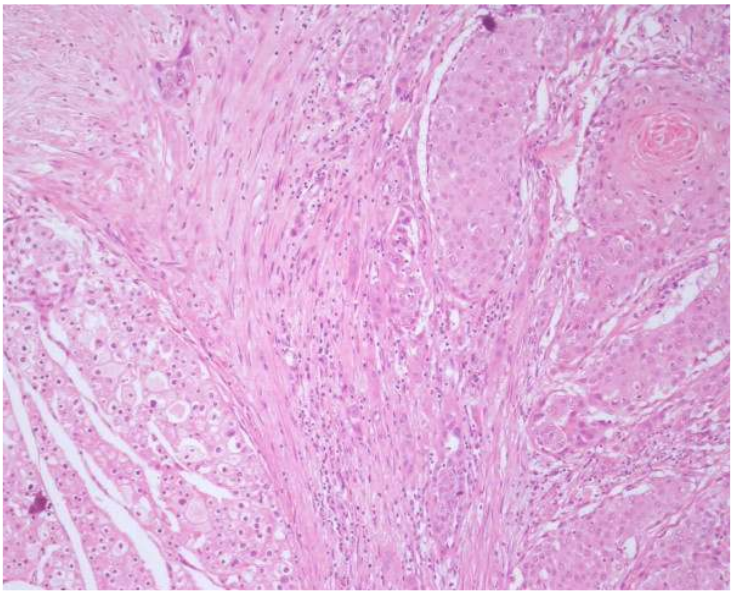


Fig. 5. Border region of the two tumors. there was no collision effect. HE x 100 Reproduced from: [13]

Fúnez R, Pereda T, Rodrigo I, Robles L, Gonzalez C. Simultaneous chromophobe renal cell carcinoma and squamous renal cell carcinoma Diagnostic Pathology. 2007;2:30. DOI: 10.1186/1746-1596-2-30. URL: http://www.diagosticpathology.org/content/2/1/30 © Fúnez et al.; licensee BioMed Central Ltd. this is an open access article distributed under the terms of the creative commons attribution license (http://creativecommons.org/licenses/by/2.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited

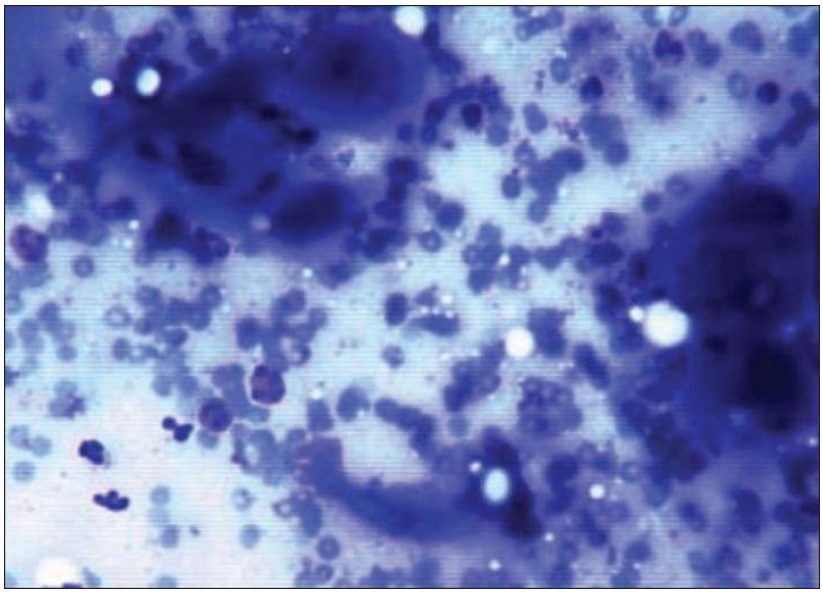


Fig. 6. Fine needle aspiration cytology smear shows pleomorphic squamous cells in a hemorrhagic background

(Giemsa stain, x 400) reproduced from: [14] Bindra R, Gupta S, Gupta N. Cytological diagnosis of squamous cell carcinoma of renal pelvis J. Cytol. 2010;27(2):76–77. DOI: 10.4103/0970-9371.70756 Copyright © Journal of Cytology. this is an open-access article distributed under the terms of the creative commons attribution license, which permits unrestricted use, distribution, and reproduction, in any medium provided the original work is properly cited

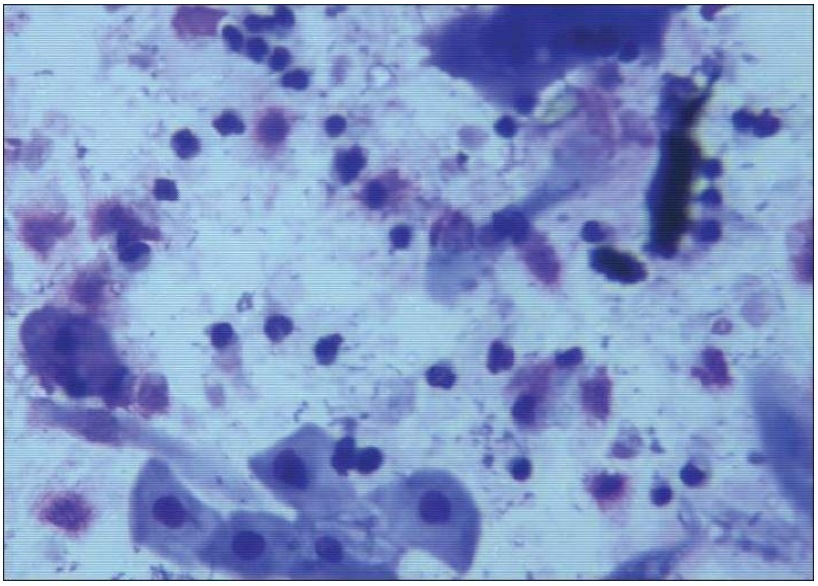


Fig. 7. Urine smear shows benign urothelial cells and pleomorphic squamous cells (giemsa stain, x 400). Fine needle aspiration cytology smear shows pleomorphic squamous cells in a hemorrhagic background

(Giemsa stain, x 400) reproduced from: [14] Bindra R, Gupta S, Gupta N. Cytological diagnosis of squamous cell carcinoma of renal pelvis J. Cytol. 2010;27(2):76–77. Squamous cell carcinoma of renal pelvis J. Cytol 2010 Apr; 27(2): 76 – 77. DOI: 10.4103/0970-9371.70756 Copyright © Journal of Cytology. This is an open-access article distributed under the terms of the creative commons attribution license, which permits unrestricted use, distribution, and reproduction, in any medium provided the original work is properly cited

The fine needle aspiration cytology features were adjudged to be consistent with a diagnosis of squamous cell carcinoma.

Kalayci et al. [15] reported a 60-year-old man who presented with a history of weight loss. His clinical examination was unremarkable. His serum urea and electrolytes were normal. He had ultra-sound scan of abdomen and renal tract which revealed intra-parenchymal hypo-echoic solid mass that measured about 4.9 cm x 5.1 cm in size with lobulated contour. The mass had extended to the upper pole of the right kidney. The ultra-sound scan also showed absence of corticomedullary distinction (see Figs. 8a-8b). Doppler ultra-sound scanning did not show any significant vascularity in the mass. Staghorn calculi were also found in the right pelvi-calyceal system without any evidence of dilatation in the pelvi-calyceal system. He also had CT scan of abdomen which showed a large non-functioning right kidney with staghorn calculi and a hypo-dense mass in the renal parenchyma which had extended to the upper pole of the right kidney. He had radiological metastatic work up which showed absence of metastasis and the kidney tumour was staged as stage III (pT3N0M0). T1-weighted imaging of the CT scan showed a contoured homogeneous isointense mass within the upper pole of the right kidney which had invaded the renal sinus. On T-2 weighted CT scan imaging, a heterogeneous hyper-intense mass with some hypo-intense areas was seen with minimal enhancement on intravenous gadolinium contrast administration. Multiple millimeter hypo-intense foci in all sequences compatible with calculi or calcifications were seen (see Figs. 8c–8e). He subsequently underwent right radical nephrectomy.

Macroscopic examination of the right radical nephrectomy specimen showed an enlarged kidney which on cut section was found to contain multiple yellow-brown colored staghorn calculi. An irregular gray-white solid tumour was seen which had replaced the renal pelvis and parenchyma. The surrounding renal parenchyma was not visible and the mass was found to have invaded the perinephric and pelvic fat (see Figs. 9a and 9b). Serial sections of the tumour had revealed haemorrhagic areas in the superior pole.

Microscopic examination showed poorly differentiated squamous cell carcinoma (SCC) which had infiltrated the renal parenchyma and the perinephric-pelvic fat. The tumour had infiltrated the renal capsule, perinephric fat and lympho-vascular structures. A lot of necrosis was evident in the tumour mass (see Figs. 10a, 10b, and 10c). Based upon the pathological findings a diagnosis of squamous cell carcinoma of the renal pelvis which had extensively infiltrated the renal parenchyma and perinephric fat was made.

Kalayci et al. [15] stated the following:

- Some authors [16,17] had stated that majority of squamous cell carcinomas of the renal pelvis tend to be moderately or poorly differentiated and thus the characteristics of squamous cell carcinomas including keratin pearls and intracellular bridges may not be readily apparent and that typically squamous cell carcinomas at the time of initial presentation and diagnosis on the whole tend to be more invasive in comparison with transitional cell carcinomas at diagnosis.
- Primary SCCP of the renal pelvis is rare and accounts for 0.5% to 0.8% of malignant kidney tumours.
- On the whole these tumours are highly aggressive in nature and tend to be diagnosed at an advanced stage at the time of initial diagnosis. Primary SCCPs also tend to be associated with poor prognosis in comparison with other upper urinary tract malignancies [18].
- Chronic irritation, inflammation, and infection induce squamous metaplasia of the collecting system of the kidney, which then develop into dysplasia and carcinoma in some patients. Whether the development of dysplasia is related to the presence of calculus which finally leads to the development of the squamous cell carcinoma or the squamous cell carcinoma is responsible for the causation of calculus had not yet been clarified [19].
- With regard to radiological characteristics of SCC of renal pelvis and kidney, the lesion may look like a solid mass with evidence of hydronephrosis, calcifications, or it may look like an infiltrative lesion in the renal pelvis without any evidence of a distinct mass.
- The differential diagnoses of SCC of renal pelvis and kidney based upon the radiological features include primary and metastatic neoplasms of the kidney and xanthogranulomatous pyelonephritis associated with renal stones.

- Mardi et al. [16] had stated that xanthogranulomatous pyelonephritis tends to be frequently associated with lithiasis; nevertheless, it rarely causes keratinizing squamous metaplasia and because its manifestations simulate neoplasm, it had tended to be misdiagnosed as malignancy.
- The radiological imaging features of squamous cell carcinoma of renal pelvis tend to be variable and some of the radiological findings include diffuse enlarged non-functioning kidney associated with renal calculi, radiological evidence of peri-renal infiltration, as well as, low-density or echogenicity in the renal parenchyma. Primary squamous cell carcinoma of the kidney cannot be differentiated from xanthogranulomatous pyelonephritis or other types of malignancies of the kidney based upon radiological features. The CT scan and MRI scan findings of a large urothelial carcinoma of the renal pelvis invading the renal parenchyma would tend to mimic that of xanthogranulomatous pyelonephritis.
- A number of authors [16,17,20,21] had stated that in view of the non-specific clinical manifestations and non-specific radiological features of squamous cell carcinoma of the kidney, difficulties in the establishment of diagnosis would necessitate reliance on histopathological examination to confirm the diagnosis.

Raghavendran et al. [22] retrospectively reviewed 18 cases of malignancies associated with stone disease in the renal pelvis. They had noted 15 cases of squamous cell carcinomas associated with stone disease out of the 18 cases. They recommended that a patient with long standing stone and associated poorly functioning kidney or haematuria should have a screening CT scan.

Lee et al. [17] reported that the CT features which are helpful for the diagnosis of squamous cell carcinoma of the kidney include presence of enhancing extra-luminal mass, exophytic mass which in some of the cases are observed to be associated with intraluminal component as well. Lee et al. [17] recommended that considering the fact that it was not practical for every patient with renal stone to have a CT scan, intravenous urography (IVU) should be undertaken periodically, particularly, in patients who have long-standing stones, and they should be assessed for split function for all areas of the renal parenchyma. Lee et al. [17] stated that some authors [17,18] had stated that the filling defect, the delay in appearance of pyelogram, renal parenchymal thickening in IVU may be suggestive of a renal tumour, despite preservation of renal contour and absence of mass effect.

Ghosh and Saha [23] in 2014, reported a 51-year-old man who presented with a history of pain in his right upper abdomen for the preceding 8 months and intermittent right loin pain for 5 months. He had a contrast-enhanced computed tomography scan (CECT) of abdomen which revealed a solitary heterogeneously enhancing relatively well-delineated mass in the lower pole of the right kidney. There was no evidence of infiltration of the adjacent organs (see Fig. 11a), and there was no evidence of lymph node involvement. There was no evidence of hydronephrosis or calculi in the renal tract. He also had contrast-enhanced CT scan of thorax and isotope bone scans which excluded metastasis. He underwent right radical nephrectomy. Macroscopic examination of the specimen revealed a variegated, light tan to yellow friable mass (see Fig. 11b), which measured 5.8 cm x 5.5 cm x 4.5 cm confined to the lower pole of the kidney with haemorrhagic and necrotic areas seen on sectioning. The pelvicalyceal system was not involved. There was no calculus in the kidney and the pelvi-calyceal system was not dilated. The histopathological examination findings of the specimen was reported as consistent with well-differentiated squamous cell carcinoma with nests of atypical squamous epithelial cells, keratin pearl formation, and focal areas of necrosis in the parenchyma of the kidney with entrapped glomeruli and tubules (see Figs. 12a, 12b, and 12c). There was evidence of chronic inflammatory reaction in the surrounding areas. The tumour was staged T1bN0M0. Microscopic examination of the pelvicalyceal system revealed that there was no tumour in the nearest urothelium, there was no evidence of squamous metaplasia or carcinoma in situ (see Fig. 12d). He had an 18-Fludeoxyglucose positron emission tomography / computed tomography (FDG – PET/CT) which excluded any other unknown primary malignancy. He did not receive any adjuvant therapy and he remained well without any evidence of local recurrence or distant metastasis at his 6 months and 12 months follow-up. Ghosh and Saha [23] stated that their reported case in 2014 was the second case of primary squamous cell carcinoma of the

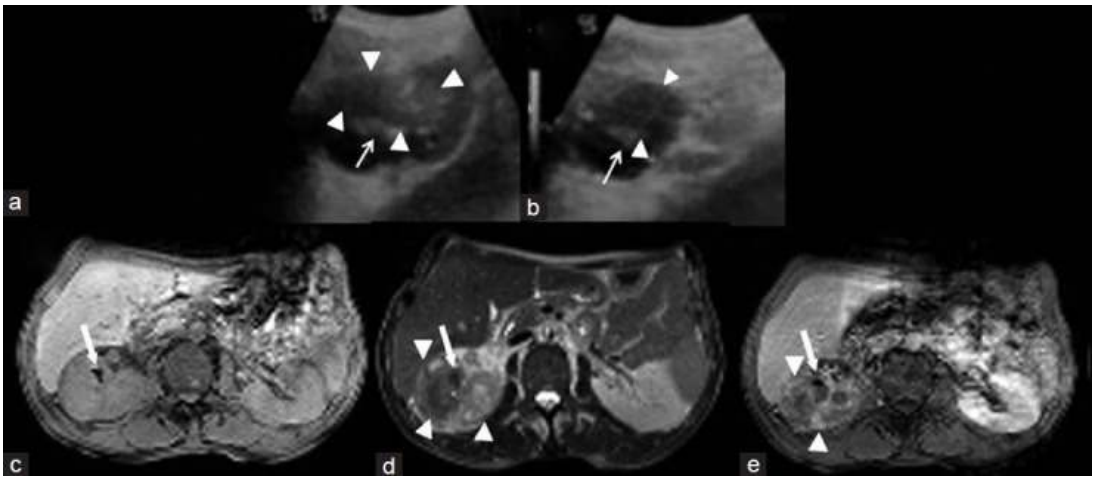
parenchyma of the kidney to be reported without involvement of the urothelium. Ghosh and Saha [23] stated the following:

- Primary squamous cell carcinoma of the renal pelvis usually would present at an advanced stage with infiltration of adjacent tissue although both squamous cell carcinoma and transitional cell carcinoma in advanced stages have similar poor prognosis [24].
- Their case presented at an earlier stage and was associated with excellent-outcome following treatment.
- Squamous cell carcinoma of the urothelial tract is believed to arise through a process of metaplasia usually keratinizing squamous metaplasia of the urothelium which leads to an increase in the chance for the development of squamous cell carcinoma in the future.
- The concept of squamous metaplasia preceding squamous cell carcinoma of the urothelial tract had been associated with controversies with different results in previous studies. The disagreement may partly be because of the relative rarity of SCC of the upper urinary tract [25].
- If an identifiable urothelial dysplastic element is found including urothelial carcinoma in situ (cis) then the tumour should be classified as primary urothelial carcinoma with squamous differentiation. Nevertheless, the conspicuous presence of keratinizing squamous metaplasia of the adjacent flattened urothelium, particularly if associated with dysplasia would be in support of primary squamous cell carcinoma of the renal pelvis which is rare [26,27].
- In their case there was no evidence of dysplastic urothelial component or metaplastic and/or dysplastic squamous lining of urothelium.
- The leading aetiological factors for the development of squamous cell carcinoma of the renal pelvis include recurrent urinary tract infections without or with vesicoureteric reflux, long-standing staghorn calculi, smoking, schistosomiasis, endogenous and exogenous chemicals, vitamin A deficiency, hormonal imbalance and others. Only anecdotal cases of squamous cell carcinoma of renal pelvis had been reported where no apparent aetiological factors had been identified. [5] [25] Their-reported case lacked the association of the carcinoma with any predisposing factors.
- Primary squamous carcinoma of the kidney should be differentiated from metastatic squamous cell carcinoma with the primary tumour elsewhere by means of a combination of clinical history, imaging studies, and histopathology [21,25].

The first case of primary squamous cell carcinoma that involved the renal parenchyma without the involvement of the renal pelvis urothelium was reported in 2012 by Kulshreshtha et al. [28] in a 60-year-old woman who presented with a history of weight loss.

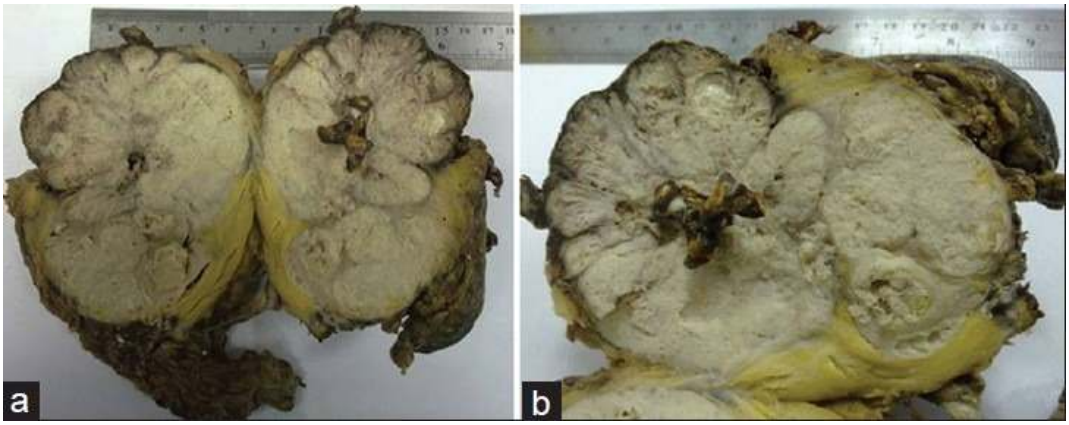
Sahoo et al. [29] reported a 50-year-old woman who presented with pain in the right side of her abdomen. She did not have any history of kidney stones, urinary tract infection or pyelonephritis. She had ultra-sound scan of the renal tract which revealed mild right hydroureteronephrosis and a hypo-echoic lesion in the upper pole of her right kidney. She had a contrast enhanced CT-scan of abdomen and pelvis and thorax which did show a mild to moderate enhancing mass of about 6 cm x 8 cm in the upper pole of the right kidney (see Fig. 13a) and right sided dilated ureter (see Fig. 13b) and the CT scan did not show any lesion anywhere else. She underwent right radical nephrectomy and histological examination of the specimen showed normal looking glomeruli and renal tubules (see Fig. 13c) together with squamous cell carcinoma component with keratin pearls (see Fig. 13d) which established the diagnosis of squamous cell carcinoma of kidney. The histological examination also showed that the renal capsule was involved but the perirenal fat and hilar lymph nodes were not involved and the renal pelvis was normal. The patient was well without any evidence of recurrence at her 6-month follow-up.

Considering the fact that squamous cell carcinoma of renal pelvis/kidney has been reported a long time after successful percutaneous nephrolithotomy even in the absence of a recurrent stone it would be argued that perhaps, there is the need for patients who have undergone percutaneous nephrolithotomy to be followed-up for a long time with regular periodic appropriate radiological imaging in order to detect early a possible SCC of renal pelvis/kidney. Nevertheless, the pick-up rate of such tumours would be low in view of the rarity of the disease.



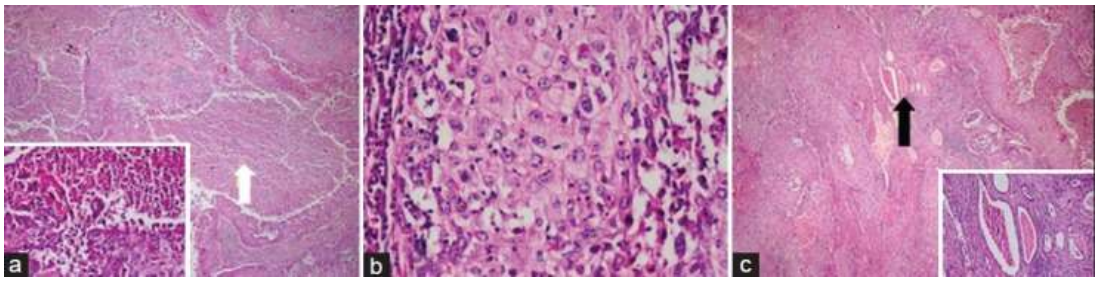
Figs. 8a, 8b, 8c, 8d and 8e. (a) Coronal and (b) axial ultrasound (US) imaging show intra-parenchymal hypo-echoic heterogeneous solid mass with lobulated contour in the upper middle portion of right kidney (arrowhead). (c) Axial T-1 weighted magnetic resonance image (MRI), (d) T-2 weighted image (WI) show an increase in the size of the right kidney and reveal a heterogeneous hyper-intense mass (arrowheads) (e) Post-contrast T-1 WI reveals a heterogeneous isointense mass lesion invading renal sinus parenchyma and the mass shows minimal enhancement after administration of intravenous contrast medium and note hyper-echoic foci on US imaging and hypo-intense foci in all MRI sequences compatible with stones (white arrows)

*Reproduced from: [15] Kalayci O T, Bozdag Z, Sonmezgoz F, Sahin N. Squamous cell carcinoma of renal pelvis associated with kidney stones: radiologic imaging features with gross and histopathological Correlation. J Clin Imaging Sci. 2013;3:14. DOI: 10.4103/2156-7514.109741 Copyright © 2013 Kalayci O T; This is an open access **a**rticle distributed under the terms of the creative commons attribution license, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited*



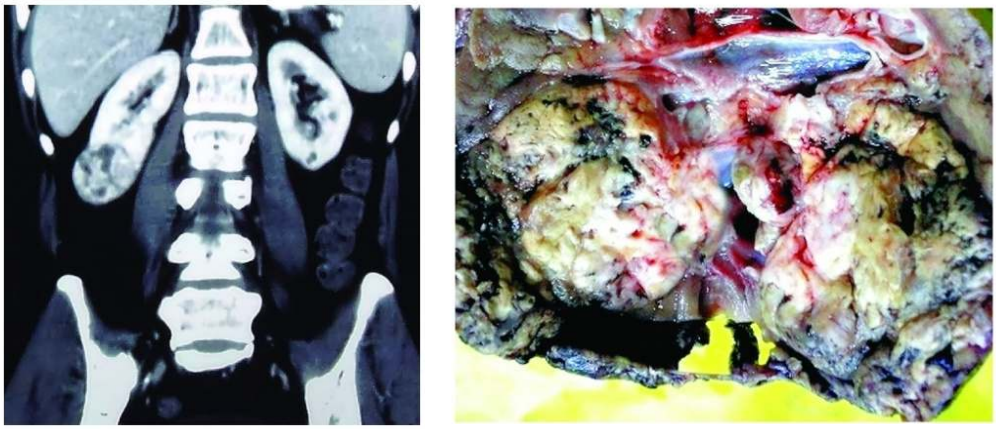
Figs. 9a and 9b. Cut sections of the nephrectomy specimen (a and b) after the right radical nephroureterectomy show an irregular gray-white solid tumor in total kidney and multiple yellow-brown colored staghorn stones

Surrounding renal parenchyma is not visible and the … reproduced from: [15] Kalayci O T, Bozdag Z, Sonmezgoz F, Sahin N. Squamous cell carcinoma of renal pelvis associated with kidney stones: radiologic imaging features with gross and histopathological correlation. J Clin Imaging Sci. 2013;3:14. DOI: 10.4103/2156-7514.109741 Copyright © 2013 Kalayci O T; This is an open access article distributed under the terms of the creative commons attribution license, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited



Figs. 10a, 10b and 10c. Histopathology samples stained with H and E x 40 (a, b, c) show poorly differentiated squamous cell carcinoma of renal pelvis, extensively infiltrating the renal parenchyma and perinephric fat

Sample shows intensive necrotic areas within … reproduced from: [15] Kalayci O T, Bozdag Z, Sonmezgoz F, Sahin N. Squamous cell carcinoma of renal pelvis associated with Kidney Stones: radiologic imaging features with Gross and Histopathological Correlation. J Clin Imaging Sci. 2013;3:14. DOI: 10.4103/2156-7514.109741 Copyright © 2013 Kalayci O T; This is an open access article distributed under the terms of the creative commons attribution license, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited



(a) **(b)**

Figs. 11a and 11b. (a) CECT of abdomen on coronal plane showing a solitary mass in the lower pole of the right kidney, (b) photograph of bisected specimen of nephrectomy showing a well-delineated mass in the lower pole

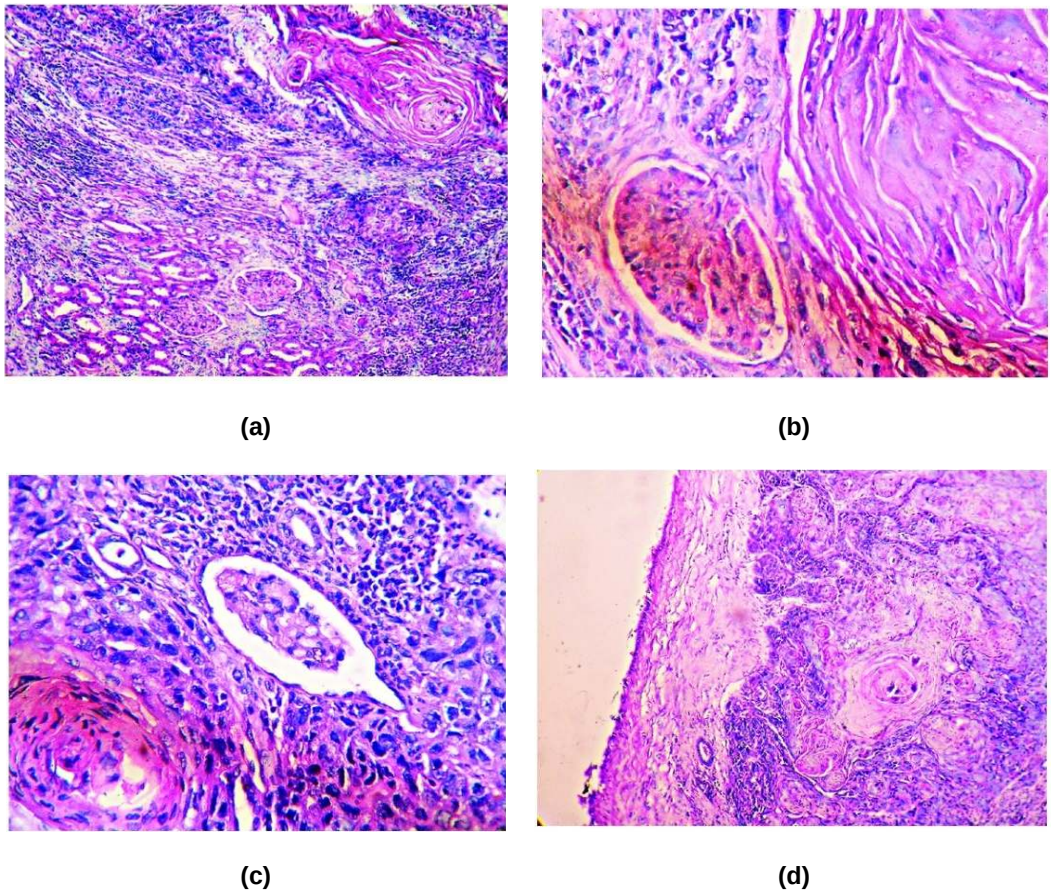
Reproduced from: [23] Ghosh P, Saha K. Primary Intraparenchymal Squamous Cell Carcinoma of the Kidney: A Rare and Unique entity. case reports in pathology volume 2014 (2014), Article ID 256813, 3 pages http://dx.doi.org/10.1155/2014/256813 with copyright permission: Copyright © 2014 Prithwijit Ghosh and Kaushit Saha; this is an open access article distributed under the terms of the creative commons attribution license, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited

With regard to MRI scanning, Fernandes et al. [30] stated that with regard to patients with impaired renal function it has been stated that MR urography can be helpful in the detection of tumours of the upper urinary tract, especially in obstructed kidneys and that the use of diffusion-weighted imaging (DWI) sequences in association with conventional T1- and T2-weighted sequences increases the accuracy and sensitivity of URO-MRI.

With regard to CT scan, Fernandes et al. [30] stated that, in addition to technological improvements in MDCT, and refinements in the tests, radiological orientation had perhaps contributed to an increase in the capacity to detect abnormalities and that a variety of techniques have been used including abdominal compression, administration of intravenous saline solution, diuretics or both, “log-rolling” (asking patients to roll 360 degrees) prior to the

excretory phase in order to maximize opacification and distension of the urinary tract.

Even though the aetiology of PSCCRP/K is considered to be multi-factorial, radiotherapy has been reported to have been associated with the development of PSCCRP/K and furthermore, a number of patients who are recurrent stone formers would require regular long-term follow-ups with radiological imaging and it is important not to radiate patients excessively in view of this there is the need to provide medical education to health care workers including physicians, surgeons, general radiologists, medical imaging physicists and CT technologists to competently manage radiation dose and to use new computed tomography technologies as low as reasonably achievable ("Image Gently" and "Image Wisely" – Radiation Safety in Adult Imaging).



(a) **(b)**

(c) **(d)**

Figs. 12a, 12b and 12c. (a) Photomicrograph of well-differentiated squamous cell carcinoma with keratin pearl formation along with glomeruli and tubules (H and E, x 100). (b) glomerulus and tubules in close relation to keratin pearl of squamous cell carcinoma (H and E, x 400). (c) photomicrograph of entrapped glomerulus and renal tubules within squamous cell carcinoma (H and E, x 400). (d) *photomicrograph of uninvolved flattened urothelium of pelvicalyceal system (left) keeping a distance from sheets of malignant squamous cells (right) (H and E, x 100)*

Reproduced from: [23] Ghosh P, Saha K. Primary Intraparenchymal Squamous Cell Carcinoma of the Kidney: A Rare and Unique entity. case reports in pathology volume 2014 (2014), Article ID 256813, 3 pages http://dx.doi.org/10.1155/2014/256813 with copyright permission: Copyright © 2014 Prithwijit Ghosh and Kaushit Saha; this is an open access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited

Table 1. Some of the reported cases of squamous cell carcinoma of kidney and renal pelvis with summary of presentation, treatment and outcome

Authors/reference/ year	Age/sex/presentation/site	Radiological investigation findings	Histological findings	Treatment	Outcome
Vella et al. [4] 1995	73; Male; haematuria; right kidney + lymph adenopathy	Ultrasound scan; CT scan – tumour mass in right kidney	Squamous cell carcinoma of the renal pelvis which had involved the renal parenchyma and had extended into the peri-renal fat. The tumour had involved the regional lymph nodes and had also invaded the inferior vena cava and also shown squamous carcinoma in situ and squamous metaplasia in the urothelium adjacent to the tumour.	Right nephrectomy + lymphadenectomy + adjuvant chemotherapy	He was alive at 3 months with local recurrence and underwent adjuvant chemotherap y
Talwar et al. [5] 2006	69 years; male; features of pyonephrosis		An unsuspected squamous cell carcinoma of renal pelvis with concomitant pyonephrosis	Nephrectomy	Outcome not available to author
Kayaselçuk et al. [6]	[1] 56 years; male; haematuria; left lumbar pain; fever; weight loss, history of untreated nephrolithiasis of his left kidney 20 years	Radiological investigations did not detect a tumour, non-functioning hydronephrotic left kidney	Squamous metaplasia and dysplasia in the in the pelvi-calyceal mucosa as well as islands of atypical squamous cells in the renal parenchyma.	Eventual long-term outcome not Available to author	
	[2] 87 years; female; haematuria, left lumbar pain, a	non- functioning hydronephrotic left kidney	Squamous metaplasia and dysplasia in the in	Eventual long-term outcome not Available	

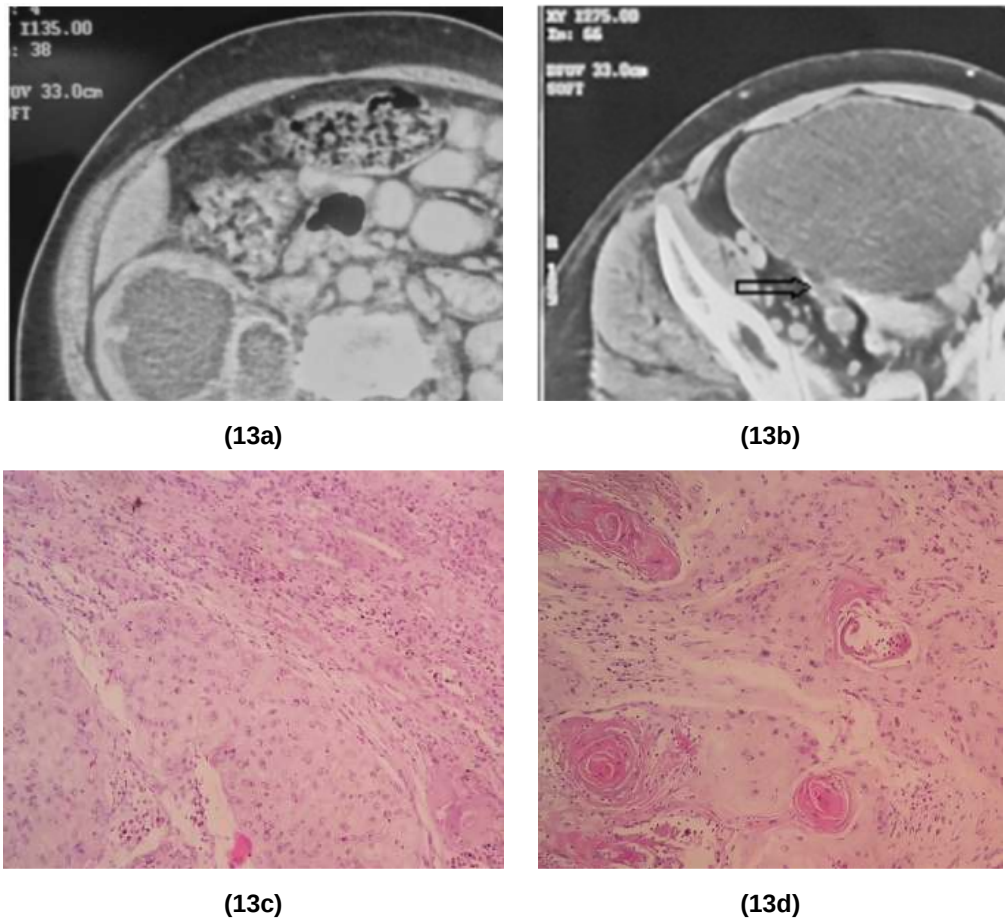
Authors/reference/ year	Age/sex/presentation/site	Radiological investigation findings	Histological findings	Treatment	Outcome
	long history of nephrolithiasis of her left kidney		the pelvi-calyceal mucosa as well as islands of atypical squamous cells in the renal parenchyma and sarcomatous changes in the renal pelvis.	to author	
Ito et al. [7]; 1988	60-years; male; multiple bilateral renal calculi and visible haematuria Left	Non-functioning right kidney and marked left sided hydronephrosis. Squamous cell carcinoma involving the treated left kidney was several months subsequently diagnosed.	Squamous cell carcinoma involving the treated left kidney	Percutaneous nephrolithotomy for his left renal calculi. Initially Chemotherapy and radiotherapy	he died of renal failure
Paonessa et al. [8]; 2011	70-years; Female; a long-history of renal calculi who had presented with vague abdominal pain. Left	A mass in the upper pole of the left kidney.	Squamous cell carcinoma of the renal collecting system.	Percutaneous CT guided biopsy of left renal mass Left nephrectomy	Alive with short history post-operatively
Mikuriya et al. [9]; 1989.	49 years; Female; left sided abdominal pain.	A complete bilateral duplication of uretero-pelvis and vesico-ureteric reflux into the upper left part of the kidney.	Squamous cell carcinoma.	Left nephroureterectomy. Plus She received 50 Gy of radiotherapy At operation, a tumour was found in the upper part of the left renal pelvis (upper moiety of the duplex system) and in the ureter belonging to the upper moiety of the left renal duplex renal pelvis.	She died four months pursuant to her operation.
Sivaramakhrishna et	Details not available. A patient,	-Previously had stone in	Squamous cell	Details of all the	Outcome

Authors/reference/ year	Age/sex/presentation/site	Radiological investigation findings	Histological findings	Treatment	Outcome
al. [10] 2004	who had undergone successful percutaneous nephrolithotomy (PCNL) for a long-standing renal pelvis calculus and who eight months subsequently presented with a large squamous cell carcinoma in the same location in the renal pelvis.	renal pelvis but details of subsequent findings not available-	carcinoma in renal pelvis	treatment is not available to author	details not available
Imbriaco et al. [11]; 2011.	69 years; man; with a past history of renal calculi who had presented with left flank abdominal pain and fever for several months.	Large mass in the left side of his horseshoe kidney with associated large renal stones.	Squamous cell carcinoma arising in horse shoe kidney with associated renal stones.	Partial nephrectomy with the removal of the left side of the horse shoe kidney.	Details of outcome not available
Holmang et al. [2]; 2007.	Holmang et al. [2] reported that only 2 (4%) out of 65 patients with squamous cell carcinoma of renal pelvis/ureter had had stage pTa/pT1/pT2 tumours and 96% of them had stages higher than T2 in comparison with 460 (62%) out of 743 patients with pTa/pT1/pT2 tumours who had urothelialial carcinoma.	Details not available	Holmang et al. [2] reported that only 2 (4%) out of 65 patients with squamous cell carcinoma of renal pelvis/ureter had had stage pTa/pT1/pT2 tumours and 96% of them had stages higher than T2 in comparison with 460 (62%) out of 743 patients with pTa/pT1/pT2 tumours who had urothelialial carcinoma.	Details not available	Details not available
O'Daly et al. [12]; 2007.	71years; Male; man who was diagnosed with squamous cell carcinoma in the renal pelvis of a solitary functioning kidney.	Details not available	Squamous cell carcinoma of renal pelvis	Details not available	Long-term outcome details not available

Authors/reference/ year	Age/sex/presentation/site	Radiological investigation findings	Histological findings	Treatment	Outcome
	The patient had undergone radical orchidectomy and adjuvant radiotherapy for stage II seminoma 34 years preceding the diagnosis of the squamous cell carcinoma of the renal pelvis and that this rare second carcinoma had occurred within the radiotherapy treatment field.				
Funez et al. [13]; 2007.	68 years; Female; visible haemauria and right flank pain.	A solid mass (a tumour) in the upper pole of the right kidney with a heterogeneous contrast caption, calcification and no evidence of lymph adenopathy.	Two tumours [1] Chromophobe renal cell carcinoma and squamous cell carcinoma with keratinization	She underwent right nephrectomy.	Alive after 32 months
Bindra et al. [14]; 2010	50 years; Female; Left flank lump, pain and fever.	Left sided hydronephrosis and multiple calculi in the lower calyx of the left kidney.	Urine cytology on microscopic examination of her urine specimen, the urine cytology was positive for malignant cells and the cytomorphological characteristics of the cells were noted to be suggestive of squamous cell carcinoma Pathological examination of the ultrasound-guided fine	Details not available	Details not available

Authors/reference/ year	Age/sex/presentation/site	Radiological investigation findings	Histological findings	Treatment	Outcome
			needle aspiration biopsy of the renal mass showed features consistent with squamous cell carcinoma.		
Kalayci et al. [15]; 2013.	60 years; Male; Weight loss; Right	A large non-functioning right kidney with staghorn calculi and a hypo-dense mass in the renal parenchyma which had extended to the upper pole of the right kidney.	Poorly differentiated squamous cell carcinoma (SCC) which had infiltrated the renal parenchyma and the perinephric-pelvic fat. The tumour had infiltrated the renal capsule, perinephric fat, and lymphovascular structures.	Right radical nephrectomy	Outcome details not available
Raghavendran et al. [22]; 2003.	18 cases of patients of various ages with renal stone disease and presentations / sex groups not included in analysis of data; 15 had squamous cell carcinoma of renal pelvis/kidney	Various	They retrospectively reviewed 18 cases of malignancies associated with stone disease in the renal pelvis. They had noted 15 cases of squamous cell carcinomas associated with stone disease (high incidence) out of the 18 cases.	Individual details not available	Details not available
Ghosh and Saha [23]; 2014;	51 years; Male; -Pain in right upper abdomen and intermittent right loin pain; Right	A solitary heterogeneously enhancing relatively well-delineated mass in the	Well-differentiated squamous cell carcinoma with nests of atypical squamous	Right radical nephrectomy	He was alive at his 12-month follow-up

Authors/reference/ year	Age/sex/presentation/site	Radiological investigation findings	Histological findings	Treatment	Outcome
		lower pole of the right kidney.	epithelial cells, keratin pearl formation, and focal areas of necrosis in the parenchyma of the kidney with entrapped glomeruli and tubules		with no evidence of local recurrence or distant metastasis
Sahoo et al. [29]; 2015	50 years; Female; Right sided abdominal pain.	Mild to moderately enhancing mass in upper pole of right kidney and right hydroureterone phrosis	Squamous cell carcinoma of kidney with keratin pearls	Right radical nephrectomy	Alive at 6-month follow-up with no evidence of disease



(13a) **(13b)**

(13c) **(13d)**

Figs. 13a, 13b, 13c and 13d. (a) Fig. (13 a) presence of a hypo-dense renal mass of size approximately 6 x 8 cms in upper pole of right kidney with mild to moderate enhancement in nephritic phase; Fig. (13b) presence of dilated ureter up to terminal part; Fig. (13c) normal glomeruli adjacent to focus of squamous epithelial carcinoma; Fig. (13d) normal tubular structures entrapped within the squamous cell carcinoma focus showing characteristics squamous pearls. Reproduced from: [29]

Sahoo T K, Das S K, Mishra C, Dhal I, Nayak R, Ali I, Panda D, Majumdar S K D, Parida D K. Squamous cell carcinoma of kidney and its prognosis: a case report and review of the literature. Case reports in urology volume 2015 (2015), Article ID 469327, 3 pages httpp://dx.doi.org/10.1155/2015/469327 Copyright © 2015 Tapan Kumar Sahoo et al. This is an open access article distributed under the terms of the creative commons attribution license, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited

5. SUMMARY

Primary squamous cell carcinomas of the kidney / renal pelvis are rare tumours that are reported sporadically. Majority of reported cases of these carcinomas involve the renal pelvis and invade the kidney. Only three cases of primary squamous cell carcinoma involving the renal parenchyma but not involving the renal pelvis have been reported. Primary squamous cell carcinomas of renal pelvis / kidney tend to be diagnosed in advanced stages of the disease and on the whole associated with a poorer prognosis in comparison transitional cell carcinomas of the renal pelvis with a 5-year-survival of less than 10% [16,21] and a mean survival of 7 months. Nevertheless, the mean survival of patients with squamous cell carcinoma of the kidney/renal pelvis when compared with transitional cell carcinomas of the renal pelvis of the same stage would appear to be similar. A number of cases of primary squamous cell carcinomas of the renal pelvis / kidney have been associated with calculi and

some have had a past history of successful treatment for stones (Percutaneous nephrolithomy). Radiological imaging characteristics in conventional studies are non-specific. Squamous cell carcinoma of the renal pelvis/kidney should be suspected when a patient is found to have a renal / renal pelvis mass and a history of treatment for renal calculi or chronic long-term renal pelvis calculi. Considering the fact that squamous cell carcinomas of the renal pelvis/kidney tend to be associated with previous treatment for stones, perhaps if patients who have undergone treatment for renal stones are followed up for a long time with appropriate radiological imaging (for example, with ultra-sound-scans and/or MRI and when eventually required a CT scan properly indicated and performed,) may be diagnosis of PSCCRP/K would be made when the tumour is less advanced which would enable early curative surgical treatment as an attempt to improve the prognosis.

6. CONCLUSIONS

Primary squamous cell carcinomas of the renal pelvis / kidney have been reported sporadically and a number of them have been associated with renal calculi and chronic infections of the urinary tract. These malignancies on the whole are initially diagnosed in advanced stages of the disease and hence associated with poor prognosis. Conventional radiological investigations are non-specific with regard to the diagnosis of squamous cell carcinoma of renal pelvis / kidney. CT and MRI scans cannot fully differentiate between xanthogranulomatous pyelonephritis, squamous cell carcinomas and other tumours of the kidney and renal pelvis. Histopathological examination of the lesion so far is the definite way to confirm the diagnosis. Clinicians should have a high index of suspicion for the possibility of squamous cell carcinoma of renal pelvis / kidney when they encounter patients with renal masses and a history of chronic renal calculi or previous treatment for renal calculi.

CONSENT

This is not applicable in cases of literature review.

ETHICAL APPROVAL

This is not applicable for literature review.

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COMPETING INTERESTS

Author has declared that no competing interests exist.

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