

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

2

3 Abstract

4 Background

5 Primary squamous cell carcinoma of renal pelvis/kidney (PSCCRP/K) is rare with
6 controversies regarding its histogenesis.

7 Aim

8 To review the literature

9 Method

10 Various internet data bases were searched.

11

12 Literature Review

13 Few cases of PSCCRP/K have been reported with only two cases of PSCC of the renal
14 parenchyma without involvement of renal pelvis. Some PSCCRP/Ks have been associated
15 with renal calculi, chronic infections, vesicoureteric reflux. Some cases had developed many
16 years after successful percutaneous nephrolithotomy; a case was reported many years after
17 curative radiotherapy for testicular tumour. The tumours are initially diagnosed in advanced
18 stages; generally the prognosis has been poor following nephrectomy/nephrourectomy.
19 Conventional radiological features of the disease are non-specific and cannot differentiate the
20 lesion from other tumours or xanthogranulomatous pyelonephritis. Diagnosis is based upon
21 strict histopathological criteria of the microscopic characteristics of tumour. Primary tumour
22 elsewhere should be excluded with radiological images. PSCCRP/K should be suspected
23 when a renal/renal pelvis mass is found with a history chronic or past stone disease treatment.
24 Perhaps if patients who have undergone treatment for kidney stones are carefully followed-up
25 with MRI / ultra-sound-scans (avoiding CT scan which could possibly induce malignancy
26 over many years) for a long time PSCCR/Ks may be diagnosed at an early stage of the
27 disease in order to provide early curative treatment.

28 Conclusions

29 A multi-centre trial of long-term follow-up of patients who have undergone treatment for
30 renal stone disease is required to see if interval follow-up MRI scan would help diagnose
31 early cases of PSCCRP/K that would develop subsequently.

32 **Key Words:** Primary squamous cell carcinoma of renal pelvis; primary squamous cell
33 carcinoma of kidney; calculi; Nephrectomy; metaplasia; chronic irritation; prognosis:

34

35 **Introduction**

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

43 **Aim**

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

45 **Method**

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

51 **Literature Review**

52 (A) Overview

53 General Comments

- 54 • It has been stated that Squamous Cell Carcinomas of the kidney tend to
 55 be associated with squamous metaplasia of renal pelvis, renal calculi or
 56 infection [1] [2]
- 57 • Cases of squamous cell carcinoma of kidney may be found associated with urothelial
 58 carcinoma or urothelial carcinoma in situ; however, it has been recommended such
 59 cases should be classified as urothelial carcinoma with squamous differentiation. [3]
 60 [3]
- 61 • Holmang et al. [2] stated most often squamous cell carcinomas of the kidney are
 62 diagnosed in advanced stages of the disease and they tend to be associated with poor
 63 prognosis.
- 64 • With regard to the origin of the disease squamous cell carcinoma of the renal pelvis /
 65 kidney has been postulated to emanate from squamous metaplasia in response to
 66 chronic irritation. [3]

67 Epidemiology

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

70

71 Presentation

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

75 Blood tests

76 Full Blood Count

- 77 • Full blood count is undertaken as part of general work up assessment
78 of the patients and those patients who are noted to have anaemia could
79 be managed appropriately considering the fact that some patients may
80 present with haematuria.

81 Coagulation screen

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

86 Serum urea and electrolytes (U/E)

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

91 Serum glucose

- 92 • Serum glucose is carried out as part of the general assessment of
93 patients

95 Liver Function-Tests

- 96 • Liver function tests are undertaken as part of the general assessment of
97 the patient

99 Urinalysis, urine microscopy and culture

- 100 • These tests are undertaken as part of the general assessment of the
101 patient. In the event a positive urine culture for urinary tract infection,
102 the infection can be treated accordingly

104 Urine cytology

- 105 • Urine cytology may show evidence of abnormal cells which may be
106 suggestive of squamous cell carcinoma,

108 Radiological investigations

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

115 Ultra-sound scan

- 116 • Ultrasound scan of abdomen and renal tract may be normal in some
117 cases it may show hydronephrosis plus or minus calculus in renal

118 pelvis; it may also show a lesion in the renal pelvis or kidney.
 119 Ultrasound scan of abdomen and pelvis can be done in the follow-up
 120 assessment of patients who had undergone
 121 nephrectomy/nephroureterectomy to exclude metastasis. If a patient
 122 needs fine needle aspiration biopsy of a subcutaneous lump or a lesion
 123 in the kidney the procedure can be done under ultrasound guidance.

124

125 Computed tomography (CT) scan

126 • CT scan of abdomen and renal tract may be normal in some cases; it
 127 may show hydronephrosis plus or minus calculus in renal pelvis; it
 128 may also show a lesion in the renal pelvis or kidney. CT scan can
 129 provide detailed assessment of the renal pelvis lesion and would show
 130 whether or not lymph nodes are enlarged in the abdomen and pelvis.
 131 The CT scan can also be used to confirm absence of a primary tumour
 132 lesion anywhere else in the abdomen. CT scan of abdomen and pelvis
 133 can be undertaken at follow-up of patients following nephrectomy or
 134 nephroureterectomy for squamous cell carcinoma of kidney/renal
 135 pelvis to exclude subsequent development of metastasis

136

137 CT scan of thorax

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

144

145 18-Fludeoxyglucose Positron Emission Tomography (FDP- PET/CT)

146

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

149

150 Magnetic Resonance Imaging (MRI)

151

152 • MRI scan of abdomen and renal tract may be normal in some cases; it
 153 may show hydronephrosis plus or minus calculus in renal pelvis; it
 154 may also show a lesion in the renal pelvis or kidney. MRI scan can
 155 provide detailed assessment of the renal pelvis lesion and would show
 156 whether or not lymph nodes are enlarged in the abdomen and pelvis.
 157 The MRI scan can also be used to confirm absence of a primary
 158 tumour lesion anywhere else in the abdomen. MRI has an additional
 159 advantage in that if it is used as regular routine. MRI scan of abdomen
 160 and pelvis can also be undertaken in the follow-up of patients who had
 161 undergone treatment for squamous cell carcinoma of kidney/renal
 162 pelvis to exclude metastasis.

163

164 MRI scan of thorax

165 • MRI scan of thorax is undertaken to exclude a metastatic tumour lesion
 166 in the thorax and it would also exclude a primary tumour in the thorax.
 167 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.

Fine needle Aspiration Cytology

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

Macroscopic features

- Macroscopic examination of SCCPs, tend to ulcerated tumours that are large and necrotic [pathology outlines.com]

Microscopic features of SCCCK

- On the whole microscopic examination of specimens of SCCPs, tend 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]

Differential diagnosis of SCCCK

- It is important to differentiate SCCCK 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 SCCCK there would not be any evidence of urothelial carcinoma anywhere in the tumour . [3]

Treatment

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

- Nephrectomy
- Radical Nephrectomy
- Nephroureterectomy

Outcome

- On the whole the outcome of SCCCKs 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 SCCCKs/SCCRPs could be diagnosed at early at less advanced stages, perhaps their prognosis would improve following treatment but this is conjectural and needs to be proven in due course.

(B) Miscellaneous narrations and discussions from some reported cases

Vella et al. [4] reported a 73-year-old Caucasian 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. Histological examination had also shown 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 had presented with clinical features of pyonephrosis who had undergone nephrectomy. Histological examination of the nephrectomy specimen had shown 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. With regard to the patient who had squamous cell carcinoma of left the kidney, Kayaselçuk et al. [6] reported that the patient was a 56-year-old man who manifested with haematuria, left lumbar pain fever and 4 to 5 kilograms 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. The second patient was an 87-year-old woman who manifested with haematuria and left lumbar 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 had revealed squamous metaplasia and dysplasia in the 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 had been admitted because of 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 involving 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 had had a long-history of renal calculi who had presented with vague abdominal pain. She had CT scan and magnetic resonance imaging (MRI) scan which had shown a mass in the upper pole of the left kidney. She had undergone percutaneous CT guided biopsy of the mass and histological examination of the specimen had 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. She made an uneventful post-operative recovery. Paonessa et al. [8] made the ensuing iterations:

- Chronic calculi of the kidney pose a risk for the development of squamous metaplasia which may emanate in 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 (which implies - in order to identify such tumours early and in order to provide early curative treatment)
- 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 had presented with left sided abdominal pain. She had various investigations which confirmed she had complete bilateral duplication of uretero-pelvis and vesico-ureteric reflux into the upper left part of the kidney. 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. After a left nephron-ureterectomy, histological examination of the specimen had shown squamous cell carcinoma. He received 50 Gy of radiotherapy but despite this treatment, she died four months pursuant to her operation.

Sivaramakrishna 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. It would be argued that the lessons learnt from the management of this case should alert clinicians to the fact that there is the possibility that patients who had undergone successful treatment for long-standing calculi in the renal pelvis potentially could subsequently develop squamous cell carcinoma of renal pelvis/kidney therefore, in order to diagnose such tumours early regular radiological evaluations would need to be undertaken at periodic intervals.

Imbriaco et al. [11] in 2011, reported a 69-year-old man with a past history of renal calculi who had presented with left flank abdominal pain and fever for

several months. 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 the removal of the left side of the horse shoe kidney. Pathological examination of the specimen showed squamous cell carcinoma arising in horse shoe kidney with associated renal stones.

Holmang et al. [2] in 2007 stated that squamous cell carcinomas of renal pelvis and ureter are rare and they reported a large series of patients 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 renal pelvis and ureteral cancers. With regard to the results, Holmang et al. [2] reported that only 2 (4%) out of 65 patients with squamous cell carcinoma 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 urothelial 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 with 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.
- It could be presumed that high stage squamous cell carcinoma and high stage urothelial carcinoma become symptomatic first at a time when the tumours are already large, deeply invasive, and most often incurable.
- New types of treatment are urgently required in order to improve upon the poor prognosis associated with patients who have advanced stage squamous cell carcinoma and urothelial carcinoma of the upper urinary tract.

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.

It would be argued that perhaps in this aforementioned case since there was no renal pelvis calculus and there was no history of chronic urinary tract infection or vesico-ureteric reflux, the radiotherapy may either have induced metaplasia within the cells lining the renal pelvis or induced de-differentiation of totipotent cells within the lining of the renal pelvis and eventually leading to squamous cell carcinoma.

Funez et al. [13] reported a 68-year-old woman who presented with haematuria and right flank pain. She had an ultra-sound scan of abdomen and renal tract which showed a solid mass with probably calcified areas and cystic changes in the upper pole of the right kidney. She also had a CT scan which revealed a tumour in the upper pole of the right kidney with a heterogeneous contrast enhancement, calcification and no evidence of lymphadenopathy. She underwent right nephrectomy. Macroscopic examination of the kidney revealed a tumour in the upper pole 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 had calcifications. There was no evidence of calculi in the renal pelvis. The tumour was related to the renal pelvis focally (see figure 1). The adrenal gland and two lymph nodes with the tumour looked normal. Microscopic examination revealed that the tumour consisted of a typical chromophobe renal cell carcinoma with positive Hale's colloidal iron stain and immunohistochemical staining of the tumour was negative for vimentin (Dakocytomation S. A.) in the areas that had brown, homogeneous appearance (see figure 2). There was another zone with necrosis, extensive calcification and solid epithelial nests with some keratin pearls and obvious squamous cell differentiation (see figures 3 and 4) close to these areas. These 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 figure 5). Focal relationship between both tumours and renal pelvis was 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 pelvic 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 two-month history of left flank lump, pain and fever. She was found to be tender in the left side of her abdomen. She had an ultra-sound scan and intravenous pyelogram which revealed left-sided hydronephrosis and multiple calculi in the lower calyx of the left kidney. 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 (see figure 6). Fine needle aspiration cytology (FNAC) of the lump under ultra-sound guidance was undertaken.

Fine needle aspiration cytology smears revealed 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. It also showed 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 figure 7). The aforementioned features were adjudged to be consistent with a diagnosis of squamous cell carcinoma.

Kalayci et al. [15] reported a 60-year-old man who had lost 10 kilograms over twenty days. He was asymptomatic otherwise. He did not have any significant past medical history. 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 which measured about 4.9 cm x 5.1 cm in size with lobulated contour and which had extended to the upper pole of the right kidney and absence of corticomedullary distinction (see figure 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 stage III (pT3N0M0). T1-weighted imaging had shown a contoured homogeneous isointense mass within the upper pole of the right kidney which had invaded the renal sinus. On T-2 weighted 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 figure 8c – 8e). He subsequently underwent right radical nephrectomy.

Macroscopic examination of the right radical nephrectomy showed an enlarged kidney which on cut section was found to contain multiple yellow-brown colored staghorn calculi. An irregular gray-white solid tumor 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 figures 9a and 9b). Serial sections of the tumour had revealed a haemorrhagic area 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 lymphovascular structures. A lot of necrosis was evident in the tumour mass (see figures 10a, 10b, and 10c). Kalayci et al. [15] stated the following:

- 464 • A pathological diagnosis of squamous cell carcinoma of renal pelvis

465 which had extensively infiltrated the renal parenchyma and perinephric

466 fat was made.
- 467 • Some authors [16] [17] had intimated that majority of squamous cell

468 carcinomas of the renal pelvis tend to be moderately or poorly

469 differentiated and thus the characteristics of squamous cell carcinomas

470 including keratin pearls and intracellular bridges may not be readily

471 apparent and that typically squamous cell carcinomas at the time of

472 initial presentation and diagnosis on the whole tend to be more

473 invasive in comparison with transitional cell carcinomas at diagnosis.
- 474 • Primary SCCP of the renal pelvis is rare and accounts for 0.5% to

475 0.8% of malignant kidney tumours.
- 476 • On the whole these tumours are highly aggressive in nature and tend to

477 manifest at an advanced stage at the time of initial diagnosis and tend

478 to be associated with poor prognosis in comparison with other upper

479 urinary tract malignancies. [18]
- 480 • Chronic irritation, inflammation, and infection induce squamous

481 metaplasia of the collecting system of the kidney, which could develop

482 into dysplasia and carcinoma in some patients. Whether the

483 development of dysplasia is related to the presence of the calculus

484 which finally emanates in carcinoma or the squamous cell carcinoma is

485 responsible for the causation of calculus had not yet been clarified.

486 [19]
- 487 • With regard to radiological characteristics of SCC of renal pelvis and

488 kidney, the lesion may look like a solid mass, with evidence of

489 hydronephrosis, calcifications, or it may look like an infiltrative lesion

490 in the renal pelvis without any evidence of a distinct mass.
- 491 • The differential diagnoses of SSC of renal pelvis and kidney based

492 upon the radiological features include primary and metastatic

493 neoplasms of the kidney and xanthogranulomatous pyelonephritis

494 associated with renal stones.
- 495 • Mardi et al. [16] had stated that xanthogranulomatous pyelonephritis

496 tends to be frequently associated with lithiasis; nevertheless, it rarely

497 causes keratinizing squamous metaplasia and because its

498 manifestations simulate neoplasm, it had tended to be misdiagnosed as

499 malignancy.
- 500 • The radiological imaging features of squamous cell carcinoma of renal

501 pelvis tend to be variable and some of the radiological findings include

502 diffuse enlarged non-functioning kidney associated with renal calculi,

503 radiological evidence of peri-renal infiltration, as well as, low-density

504 or echogenicity in the renal parenchyma. Primary squamous cell

505 carcinoma of the kidney cannot be differentiated from

506 xanthogranulomatous pyelonephritis or other types of malignancies of

507 the kidney based upon radiological features. The CT scan and MRI
508 scan findings of a large urothelial carcinoma of the renal pelvis
509 invading the renal parenchyma would tend to mimic that of
510 xanthogranulomatous pyelonephritis.

511 • A number of authors [16] [17] [20] [21] had stated that in view of the
512 non-specific clinical manifestations and non-specific radiological
513 features of squamous cell carcinoma of the kidney, difficulties in the
514 establishment of diagnosis would necessitate reliance on
515 histopathological examination to confirm the diagnosis.

516 Raghavendran et al. [22] reported their case series study to determine the
517 clinic-pathological features of renal pelvis malignancies associated with
518 stones. They retrospectively reviewed 18 cases of malignancies associated
519 with stone disease in the renal pelvis. They had noted 15 cases of squamous
520 cell carcinomas associated with stone disease (high incidence) out of the 18
521 cases. They recommended that a patient with long standing stone and
522 associated poorly functioning kidney or haematuria should have a screening
523 CT scan. Considering the fact that squamous cell carcinoma of renal
524 pelvis/kidney has been reported a long time after successful percutaneous
525 nephrolithotomy even in the absence of a recurrent stone it would be argued
526 that there is the need for patients who have undergone percutaneous
527 nephrolithotomy for a long time with regular periodic / yearly imaging by
528 means of ultra-sound scans of renal tract or MRI scans in order to detect early
529 a possible SCC of renal pelvis/kidney. Considering the fact that squamous cell
530 carcinoma of the renal pelvis/kidney many years after a patient had undergone
531 radiotherapy for a testicular cancer and the involved kidney was in the
532 radiation field of the radiotherapy it is the view of the author that regular CT
533 scans should not be undertaken in cases of long-term follow-up because of
534 potential possible risk of inducing another malignancy from repeated
535 cumulative radiation effect (even though CT would be good for detecting any
536 new malignancy).

537 Lee et al. [17] reported that the following CT features are helpful for the
538 diagnosis of squamous cell carcinoma the kidney presence of enhancing extra-
539 luminal and exophytic mass in some of the cases associated with intraluminal
540 component. Lee et al. [17] recommended that considering the fact that it was
541 not practical for every patient with renal stone to have a CT scan, intravenous
542 urography (IVU) should be undertaken periodically, particularly, in patients
543 who have long-standing stones, and they should be assessed for split function
544 for all areas of the renal parenchyma. It had been stated by some authors [17]
545 [18] that the filling defect, the delay in appearance of pyelogram, renal
546 parenchymal thickening in IVU may be suggestive of a renal tumour, despite
547 preservation of renal contour and absence of mass effect. Furthermore,
548 considering the fact that CT scanning is associated with a lot of radiation
549 effect and the fact repeated CT scanning might be associated with a potential
550 risk for the development of other malignancies in the future, perhaps ultra-
551 sound scan of the renal tract and MRI scan which are not associated radiation
552 effect should be regarded as good radiological imaging alternatives to CT
553 scan.

Ghosh and Saha [23] in 2014, [23] reported a 51-year-old man who presented with a history of 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 figure 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 figure 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 figures 12a, 12b, and 12c). There was evidence chronic inflammatory reaction in the surrounding areas. The tumour was staged T1bN0M0 based upon the fact that there was no tumour involvement of the renal vein, perinephric fat and Gerota's fascia. 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 figure 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

600 controversies with different results in previous studies. The
601 disagreement may partly be because of the relative rarity of the upper
602 urinary tract. [25]

603 • If an identifiable urothelial dysplastic element is found including
604 urothelial carcinoma in situ (cis) then the tumour should be classified
605 as primary urothelial carcinoma with squamous differentiation.
606 Nevertheless, the conspicuous presence of keratinizing squamous
607 metaplasia of the adjacent flattened urothelium, particularly if
608 associated with dysplasia would be in support of primary squamous
609 cell carcinoma of the renal pelvis which is rare. [26] [27]

610 • In their case there was no evidence of dysplastic urothelial component
611 or metaplastic and/or dysplastic squamous lining of urothelium.

612 • The leading aetiological factors for the development of squamous cell
613 carcinoma of the renal pelvis include recurrent urinary tract infections
614 without or with vesicoureteric reflux, long-standing staghorn calculi,
615 smoking, schistosomiasis, endogenous and exogenous chemicals,
616 vitamin A deficiency, hormonal imbalance and others. Only anecdotal
617 cases of squamous cell carcinoma of renal pelvis had been reported
618 where no apparent aetiological factors had been identified. [5] [25]
619 Their case lacked the association of the carcinoma with any
620 predisposing factors.

621 • Primary squamous carcinoma of the kidney should be differentiated
622 from metastatic squamous cell carcinoma with the primary tumour
623 elsewhere by means of a combination of clinical history, imaging
624 studies, and histopathology. [21] [25]

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

629 **Summary**

630 Primary squamous cell carcinomas of the kidney / renal pelvis are rare tumors
631 that are reported sporadically. Majority of reported cases of these carcinomas
632 involve the renal pelvis and invade the kidney. Only two cases of primary
633 squamous cell carcinoma involving the renal parenchyma but not involving
634 the renal pelvis have been reported. Primary renal cell carcinomas of renal
635 pelvis / kidney tend to be diagnosed in advanced stages of the disease and and
636 on the whole associated with a poorer prognosis in comparison transitional
637 cell carcinomas of the renal pelvis with a 5-year-survival of less than 10% [16]
638 [21] and a mean survival of 7 months. Nevertheless, the mean survival of
639 patients with squamous cell carcinoma of the kidney/renal pelvis when
640 compared with transitional cell carcinomas of the renal pelvis of the same
641 stage would appear to be similar. A number of cases of primary squamous cell
642 carcinomas of the renal pelvis / kidney have been associated with calculi and
643 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 (MRI scans at yearly intervals) may be diagnosis of squamous cell carcinoma would be made when the tumour is less advanced which would enable early curative surgical treatment as an attempt to improve the prognosis. Repeated CT scans would not be recommended in view of the possibility that cumulative radiation could be a risk for the development of a new cancer.

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 a history of chronic renal calculi or previous treatment for renal calculi.

References

- [1] Bhandari A, Alassi O, Rogers C, Mac Lennan G T Squamous cell carcinoma of the renal pelvis. J Urol. 2010 May; 183(5): 2023 – 2024 doi: 10.1016/j.juro.2010.02.2370 Epub 2010 Mar 19
- [2] Holmäng S, Lele S M, Johansson S L. Squamous cell carcinoma of the renal pelvis and ureter: Incidence, symptoms, treatment and outcome. J Urol. 2007 Jul; 178(1): 51 – 56. Epub 2007 May 11
- [3] Williamson S. Kidney tumor – adult malignancies Adult renal cell carcinoma Squamous cell carcinoma of kidney Pathology Outlines.com 2012 Jun 29; www.pathologyoutlines.com/topic/kidneytumormalignantsquamous.html
- [4] Vella R, Manini C, Piccoli F, Revelli G. Description of a squamous cell carcinoma of the renal pelvis. Minerva Urol. Nefrol 1995 Mar; 47(1): 43 -47
- [5] Talwar N, Dargan P, Arora M P, Sharma A, Sen A K. Primary squamous cell carcinoma of the renal pelvis masquerading as pyonephrosis: a case report. Indian J Pathol Microbiol 2006 Jul; 49(3): 418 - 420

- 687 [6] Kayaselçuk F, Bal N, Guvel S, Egilmez T, Kilinc F, Tuncer I.
688 Carcinosarcoma and squamous cell carcinoma of the renal pelvis associated
689 with nephrolithiasis: a case report of each tumor type. *Pathol Res Pract* 2003;
690 199(7): 489 – 492
691
- 692 [7] Ito H, Oishi M, Murase T. A case of squamous cell of the renal pelvis
693 originating from a functional solitary kidney associated with renal stones.
694 *Hinyokika Kiyo* 1988 Dec; 24(12): 2171 - 2174
- 695 [8] Paonessa J, Beck H, Cook S. Squamous cell carcinoma of renal pelvis
696 associated with kidney stones: a case report. *Med Oncol* 2011 Dec; 28 Sypl
697 1: S312 – 314. Doi: 10.10007/s12032-010-9704—z. Epub 2010 Oct 9
- 698 [9] Mikuriya H, Ueda M, Higashi Y, Kiyota H, Kobari T, Igarashi H, Ooishi
699 H, Machida T. A case of squamous cell carcinoma of renal pelvis
700 accompanying an ectopic opening with vesicoureteral reflux of complete
701 duplication of uretero-pelvis *Hinyokika Kiyo* 1989 May; 35(5): 847 - 850
- 702 [10] Sivaramakrishna et al. B, Aron M, Ansari M S, Seth A, Goel R,
703 Mundada O P, Balchander Squamous cell carcinoma of the renal pelvis
704 manifesting after percutaneous nephrolithotomy for long standing calculus. *Int*
705 *Urol. Nephrol* 2004; 36(2): 149 – 151
706
- 707 [11] Imbriaco M, Iodice D, Erra P, Terlizza A, Di Carlo R, Di Vito C,
708 Imbimbo C. Squamous cell carcinoma within a horse shoe kidney with
709 associated renal stones detected by computed tomography and magnetic
710 resonance imaging. *Urology* 2011 Jul; 78(1): 64 – 55 doi:
711 10.1016/j.urology.2010.06.006. Epub 2010 Aug 30
- 712 [12] O'Daly B J, O'Brien M F, Dowling C M, Crotty T B, Watson A J,
713 Moriarty M J, Mulvin D W. Squamous cell carcinoma of the renal pelvis after
714 curative retroperitoneal radiotherapy for seminoma. *Urology* 2007 Oct; 70(4):
715 812: e3 –e6
- 716 [13] Fúnez R, Pereda T, Rodrigo I, Robles L, Gonzalez C. Simultaneous
717 Chromophobe renal cell carcinoma and squamous renal cell carcinoma.
718 *Diagnostic Pathology* 2007; 2:30 doi: 10.1186/1746-1596-2-30. URL:
719 <http://www.diagnosticpathology.org/content/2/1/30>
- 720 [14] Bindra R, Gupta S, Gupta N. Cytological diagnosis of squamous cell
721 carcinoma of renal pelvis *J. Cytol* 2010 Apr; 27(2): 76 – 77. Doi:
722 10.4103/0970-9371.70756
- 723 [15] Kalayci O T, Bozdag Z, Sonmezgoz F, Sahin N. Squamous Cell
724 Carcinoma of Renal Pelvis Associated with Kidney Stones: Radiologic
725 Imaging Features with Gross and Histopathological Correlation. *J Clin*
726 *Imaging Sci.* 2013; 3:14 doi: 10.4103/2156-7514.109741
- 727 [16] Mardi K, Kaushal V, Sharma V. Rare coexistence of keratinizing
728 squamous cell carcinoma with xanthogranulomatous pyelonephritis in the

- 729 same kidney: Report of two cases J Cancer Res Ther. 2010 Jul - Sep; 6(3): 399
730 – 341 doi: 10.4103/0973-1482.73351
- 731 [17] Lee T Y, Ko S F, Wan Y L, Cheng Y F, Yang B Y, Huang D L, Hsieh H
732 H, Yu T J, Chen W J. Renal squamous cell carcinoma: CT findings and
733 clinical significance. Abdom Imaging 1988 Mar - Apr; 23(2): 203 – 208
- 734 [18] Jain A, Mittal D, Jindal A, Solanki R, Khatri S, Parikh A, Yadav K.
735 Incidentally detected squamous cell carcinoma of renal pelvis in patients with
736 staghorn calculi: Case series with review of the literature. ISRN Oncol 2011;
737 2011: 620574 doi: 10.5402/2011/620574. Epub 2011 Apr 26]
- 738 [19] Li M K, Cheung W L. Squamous cell carcinoma of the renal pelvis. J
739 Urol. 1987 Aug; 138(2): 269 - 271] [2] [Holmäng S, Lele S M, Johansson S L.
740 Squamous cell carcinoma of of the renal pelvis and ureter: Incidence,
741 symptoms, treatment and outcome. J Urol. 2007 Jul; 178(1): 51 – 56. Epub
742 2007 May 11
- 743 [20] Karabulut A, Emir L, Gonultas M, Incel N, Germiyanoglu C, Erol D.
744 Turk J Cancer. 2002; 32: 20 - 24] [Mardi K, Kaushal V, Sharma V. Rare
745 coexistence of keratinizing squamous cell carcinoma with
746 xanthogranulomatous pyelonephritis in the same kidney: Report of two cases.
747 J Cancer Res Ther 2010 Jul - Sep; 6(3): 339 – 341 doi: 10.4103/0973-
748 1482.73351
- 749 [21] Bhaijee F. Squamous cell carcinoma of the renal pelvis Ann Diagn Pathol
750 2012 Apr; 16(2): 124 – 127 doi: 10.1016/j.anndiagpath.2011.08.009. Epub
751 2011 Dec 20
- 752 [22] Raghavendran M, Rastogi A, Dubey D, Chaudhary H, Kumar A,
753 Srivastava A, Mandhani A, Krishnani N, Kapoor R. Stones associated with
754 renal pelvic malignancies. Indian J Cancer. 2003 Jul-Sep; 40(3): 108 - 112
- 755 [23] Ghosh P, Saha K. Primary Intraparenchymal Squamous Cell Carcinoma
756 of the Kidney: A Rare and Unique Entity. Case Reports in Pathology Volume
757 2014 (2014), Article ID 256813, 3 pages
758 <http://dx.doi.org/10.1155/2014/256813>
- 759 [24] Bandyopadhyay R, Biswas S, Nag D, Ghosh A K. Squamous cell
760 carcinoma of the renal pelvis presenting as hydronephrosis, Journal of Cancer
761 Research and Therapeutics 2010; 6(4): 537 - 539
- 762 [25] Bonsib S M, Cheng L. Renal pelvis and ureter. In Urologic Surgical
763 Pathology, Cheng L and Bostwick D G, Eds, pp 173 – 193, Mosby / Elsevier,
764 Philadelphia, Pa, USA, 2nd edition 2008
- 765 [26] Lopez-Beltran A, Montironi R, Vidal-Jimenez A, Cheng L. Pathology of
766 tumors of the urinary bladder, In Clinical Pathology of Urologic Tumors,
767 Mikuz G, Ed., 57 – 89 Informa Healthcare, Boca Raton, Fla, USA, 2007

768 [27] MacLennan G T, Cheng L. Renal pelvis and ureter, In Atlas of
 769 Genitourinary Pathology, MacLennan G T, Cheng L, Eds., pp123 – 140,
 770 Springer New York, NY, USA, 2011

771 [28] Kulshreshtha P, Kannan N, Bhardwaj R. Primary squamous cell of the
 772 renal parenchyma Indian Journal of Pathology and Microbiology 2012; 55(3):
 773 370 - 371

774 Figure 1: Macroscopical aspect of the neoplasm. Squamous cell carcinoma
 775 (sq) and Chromophobe renal cell carcinoma (chr). Reproduced from: [13]
 776 Fúnez R, Pereda T, Rodrigo I, Robles L, Gonzalez C. Simultaneous
 777 Chromophobe renal cell carcinoma and squamous renal cell carcinoma.
 778 Diagnostic Pathology 2007; 2:30 doi: 10.1186/1746-1596-2-30. URL:
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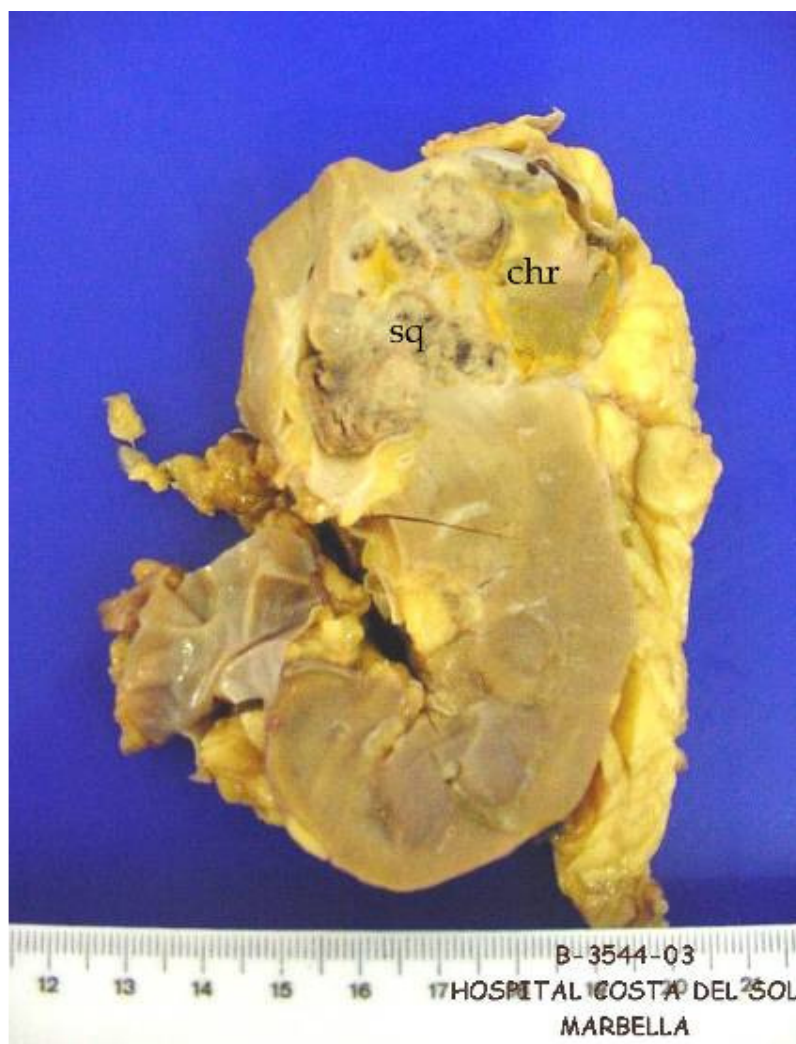


Figure 2

Areas with typical chromophobe renal cell carcinoma HE x 200.

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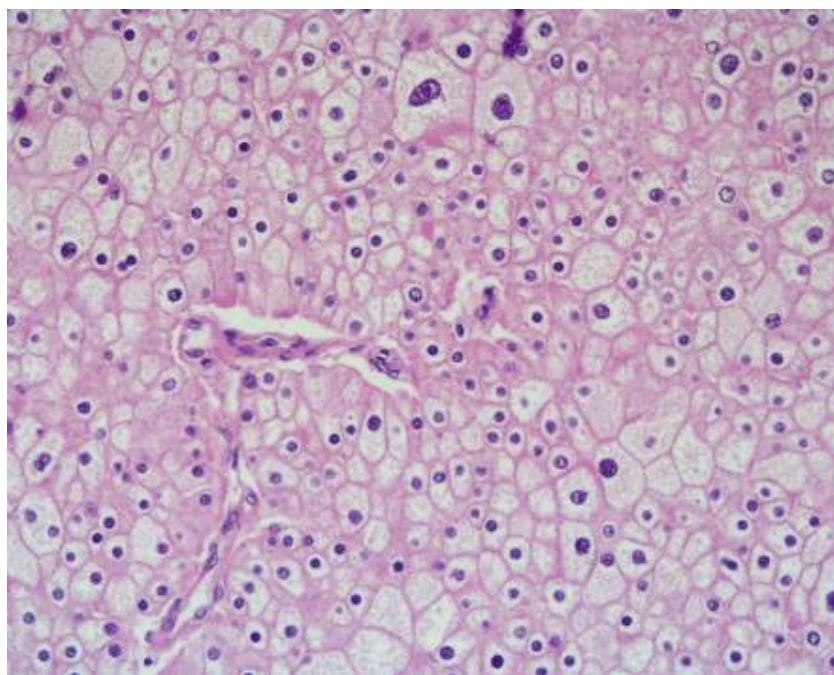
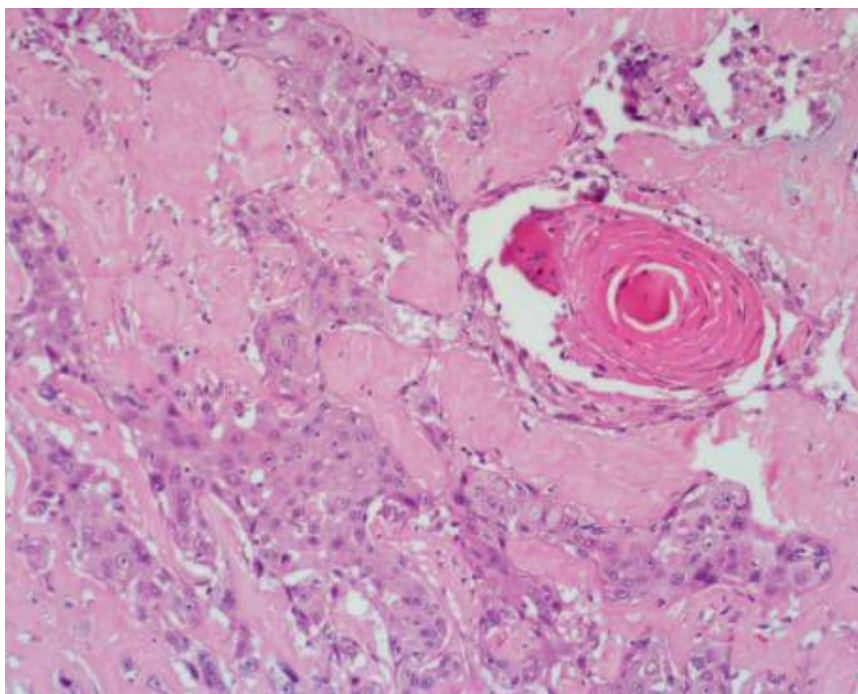


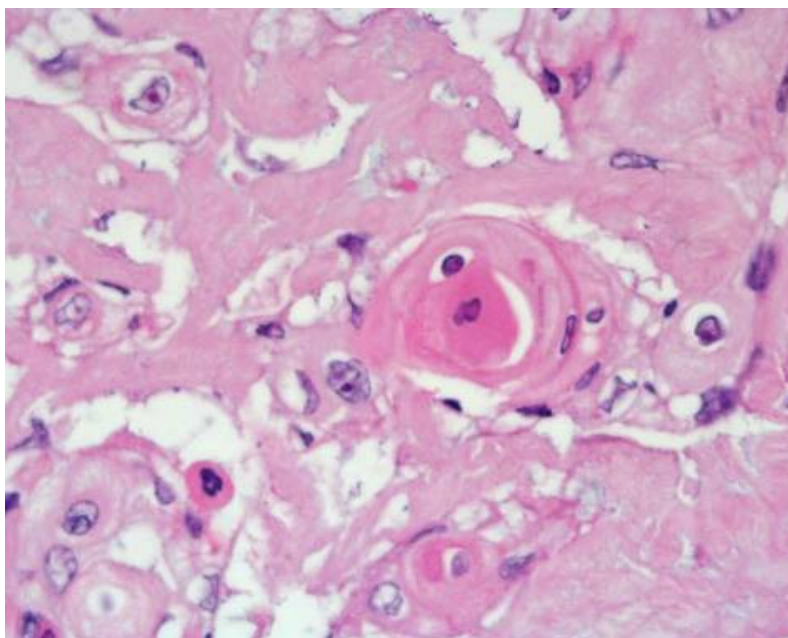
Figure 3: Zone with squamous cell carcinoma HE x 200. Reproduced from:

[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.diagnosticpathology.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.



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814 Figure 4: Zone with squamous cell carcinoma HE x 400. Reproduced from:
 815 [13] Fúnez R, Pereda T, Rodrigo I, Robles L, Gonzalez C. Simultaneous
 816 Chromophobe renal cell carcinoma and squamous renal cell carcinoma
 817 Diagnostic Pathology 2007; 2:30 doi: 10.1186/1746-1596-2-30. URL:
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824

Figure 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.diagnosticpathology.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.

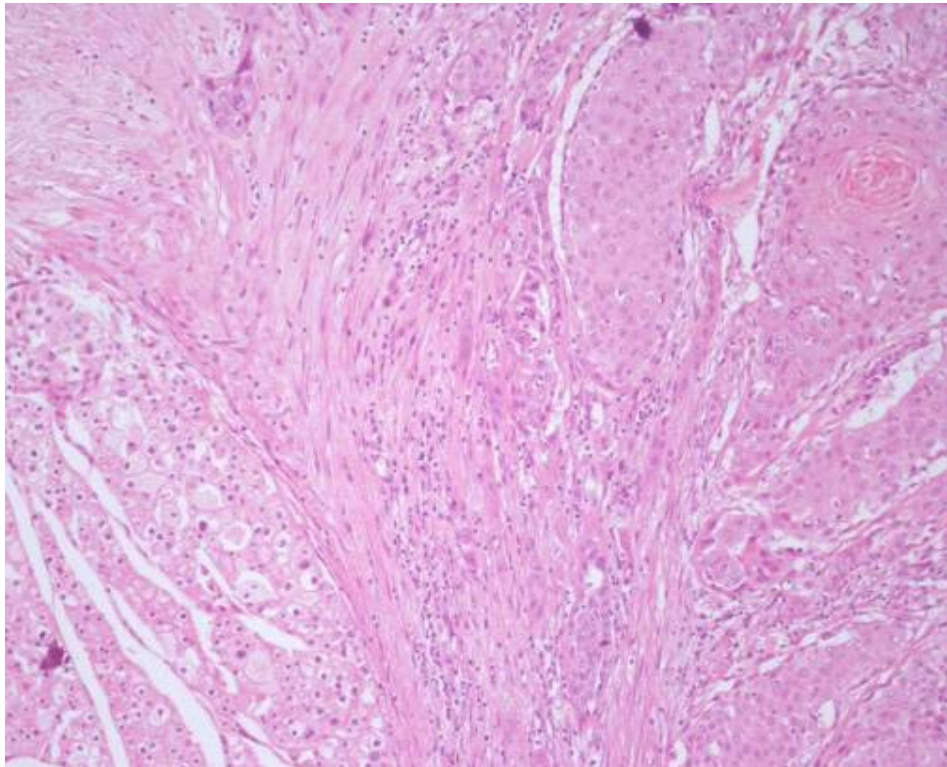
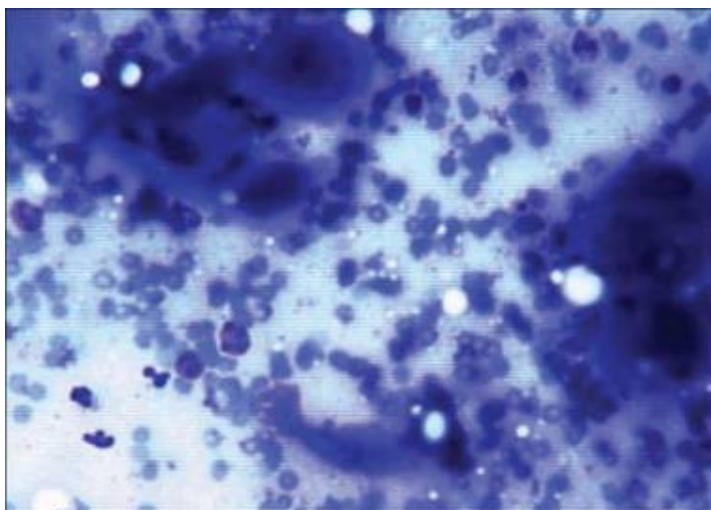


Figure 6: Fine needle aspiration cytology smear shows pleomorphic squamous cells in a hemorrhagic background. (Giemsa stain, x 400) Reproduced from: [14] Bindra R, Gupta S, Gupta N. Cytological diagnosis of squamous cell carcinoma of renal pelvis J. Cytol 2010 Apr; 27(2): 76 – 77. Doi: 10.4103/0970-9371.70756 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.

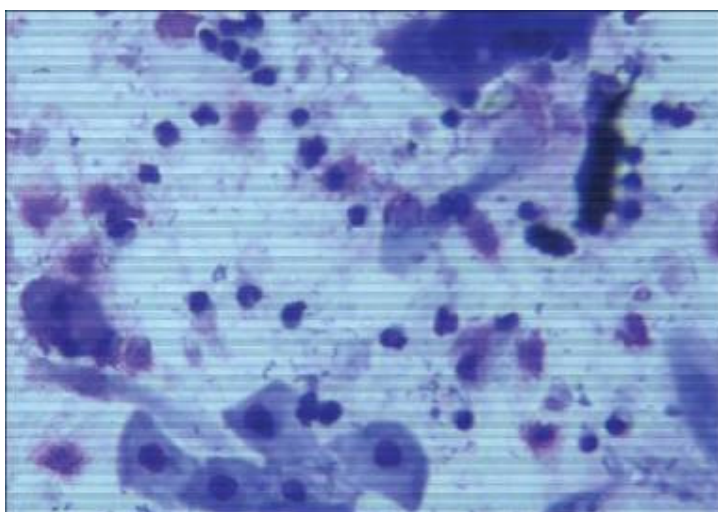


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849 Figure 7

850 Urine smear shows benign urothelial cells and pleomorphic squamous cells
 851 (Giemsa stain, x 400). Fine needle aspiration cytology smear shows
 852 pleomorphic squamous cells in a hemorrhagic background. (Giemsa stain, x
 853 400) Reproduced from: [14] Bindra R, Gupta S, Gupta N. Cytological
 854 diagnosis of squamous cell carcinoma of renal pelvis J. Cytol 2010 Apr; 27(2):
 855 76 – 77. Squamous cell carcinoma of renal pelvis J. Cytol 2010 Apr; 27(2): 76
 856 – 77. Doi: 10.4103/0970-9371.70756 Copyright © Journal of Cytology. This
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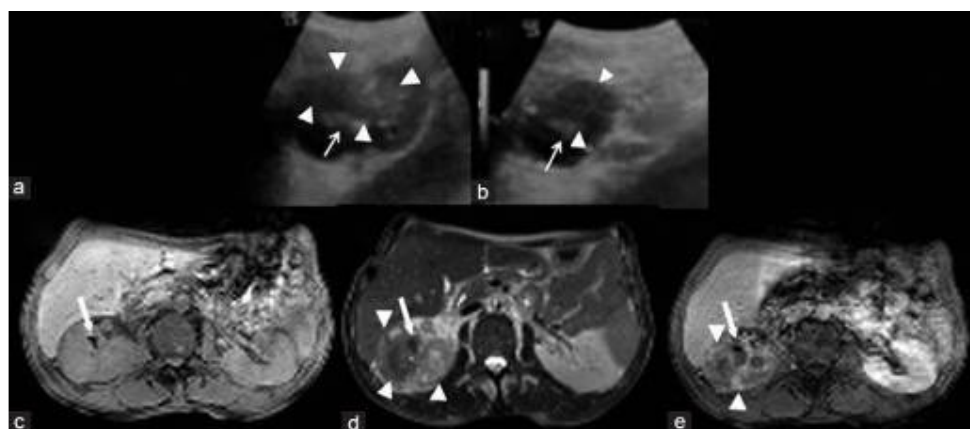
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863 Figures 8a; 8b; 8c; 8d; 8e:

(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 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.



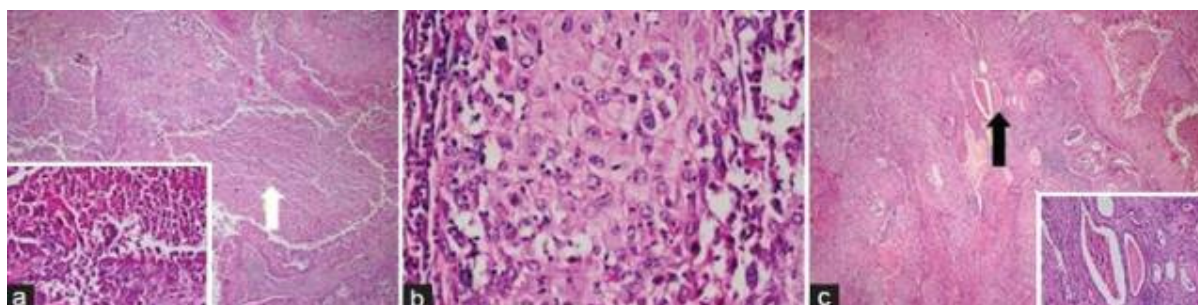
Figures 9a and 9b

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.



Figures 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, Bozdog 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.



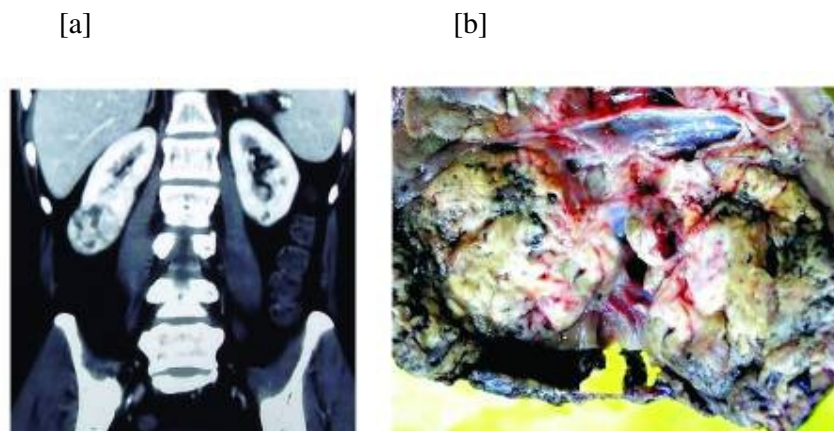
Figures 11a and 11b:

(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.

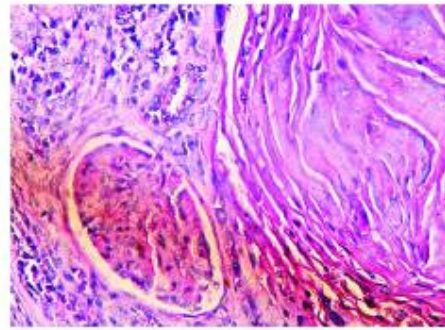
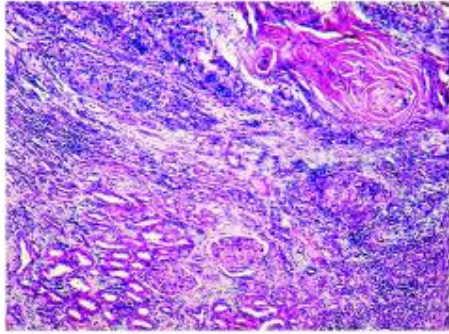
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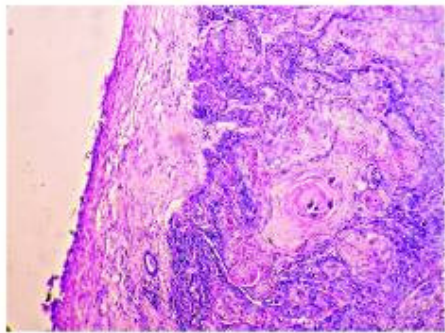
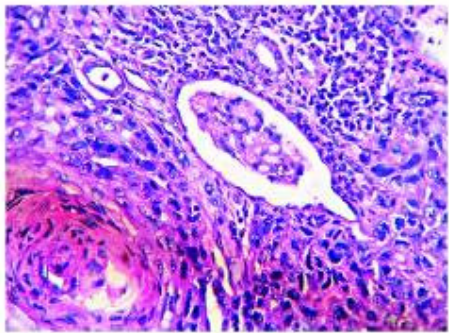


Figures 12a, 12b, and 12c:

- (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: 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.



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[c]

[d]

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