

Research Article

Clinical Outcomes and Safety of Pembrolizumab Monotherapy in Iraqi Patients with Metastatic Lung Cancer and Renal Cell Carcinoma

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Abstract

Pembrolizumab, an anti-programmed cell death protein 1 (PD-1) immune checkpoint inhibitor, has demonstrated efficacy across various malignancies, including non-small cell lung cancer (NSCLC) and renal cell carcinoma (RCC). However, real-world treatment responses and toxicity profiles remain insufficiently characterised in Iraqi populations. This study aimed to evaluate the clinical response and safety outcomes of pembrolizumab in patients with metastatic lung cancer and RCC. A retrospective observational study was conducted involving 100 patients, comprising 50 with lung cancer and 50 with RCC, who received pembrolizumab. Demographic characteristics, disease features, treatment timelines, radiological responses at 3, 6, and 9 months, and immune-related adverse events (irAEs) were recorded. Treatment responses were assessed according to the Response Evaluation Criteria in Solid Tumours (RECIST), and toxicity was graded using the Common Terminology Criteria for Adverse Events (CTCAE). Among patients with lung cancer, the mean age was 58.6 ± 13.9 years, 72% were male, and 68% were non-smokers. Patients with RCC had a mean age of 55.6 ± 13.3 years and showed similar demographic characteristics. All patients in both groups had metastatic disease. In the lung cancer group, the reported partial response (PR) rate increased from 2% at 3 months to 52.3% at 9 months, while the complete response (CR) rate reached 14.2% at 9 months. Patients with RCC demonstrated earlier responses, with the PR rate increasing from 18% at 3 months to 53.3% at 6 months, while the CR rate reached 20% at 9 months. Treatment-related toxicities were reported in 25 patients with lung cancer and 9 patients with RCC. Common irAEs included diarrhoea, hypothyroidism, rash, and pneumonitis, while Grade III toxicities were uncommon. Overall, pembrolizumab demonstrated clinical activity in both patient groups, with the reported responses suggesting earlier tumour regression in the RCC group. The observed toxicities were consistent with recognised immune-related adverse event profiles. However, further investigation is required to confirm these findings and assess their generalisability to routine clinical practice in Iraq.

Keywords: Pembrolizumab; Lung Cancer; Renal Cell Carcinoma; Immunotherapy; Immune-Related Adverse Events

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Introduction

The treatment of advanced lung cancer and renal cell carcinoma (RCC) continues to present difficulties, not least because many patients have disseminated disease when systemic therapy begins. Lung cancer contributes substantially to cancer mortality worldwide, whereas RCC represents a smaller but clinically important group of adult cancers with distinctive tumour biology (Herbst et al., 2018; Motzer et al., 2020; Sung et al., 2021; Bray et al., 2021; Capitanio & Montorsi, 2016; Torre et al., 2016). Over the past decade, immunotherapy has broadened treatment options for both diseases. In particular, immune checkpoint blockade can produce responses that persist in some patients with metastatic disease (Borghaei et al., 2015; Mok et al., 2019; Reck et al., 2016).

Pembrolizumab binds programmed cell death protein 1 (PD-1), thereby interfering with inhibitory signalling that can restrain antitumour T-cell activity. Evidence supporting its use in non-small cell lung cancer (NSCLC) includes the KEYNOTE-010, KEYNOTE-024, and KEYNOTE-042 programmes, in which clinical benefit was reported in appropriately selected populations, including those defined by PD-L1 expression (Herbst et al., 2016; Reck et al., 2016; Mok et al., 2019). Immune-based approaches have also demonstrated activity in RCC. However, it is important to distinguish evidence from pembrolizumab monotherapy studies, such as KEYNOTE-427, from trials evaluating different checkpoint inhibitors or combination regimens (Donskov et al., 2018; Motzer et al., 2015; Rini et al., 2019; Choueiri et al., 2021).

Published trials provide essential efficacy and safety estimates, but their populations and care pathways may not fully reflect treatment delivery in Iraq. Local data remain relatively limited, even though exposure histories, access to oncology services, diagnostic pathways, and patterns of follow-up may differ from those in international trials (Alwan et al., 2022; Cancer Country Profile 2020, 2020; Torre et al., 2016). Lung tumours and RCC also differ biologically, potentially affecting the behaviour of immune-mediated treatment responses. Features including antigenicity, PD-L1 expression, and the immune microenvironment may influence outcomes, although their effects cannot be inferred in a cohort without relevant molecular testing (McGranahan et al., 2016; Reck et al., 2016; Yarchoan et al., 2017).

Beyond tumour response, the practical value of PD-1 inhibition depends on recognising and managing toxicity. Immune-mediated complications may involve the skin, gastrointestinal tract, endocrine organs, lungs, or kidneys; their severity varies considerably between individuals (Motzer et al., 2015; Postow et al., 2018; Weber et al., 2015). Monitoring and timely clinical

intervention are consequently central to safe treatment delivery (Haanen et al., 2022; Schneider et al., 2021). Information on these events in local practice can complement efficacy data when evaluating treatment services.

Against this background, we examined documented imaging responses and adverse events after pembrolizumab monotherapy in two Iraqi cohorts with metastatic lung cancer or RCC. The comparison was intended to describe patterns observed in routine care rather than to establish that cancer type itself caused differences in treatment outcomes.

Methods

Study Design And Setting

This retrospective observational study was conducted at a tertiary oncology centre in Iraq. Medical records of patients treated between January 2021 and December 2024 were reviewed. The study included adult patients with metastatic lung cancer or renal cell carcinoma (RCC) who received pembrolizumab monotherapy in routine clinical practice. A retrospective observational design was selected to evaluate real-world treatment response and safety outcomes outside the constraints of controlled clinical trials.

Study Population

The analysis covered 100 eligible individuals: 50 diagnosed with metastatic lung cancer and 50 with metastatic RCC. Pembrolizumab had been administered in accordance with the dosing schedules used in clinical practice and referenced treatment guidance (Mok et al., 2019; Rini et al., 2019). Inclusion in the evaluated sample required documentation of at least one imaging assessment after starting therapy.

Eligibility Criteria

Eligibility was restricted to adults aged 18 years or above with histological confirmation of metastatic lung cancer or RCC, a record of pembrolizumab monotherapy, and imaging results available at one or more of the month-3, month-6, or month-9 assessment windows. We did not include records indicating previous exposure to PD-1- or PD-L1-directed checkpoint therapy, insufficient clinical or imaging documentation, active autoimmune disease requiring systemic immunosuppression, or participation in a concurrent interventional trial.

Data Collection And Variables

Information was abstracted from the available paper and electronic charts. Baseline fields comprised age, sex, smoking history, tumour category, and metastatic status. We also documented the elapsed time between diagnosis and commencement of pembrolizumab.

Tumour response was classified from radiology records according to RECIST version 1.1. Outcomes were tabulated for assessments occurring approximately 3, 6, and 9 months after the start of treatment. These intervals allowed responses documented at different stages of follow-up to be described. As the dataset was retrospective, analyses used the assessments available at each interval.

Recorded on-treatment adverse events were classified by type and severity using CTCAE version 5.0, with emphasis on events considered potentially immune related.

Statistical Analysis

Analyses were conducted in SPSS (version 26). Continuous variables were described using suitable measures of central tendency and dispersion, including means with standard deviations or medians with ranges. Counts and percentages summarised categorical information. For each cancer cohort and available imaging time point, we reported complete response (CR), partial response (PR), stable disease (SD), and progressive disease (PD).

Between-cohort comparisons at individual assessments used the chi-square test or Fisher's exact test, as indicated by cell frequencies. The original analysis also specified Cochran's Q test for temporal changes in response. Statistical significance was defined as a two-sided p value below 0.05. Missing outcomes were not imputed; reported percentages therefore refer to the cases evaluable at the relevant time point. The appropriateness of repeated-measures testing should be checked against patient-level follow-up and attrition.

Results

Overall Summary of Findings

The review comprised equal-sized cohorts of metastatic lung cancer and RCC (50 patients each). Baseline demographic and treatment-timing variables, imaging-based response at three assessment windows, and recorded treatment toxicities were examined. Although every patient had metastatic disease at entry, timing of treatment initiation differed between the groups. Later imaging summaries were based on fewer patients than the initial assessments, an important consideration when interpreting changes in response proportions.

Demographic Characteristics of Lung Cancer Patients

Patients with lung cancer had a mean age of 58.6 ± 13.9 years; 36 (72%) were men and 14 (28%) women. Sixteen patients (32%) were recorded as smokers. None of these baseline distributions differed significantly from those of the RCC cohort (age $p = 0.24$; sex $p = 0.65$; smoking $p = 1.00$). Table 1 provides the corresponding cohort-level values.

Demographic Characteristics of RCC Patients

Within the RCC group, mean age was 55.6 ± 13.3 years (median 60 years). There were 34 men (68%) and 16 women (32%), and 16 individuals (32%) had a smoking history. These distributions were comparable with those of the lung cancer group, as detailed in Table 1.

Table 1. Demographic Characteristics of Lung Cancer and RCC Patients (N = 100)

Variable	Lung Cancer (N = 50)	RCC (N = 50)	p-value
Age (years)			
Mean $\pm$ SD	58.6 ± 13.9	55.6 ± 13.3	0.24
Median (Range)	60 (26–81)	60 (23–74)	—
Sex			
Female	14 (28%)	16 (32%)	0.65
Male	36 (72%)	34 (68%)	—
Smoking status			
Smoker	16 (32%)	16 (32%)	1.00
Non-smoker	34 (68%)	34 (68%)	—

Disease Characteristics among Lung Cancer Patients

Metastatic disease was present in all 50 lung cancer cases. The reported mean interval from diagnosis to pembrolizumab initiation was 6.5 ± 4.1 months, compared with 3.1 ± 4.1 months for RCC ($p < 0.001$). A delay or postponement at treatment initiation was documented for seven lung cancer patients (14%),

versus one RCC patient (2%; $p = 0.03$). The measures are displayed in Table 2.

Disease Characteristics among RCC Patients

All 50 RCC patients were metastatic at baseline. The time between diagnosis and initiation of pembrolizumab had a median of 1 month and a mean of 3.1 ± 4.1 months; both values are presented alongside those for lung cancer in Table 2. Only one RCC patient (2%) had a documented initial postponement.

Table 2. Disease Characteristics of Lung Cancer and RCC Patients

Variable	Lung Cancer (N = 50)	RCC (N = 50)	p-value
Metastatic disease at baseline	50 (100%)	50 (100%)	—
Time from diagnosis to pembrolizumab (months)			
Mean ± SD	6.5 ± 4.1	3.1 ± 4.1	<0.001
Median	6.5	1	—
Initial delay/postponement of therapy			
Yes	7 (14%)	1 (2%)	0.03
No	43 (86%)	49 (98%)	—

Treatment Response among Lung Cancer Patients

Among 50 lung cancer patients assessed at month 3, the response categories comprised one PR (2%), 45 SD (90%), and four PD (8%), with no CR. At month 6, 39 patients were evaluable: 12 had PR (30.7%), 22 SD (56.4%), and five PD (12.8%). By month 9, the evaluable sample had decreased to 21, of whom three

had CR (14.2%), 11 PR (52.3%), five SD (23.8%), and two PD (9.5%). The source analysis reported $p < 0.01$ for changes in PR proportions and for the temporal response comparison. Because different numbers of patients contributed at each assessment, these percentages should not be interpreted as an unqualified within-patient improvement. Detailed counts appear in Table 3.

Table 3. Treatment Response to Pembrolizumab in Lung Cancer and RCC

Response	Lung Ca (%)	RCC (%)	p-value
At 3 months			
CR	0	0	—
PR	1 (2%)	9 (18%)	0.008
SD	45 (90%)	36 (72%)	0.02
PD	4 (8%)	5 (10%)	0.72
Overall Response Rate (CR+PR)	2%	18%	0.008
At 6 months			
CR	0	3 (10%)	0.04
PR	12 (30.7%)	16 (53.3%)	0.02
SD	22 (56.4%)	9 (30%)	0.01
PD	5 (12.8%)	2 (6.6%)	0.39
Overall Response Rate (CR+PR)	30.7%	63.3%	0.002
At 9 months			
CR	3 (14.2%)	2 (20%)	0.63
PR	11 (52.3%)	5 (50%)	0.88
SD	5 (23.8%)	3 (30%)	0.69
PD	2 (9.5%)	0	0.29
Overall Response Rate (CR+PR)	66.5%	70%	0.78

Treatment Response among RCC Patients

At the first imaging interval, nine of the 50 RCC patients had PR (18%), 36 had SD (72%), and five had PD (10%); no CR was recorded. Thirty patients contributed data at month 6, including three with CR (10%), 16 with PR (53.3%), nine with SD (30%), and two with PD (6.6%). Only 10 patients were assessed at month 9: two had CR (20%), five PR (50%), three SD (30%), and none PD. The reported objective response proportions (CR plus PR) were 18%, 63.3%, and 70% at the respective intervals. The original analysis indicated $p < 0.01$ for changes over time. Its between-cohort comparisons are reproduced in Table 3, but the small and changing follow-up samples limit how firmly later differences can be interpreted.

Adverse Events among Lung Cancer Patients

The lung cancer cohort was reported to have 25 adverse events. In the summary provided, diarrhoea represented 16%, pneumonitis and hypothyroidism

12% each, and rash 8%. Five Grade III events (20% of the stated total) were reported, including pulmonary, endocrine, and thromboembolic complications. The authors reported a higher overall event count for lung cancer than RCC ($p = 0.01$), while the comparison of Grade III events was not statistically significant. Table 4 reproduces the reported categories and frequencies; event-level counts should be reconciled with the stated total before publication.

Adverse Events among RCC Patients

The RCC cohort had nine reported adverse events. Hypothyroidism accounted for five (55.5%) of the stated total; individual cases of rash, renal impairment, diarrhoea, and pneumonitis were also listed. One Grade III pneumonitis event was recorded, and the between-cohort severity comparison was not statistically significant. The categories in Table 4 need verification against the source records because their displayed counts do not align perfectly with the reported total.

Table 4. Immune-Related Adverse Events (irAEs) in Lung Cancer and RCC

Adverse Event	Lung Cancer (N=25)	RCC (N=9)	p-value
Pneumonitis	3 (12%)	1 (11.1%)	0.94
Diarrhea	4 (16%)	1 (11.1%)	0.71
Rash	2 (8%)	1 (11.1%)	0.74
Hypothyroidism	3 (12%)	5 (55.5%)	0.002
Renal impairment	0	1 (11.1%)	0.02
Hematologic toxicities (anemia/neutropenia)	3 (12%)	0	0.22
Thromboembolic events (DVT/PE)	2 (8%)	0	0.34
Total irAEs	25	9	0.01
Grade III events	5 (20%)	1 (11.1%)	0.28

Discussion

This retrospective comparison documents the experience of an Iraqi oncology centre treating metastatic lung cancer and RCC with pembrolizumab monotherapy. An important descriptive finding is that radiological response proportions differed at the early assessment, while both cohorts had patients whose later scans met criteria for partial or complete response. These observations should be understood in the context of substantial loss of evaluable follow-up data and the absence of adjustment for disease-specific prognostic factors.

At month 3, most lung cancer patients had stable disease rather than tumour shrinkage sufficient for a RECIST response. Higher response proportions were subsequently reported among those with scans at months 6 and 9. Checkpoint blockade can produce response trajectories that differ from those seen with cytotoxic treatment, and prior NSCLC studies provide relevant context for this observation (Borghaei et al., 2015; Gandhi et al., 2018; Herbst et al., 2016; McGranahan et al., 2016; Mok et al., 2019; Reck et al., 2016; Wolchok et al., 2009). Nevertheless, the changing denominators in this cohort mean that an apparent increase in response rate cannot be attributed to continued treatment without longitudinal patient-level analysis. Decisions about treatment continuation must also account for clinical status and unequivocal progression.

A greater proportion of evaluable RCC patients had an objective response at month 3 than did those with lung cancer. Later RCC assessments also documented responses, although only 10 patients remained in the month-9 tabulation. RCC has biological features relevant to immune recognition, and clinical evidence supports the activity of checkpoint-based therapy in this disease (Donskov et al., 2018; Motzer et al., 2015; Rini et al., 2019; Choueiri et al., 2021). Because these references include combination treatment and agents other than pembrolizumab, comparisons with the present monotherapy experience must be made carefully. Neither the molecular drivers of response nor a tumour-type-specific treatment effect can be determined from these data (McGranahan et al., 2016; Yarchoan et al., 2017).

The cohorts also differed in the interval between diagnosis and treatment initiation, with a longer mean interval recorded for lung cancer. This observation may indicate differences in diagnostic or treatment pathways, but it is not possible to determine from the available information whether delayed initiation affected tumour response. Variables such as prior treatment, disease burden, functional status, and access to care would be needed to investigate this possibility. Timely assessment and appropriate treatment planning remain clinically relevant in advanced cancer (Haanen et al., 2022; Mok et al., 2019).

The toxicity summaries suggest a larger reported number of events in the lung cancer cohort, although Grade III events were uncommon in both groups. Pulmonary, gastrointestinal, dermatological, and endocrine complications fall within the established spectrum of toxicities associated with immune checkpoint blockade (Postow et al., 2018; Schneider et al., 2021; Weber et al., 2015). Thyroid dysfunction accounted for a particularly high fraction of the nine events reported for RCC. However, event counts are not necessarily equivalent to numbers of affected patients, and the adverse-event table requires reconciliation before rates or comparisons can be regarded as definitive. The findings therefore support the need for routine toxicity surveillance rather than a firm conclusion that one cancer group is intrinsically more susceptible.

The apparent difference in response between tumour groups was clearest at early follow-up. By month 9, the tabulated overall response proportions were 66.5% for lung cancer and 70% for RCC, with a reported between-group p value of 0.78. Thus, the available data do not establish a consistent difference across all visits. Comparisons are further complicated by differences in the diseases themselves, baseline characteristics, treatment histories, and the marked reduction in the number of participants with later assessments (Choueiri et al., 2021; McGranahan et al., 2016; Yarchoan et al., 2017). Future analyses based on individual-level longitudinal data would be better suited to assessing temporal response and potential predictors.

For oncology services in Iraq, these observations highlight the value of consistent imaging schedules, documentation of why follow-up becomes unavailable,

and systematic recording of immune-related toxicity. Patients with an initially non-progressive scan require individualised clinical assessment rather than decisions driven solely by early response percentages. Thyroid and respiratory monitoring deserve particular attention during treatment. Broader multicentre data would help determine whether the patterns reported here are reproducible in other Iraqi settings.

Strengths And Limitations

A strength of this study is its description of pembrolizumab monotherapy in routine Iraqi oncology care, an area with relatively little locally published evidence. Reporting both imaging outcomes and treatment-related events across two metastatic cancer cohorts provides a useful starting point for future audit and research. The study also includes assessments at more than one follow-up interval, enabling a description of the available response distributions.

Interpretation is limited by the retrospective, single-centre design and by the potential for selection and documentation bias. Follow-up imaging was available for progressively smaller samples, particularly in the RCC group at month 9. Consequently, percentages from different visits do not necessarily reflect changes among the same individuals. Data on factors such as PD-L1 status, tumour mutational burden, treatment line, and other potential confounders were not available for an adjusted comparison. Moreover, the adverse-event summary contains category totals that should be checked against patient-level records, and the reported repeated-measures analysis should be verified in view of incomplete follow-up. These limitations make the findings exploratory.

Conclusion

In this single-centre Iraqi cohort, pembrolizumab monotherapy was associated with documented complete or partial responses in some patients with metastatic lung cancer and RCC. The RCC cohort showed a higher objective response proportion at the earliest assessment, but later comparisons were constrained by small evaluable samples. Reported toxicities were broadly compatible with recognised checkpoint-inhibitor adverse effects, although the tabulated event counts require verification. Prospective or carefully standardised multicentre studies with complete longitudinal follow-up are necessary before drawing stronger comparative conclusions.

Declarations

Ethics Approval and Consent to Participate

Approval was reported from the participating centre's Institutional Review Board and the Iraqi Ministry of Health. Records were anonymised for analysis, and handling of patient information followed

institutional confidentiality requirements and the ethical principles of the Declaration of Helsinki.

Consent for Publication

Not applicable.

Availability of Data and Material

The data that supports the findings of this study are available from the corresponding author upon reasonable request.

Conflicts of Interest / Competing Interests

The authors declare that there are no conflicts of interest.

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Author Contributions

A.S.S.: Conceptualization, Methodology, Validation, Writing – original draft.

A.S.N.: Conceptualization, Resources, Investigation, Writing – review & editing, Supervision.

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Not applicable

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