SUPPORTING INFORMATION

X-ray Structure Determination

The glass fiber was employed to mount appropriate crystals on the goniometer of the Bruker D8 Venture X-ray diffractometer, which was equipped with a CMOS PHOTON II detector. A copper monochromated beam of 1.54 Å was used as an X-ray source. Refinement and reduction of data [45] was conducted using the Bruker SAINT program. SIR92 [46] was used to solve the structure that was further refined by SHELXL-2015/1 [47] of the WinGX program. The *ORTEP-3* [48] program was used to draw the molecular structure. Mercury 3.8 [49] software was used to draw the inter-molecular interactions as well as the crystal packing diagram.

DFT calculations

All DFT computations were performed using Gaussian 09 software [50]. Natural charge calculations [51] were performed at MPW1PW91 [52] level combined with 6-31G(d,p) and cc-PVTZ-PP basis sets for nonmetal and metal atoms, respectively [53, 54]. Atoms in molecules (AIM) parameters were calculated [55] using the Multiwfn program [56].

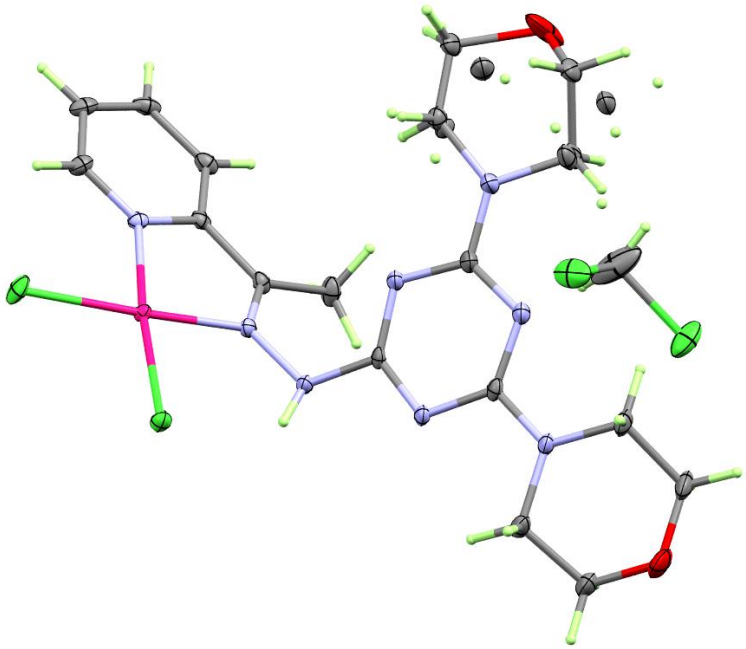

Figure. S1 Structure of the studied Pd(II) complex showing the morpholine disorder.

Cytotoxicity using MTT assay.

Cancer cell lines of liver (HepG2), breast (MCF-7), and lung (A549) were obtained from the National Cancer Institute in Cairo, Egypt, cultured in "RPMI-1640/DMEM media L-Glutamine (Lonza Verviers SPRL, Belgium, cat#12-604F). The cells were cultured in 10% fetal bovine serum (FBS, Sigma-Aldrich, MO, USA) and 1% penicillin-streptomycin (Lonza, Belgium)". All cells were incubated at 37 ºC in a 5% carbon dioxide atmosphere (NuAire). In a 96-well plate, cells were plated in triplicate at a density of 5x10^4 cells and were treated with the Pd(II)-Complex at concentrations of (0.01, 0.1, 1, 10, and 100 μg/mL) on the second day. Cell viability was assessed using MTT solution (Promega, USA) (Mosmann, 1983). Three hours were spent incubating the plate. The absorbance was then measured with an ELISA microplate reader (BIO-RAD, model iMark, Japan). The viability was calculated compared to control, and the IC_{50} values were computed using the GraphPad prism 7 as previously reported in (Mosmann, 1983; Khodair et al., 2021) [58, 59].

Investigation of apoptosis

Annexin V/PI staining and cell cycle analysis

MCF-7 cells were incubated into 6-well culture plates (3-5× 10^5 cells/well) overnight, and they were then treated with Pd(II) complex (IC_{50}=2.1 μg/mL, 48h). Then, media supernatants and cells were collected. The cells were suspended in 100 μL of Annexin binding buffer solution "25 mM CaCl2, 1.4 M NaCl, and 0.1 M Hepes/NaOH, pH 7.4" and incubated with "Annexin V-FITC solution (1:100) and propidium iodide (PI) at a concentration equals 10 μg/mL in the dark for 30 min." The stained cells were then harvested using the Cytoflex FACS machine, and cytExpert software was used to analyze the data (Boraei et al., 2021; ElZahabi et al., 2021) [60, 61].