A Dual-Targeting Ruthenium Nanodrug that Inhibits Primary Tumor Growth and Lung Metastasis by the PARP/ATM Pathway

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Table 1. Stern-Volmer quenching constant (K_{sv} , $L \cdot mol^{-1}$), biomolecular quenching rate constant (K_q , $L \cdot mol^{-1} \cdot s^{-1}$), binding constant (K_b , $L \cdot mol^{-1}$) and the number of binding sites (n) of Ru complexes and human transferrin.

	$K_{sv} \cdot 10^5$	$K_q \cdot 10^{13}$	n	$K_b \cdot 10^5$
2b	1.09	1.89	1.1	3.97

Figures

Figure 1

Physicochemical characterization of 2b. (A) Structure of 2, 2a and 2b. (B) TEM image of the Ru ligand 2 (up) and complex 2b (down). (C) SEM image of the Ru ligand 2 (up) and complex 2b (down). (D) Size of 2 (up) and 2b (down) at different pH values. (E) Zeta potentials of 2 (up) and 2b (down) at different pH

values within 96 h (detected at 0.5 h, 24 h, 48 h, 72 h and 96 h). (F) UV spectra of 2b with different concentrations of ctDNA. (G) Fluorescence emission spectra of hTF (0.4 μ M, λ_{ex} = 280 nm) with different concentrations of 2b. The classical Stern-Volmer equation and modified Stern-Volmer equation plots show tryptophan quenching in hTF.

Figure 2

(A-D) Cell viability of LLC, 95D, A549-TAX and A549 cancer cells treated with different concentrations of 2b and 100 μ M NAMI-A. The concentrations of 2b were 6.25, 12.5, 25, 50, and 100 μ M. (E) Morphological changes in cells in the control and administration groups incubated with 5% CO₂ at 37 $^{\circ}$ C for 48 h. (F) The intracellular uptake of Ru in the 20 μ M group. (G-H) Western blotting image and relative gray value analysis of proteins in A549 cells treated with 2b.

Figure 3

(A-B) Effect of 2b on the cell cycle. (C-D) Effect of 2b on cell apoptosis (Annexin V-FITC/PI, collected by flow cytometry). (E-F) Effect of 2b on cell apoptosis (Annexin V-PE/Hoechst, observed by confocal microscopy).

Figure 4

Effect of the Ru complex 2b on LLC tumor growth and metastasis in C57BL/6 mice. (A) Dose-dependent volume curve of LLC tumors. (B) Tumor weight of treated C57BL/6 mice. (C) Representative images of metastasis in the lung. (D) The number of metastases. (E) Body distribution of 2b (5.0 mg/kg). It is represented by the mean $\pm$ SD (ng) of ruthenium per g of organ, n = 6.

Figure 5

(A-B) Images and statistics of apoptosis tumor tissue apoptosis by TUNEL. (C-D) Image and statistics of CD31 expression in tumor tissue.

Figure 6

Mechanisms of complex 2b.

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