DESCRIPTION

Title of Invention

THERAPEUTIC AGENT FOR BILE DUCT CANCER

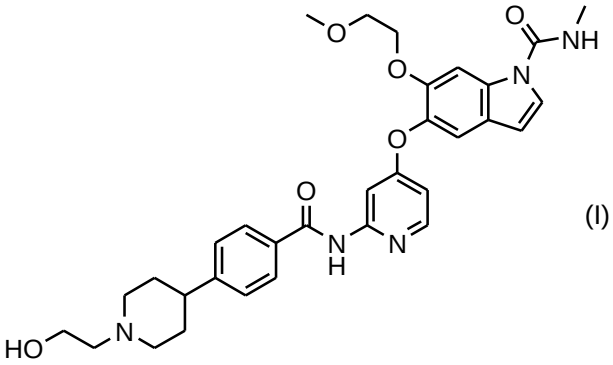
Technical Field

[0001] The present invention relates to a therapeutic agent for bile duct cancer comprising a monocyclic pyridine derivative or a pharmacologically acceptable salt thereof having an FGFR inhibitory activity.

Background Art

[0002] The compound represented by the formula (I) is known as 5-((2-(4-(1-(2-hydroxyethyl)piperidin-4-yl)benzamide)pyridin-4-yl)oxy)-6-(2-methoxyethoxy)-N-methyl-1H-indole-1-carboxamide. It has been reported that the compound represented by the formula (I) has an inhibitory activity on fibroblast growth factor receptors (FGFRs) 1, 2 and 3 and has a cell growth suppressing activity in gastric cancer, lung cancer, bladder cancer and endometrial cancer (Patent Literature 1).

[0003] [Chemical Formula 1]



(I)

[0004] Bile duct cancer is low in incidence, but is known as a tumor with poor prognosis. The main therapeutic method for the bile duct cancer is surgical extirpation of the bile duct, but in many cases cancer cells cannot be completely removed. In such a case, a combined administration of gemcitabine and cisplatin is carried out after the surgery (Non Patent Literature 1).

Citation List

Patent Literature

[0005] Patent Literature 1: US 2014-235614

Non Patent Literature

[0006] Non Patent Literature 1: Celina Ang, "Role of the fibroblast growth factor receptor axis in cholangiocarcinoma", Journal of Gastroenterology and Hepatology, vol.30, p.1116-1122, 2015.

Summary of Invention

Technical Problem

[0007] However, a sufficient therapeutic activity cannot be obtained by the so far reported therapeutic agents for bile duct cancer.

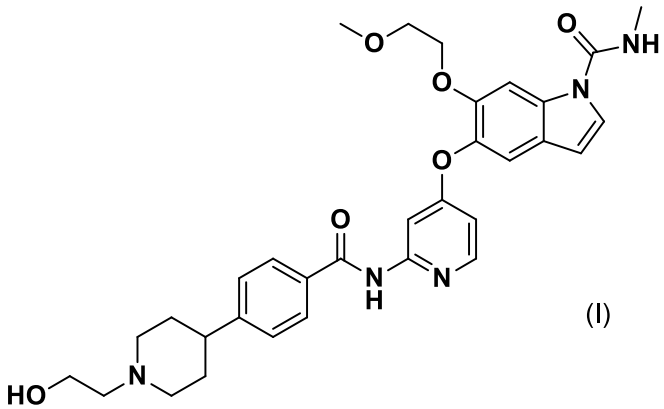
Solution to Problem

[0008] In view of such a situation, the present inventors have conducted intensive studies and as a result, have found that the compound represented by the formula (I) is effective for the treatment of bile duct cancer, and have completed the present invention.

[0009] That is, the present invention provides the following [1] to [12]:

[1] A therapeutic agent for bile duct cancer comprising 5-((2-(4-(1-(2-hydroxyethyl)piperidin-4-yl)benzamide)pyridin-4-yl)oxy)-6-(2-methoxyethoxy)-N-methyl-1H-indole-1-carboxamide represented by the formula (I) or a pharmaceutically acceptable salt thereof.

[Chemical Formula 2]



(I)

[2] The therapeutic agent according to [1], wherein the bile duct cancer is intrahepatic bile duct cancer.

[3] A pharmaceutical composition for the treatment of bile duct cancer, comprising 5-((2-(4-(1-(2-hydroxyethyl)piperidin-4-yl)benzamide)pyridin-4-yl)oxy)-6-(2-

methoxyethoxy)-N-methyl-1H-indole-1-carboxamide represented by the formula (I) or a pharmaceutically acceptable salt thereof as an active ingredient.

[4] The pharmaceutical composition according to [3], wherein the bile duct cancer is intrahepatic bile duct cancer.

[5] A method for treating bile duct cancer, comprising administering to a patient a pharmacologically effective amount of 5-((2-(4-(1-(2-hydroxyethyl)piperidin-4-yl)benzamide)pyridin-4-yl)oxy)-6-(2-methoxyethoxy)-N-methyl-1H-indole-1-carboxamide represented by the formula (I) or a pharmaceutically acceptable salt thereof.

[6] The method according to [5], wherein the patient has been confirmed to have a gene encoding FGFR 2-fusion protein before the administration.

[7] The method according to [6], wherein the gene encoding the FGFR 2-fusion protein is FGFR2-AHCYL1, FGFR2-BICC1 type1, FGFR2-BICC1 type2, FGFR2-TXLNA or FGFR2-KCTD1.

[8] The method according to any one of [5] to [7], wherein the bile duct cancer is intrahepatic bile duct cancer.

[9] 5-((2-(4-(1-(2-Hydroxyethyl)piperidin-4-yl)benzamide)pyridin-4-yl)oxy)-6-(2-methoxyethoxy)-N-methyl-1H-indole-1-carboxamide represented by the formula (I) or pharmaceutically acceptable salts thereof for the treatment of bile duct cancer.

[10] The compound or pharmaceutically acceptable salts thereof according to [9], wherein the bile duct cancer is intrahepatic bile duct cancer.

[11] Use of 5-((2-(4-(1-(2-hydroxyethyl)piperidin-4-yl)benzamide)pyridin-4-yl)oxy)-6-(2-methoxyethoxy)-N-methyl-1H-indole-1-carboxamide represented by the formula (I) or pharmaceutically acceptable salts thereof for the preparation of a therapeutic agent for bile duct cancer.

[12] The use according to [11], wherein the bile duct cancer is intrahepatic bile duct cancer.

Advantageous Effects of Invention

[0010] According to the present invention, the therapeutic agent which may

be effective for the treatment of bile duct cancer can be provided.

Brief Description of the Drawings

[0011] [Figure 1] Figure 1 is a schematic diagram illustrating structures of FGFR2-BICC1 type1 and type2 genes.

[Figure 2] Figure 2 is a diagram showing the results of Western blot analysis of proteins obtained by culturing mouse fibroblast cell line NIH3T3 transfected with various FGFR2 fusion genes.

[Figure 3] Figure 3 is a diagram showing the results of Western blot analysis of proteins obtained by culturing NIH3T3 cell line transfected with FGFR2 fusion genes.

[Figure 4] Figure 4 is a diagram showing the results of analysis of proteins obtained by culturing NIH3T3 cell line transfected with various FGFR2 fusion genes.

[Figure 5] Figure 5 is a diagram showing the activity of FGFR inhibitors on the growth capacity of NIH3T3 cell line transfected with FGFR2 fusion genes.

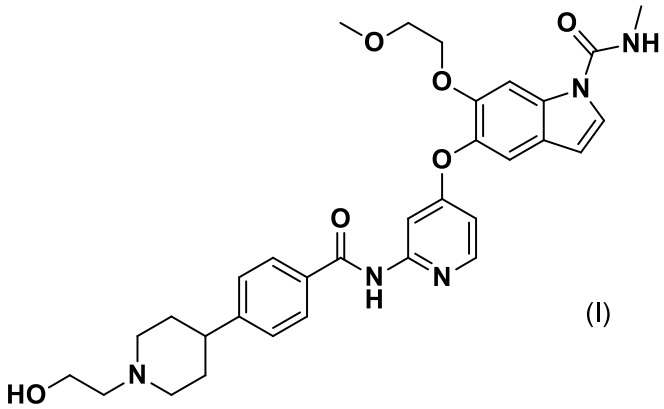
[Figure 6] Figure 6 is a graph showing the activity of FGFR inhibitors on the growth capacity of NIH3T3 cell line transfected with FGFR2 fusion genes.

[Figure 7] Figure 7 is a diagram showing the activity of FGFR inhibitors on the growth capacity of NIH3T3 cell line transfected with FGFR2 fusion genes.

Description of Embodiments

[0012] One embodiment of the present invention is a therapeutic agent for bile duct cancer comprising 5-((2-(4-(1-(2-hydroxyethyl)piperidin-4-yl)benzamide)pyridin-4-yl)oxy)-6-(2-methoxyethoxy)-N-methyl-1H-indole-1-carboxamide represented by the formula (I) or a pharmaceutically acceptable salt thereof.

[Chemical Formula 3]



(I)

[0013] In the present specification, examples of pharmacologically acceptable salts may include salts with inorganic acids, salts with organic acids or salts with acidic amino acids.

[0014] Suitable examples of salts with inorganic acids include salts with hydrochloric acid, hydrobromic acid, sulfuric acid, nitric acid and phosphoric acid.

[0015] Suitable examples of salts with organic acids include salts with carboxylic acids such as acetic acid, succinic acid, fumaric acid, maleic acid, tartaric acid, citric acid, lactic acid, stearic acid and benzoic acid, and salts with sulfonic acids such as methanesulfonic acid, ethanesulfonic acid and p-toluenesulfonic acid.

[0016] Suitable examples of salts with acidic amino acids include salts with aspartic acid and glutamic acid.

[0017] A preferred pharmacologically acceptable salt is a succinate or maleate, and a more preferred salt is a succinate. As the pharmacologically acceptable salt, a salt containing succinic acid 1.5 times on a mass basis more than the compound represented by the formula (I) (1.5 succinate) is particularly preferable.

[0018] The compound represented by the formula (I) or pharmacologically acceptable salts thereof according to the present invention can be produced by the process described in the Patent Literature 1.

[0019] In the present specification, the term "biliary duct" is used synonymously with "biliary tract". That is, bile duct cancer refers to intrahepatic bile duct cancer, extrahepatic bile duct cancer, cystic duct cancer, gallbladder cancer or duodenum papilla cancer. The bile duct cancer also

include these cancers metastasized to sites other than the bile duct. The therapeutic agent for bile duct cancer of the present invention is particularly effective against intrahepatic bile duct cancer.

[0020] The therapeutic agent for bile duct cancer of the present invention may be in the form of a preparation for oral administration, for example, a solid preparation such as a tablet, a granule, a subtle granule, a powder or a capsule, or a solution, a jelly or a syrup. The therapeutic agent for bile duct cancer of the present invention may also be in the form of a preparation for parenteral administration such as an injection, a suppository, an ointment or a cataplasm.

[0021] When preparing the preparation for oral administration, a pharmaceutically acceptable carrier such as an excipient, a binder, a disintegrator, a lubricant and a colorant may be added as appropriate to the compound represented by the formula (I) or a pharmaceutically acceptable salt thereof. The preparation such as a tablet, a granule, a powder and a capsule may also be coated as appropriate.

[0022] When preparing an injection (such as for intravenous administration, intramuscular administration, subcutaneous administration or intraperitoneal administration), a pharmaceutically acceptable carrier such as a pH adjuster, a buffer, a suspending agent, a solubilizing agent, an antioxidant, a preservative (an antiseptic agent) or an isotonizing agent may be added as appropriate to the compound represented by the formula (I) or a pharmaceutically acceptable salt thereof, and then the injection may be prepared by the conventional method. The injection may also be lyophilized to provide a lyophilized preparation which is dissolved before use.

[0023] When preparing an external preparation, a base material may be added to the compound represented by the formula (I) or a pharmaceutically acceptable salt thereof, and the above-mentioned pharmaceutically acceptable carrier such as a preservative, an stabilizer, a pH adjuster, an antioxidant or a colorant may be then added thereto as appropriate, and thereafter, for example, a transdermal preparation (such as an ointment or a patch), an eye dropper, a nasal preparation, or a suppository may be prepared by the conventional method.

[0024] Examples of base materials which can be used include various materials usually used in pharmaceuticals, quasi drugs, cosmetics and the like.

[0025] The therapeutic agent for bile duct cancer of the present invention can be prepared with the compound represented by the formula (I) or a pharmacologically acceptable salt thereof according to the method described in the Japanese Pharmacopoeia 16th edition.

[0026] The dosage of the compound represented by the formula (I) or a pharmacologically acceptable salt thereof in the therapeutic agent for bile duct cancer of the present invention can be appropriately selected depending on the severity of the symptoms, the age, sex, body weight and differential sensitivity of the patient, the method of administration, time of administration, interval of administration, the type of pharmaceutical preparation, and the like. The therapeutic agent for bile duct cancer of the present invention, when administered orally, can be administered so that the dosage of the compound represented by the formula (I) or a pharmacologically acceptable salt thereof is 100 μg to 10 g per day, preferably 500 μg to 10 g per day, more preferably 1 mg to 5 g per day for an adult (body weight: 60kg). The therapeutic agent for bile duct cancer of the present invention can be administered in 1 to 3 divided portions daily.

[0027] According to the present invention, a method for treating bile duct cancer, comprising administering to a patient the compound represented by the formula (I) or a pharmaceutically acceptable salt thereof can be provided. It is preferable that the subject for administration is a patient with bile duct cancer, it is more preferable that the subject is a patient with intrahepatic bile duct cancer, and it is particularly preferable that the subject is a patient with bile duct cancer having a gene encoding FGFR 2-fusion protein (FGFR2 fusion gene).

[0028] The FGFR2 fusion gene refers to a gene in which the FGFR2 and a particular other gene are fused, and examples of the FGFR2 fusion gene include FGFR2-BICC1 type1, FGFR2-BICC1 type2 (SEQ ID NO: 5), FGFR2-TXLNA (SEQ ID NO: 1), FGFR2-AHCYL1, FGFR2-CCDC6, FGFR2-KCTD1 (SEQ ID NO: 3), FGFR2-MGEA5, FGFR2-TACC3, FGFR2-PPHLN1, FGFR2-KIAA1598, FGFR2-CCAR1, FGFR2-NOL4 and

FGFR2-PARK2. Herein, as shown in Figure 1, FGFR2-BICC1 type1 refers to a gene having FGFR2 fused to the 5' terminal side of KHKH sequence of BICC1 gene, while FGFR2-BICC1 type2 refers to a gene having FGFR2 fused to the 5' terminal side of SAM region (sterile α motif) of BICC1 gene. FGFR2-BICC1 type1 encodes a peptide consisting of 1,574 amino acids, whereas FGFR2-BICC1 type2 encodes a peptide consisting of 835 amino acids (SEQ ID NO: 6). BICC1 type1 was also referred to as BICC1 until BICC1 type2 was discovered.

[0029] As the patient with bile duct cancer, the patient having FGFR2-AHCYL1, FGFR2-BICC1 type1, FGFR2-BICC1 type2, FGFR2-TXLNA or FGFR2-KCTD1 is preferable, the patient having FGFR2-BICC1 type2, FGFR2-TXLNA or FGFR2-KCTD1 is more preferable, and the patient with FGFR2-BICC1 type2 is particularly preferable.

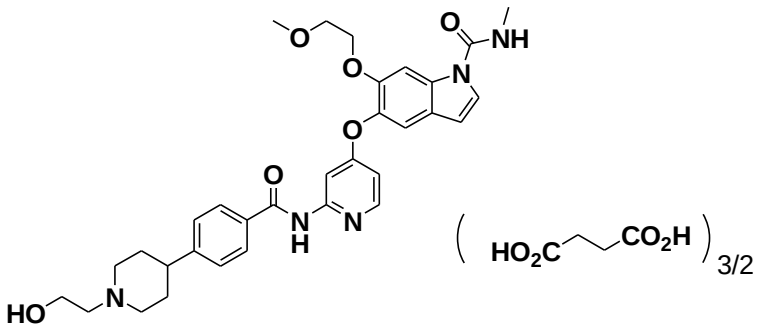
[0030] Before administering the therapeutic agent for bile duct cancer of the present invention, it may be diagnosed whether the subject to be administered has the FGFR2 fusion gene. The method for diagnosing the presence or absence of the FGFR2 fusion gene may be a genetic diagnosis commonly used.

Examples

[0031] The present invention will be described in greater detail by the following examples.

[0032] Production Example 1: Production of 5-((2-(4-(1-(2-hydroxyethyl)piperidin-4-yl)benzamide)pyridin-4-yl)oxy)-6-(2-methoxyethoxy)-N-methyl-1H-indole-1-carboxamide 1.5 succinate (hereinafter also referred to as Compound A)

[Chemical Formula 4]



2.93 g of 5-((2-(4-(1-(2-hydroxyethyl)piperidin-4-yl)benzamide)pyridin-4-yl)oxy)-6-(2-methoxyethoxy)-N-methyl-1H-indole-1-carboxamide was weighed out in an eggplant flask, 60 mL of ethanol was added thereto, and the reaction mixture was heated to 70°C while stirring in an oil bath to dissolve it. Succinic acid (1.23 g) was added, then the heating of the oil bath was stopped, and the reaction mixture was slowly cooled. The reaction mixture was stirred at room temperature for about 2 hours, and further stirred at 5°C for one hour. The resulting solid was collected by filtration to obtain Compound A (3.70 g).

^{1}H-NMR Spectrum (600MHz, CD_3OD) δ (ppm): 1.96-2.10 (4H, m), 2.52 (6H, s), 2.93 (1H, m), 2.96 (3H, s), 3.01 (2H, m), 3.16 (2H, t, J = 5.4 Hz), 3.22 (3H, s), 3.56 (2H, t, J = 4.7 Hz), 3.61 (2H, m), 3.87 (2H, t, J = 5.4 Hz), 4.14 (2H, t, J = 4.6 Hz), 6.61 (1H, d, J = 3.6 Hz), 6.68 (1H, dd, J = 5.8, 2.3 Hz), 7.37 (1H, s), 7.42 (2H, d, J = 8.3 Hz), 7.58 (1H, d, J = 3.6 Hz), 7.73 (1H, d, J = 2.2 Hz), 7.88 (2H, d, J = 8.3 Hz), 8.08 (1H, s), 8.15 (1H, d, J = 5.8 Hz).

^{13}C-NMR Spectrum (100MHz, solid state) δ (ppm): 27.1, 28.3, 29.7, 34.8, 38.0, 41.3, 54.0, 57.3, 59.7, 60.9, 72.1, 72.5, 103.3, 104.2, 108.5, 116.9, 126.9, 128.6, 134.5, 136.7, 140.7, 149.4, 151.3, 155.1, 169.5, 170.1, 175.6, 179.9, 183.7.

[0033] Construction of the FGFR2 fusion genes

cDNAs of three types of FGFR2 fusion genes (FGFR2-BICC1 type2 (SEQ ID NO: 5), FGFR2-TXLNA (SEQ ID NO: 1), FGFR2-KCTD1 (SEQ ID NO: 3)) were prepared from cancer tissues from a patient with biliary tract cancer, respectively. A nucleotide sequence encoding a FLAG epitope tag was ligated to the N-terminal of the resulting cDNA of each FGFR2 fusion gene in accordance with the reading frame of translation, and cloned in a

pMXs retrovirus vector to construct a retrovirus. Herein, the above ligated FGFR2 fusion gene is also referred to as "wild-type FGFR2 fusion gene". The peptide sequence of the FLAG epitope tag is H_2N-DYKDDDDK-COOH (molecular weight: 1,012Da).

Herein, the polynucleotide sequences of each cDNA of FGFR2, TXLNA and KCTD1 correspond to SEQ ID NOs: 7, 9 and 11, respectively, and the sequences of the peptides encoded by FGFR2, TXLNA and KCTD1 correspond to SEQ ID NOs: 8, 10 and 12, respectively.

[0034] Next, a retrovirus having the wild-type FGFR2 fusion gene in which two amino acids in the region encoding FGFR2 kinase were further mutated was constructed. The mutation means that the tyrosine which is a residue at position 568 was replaced by phenylalanine (Y568F) and the tyrosine which is a residue at position 569 was replaced by phenylalanine (Y569F). Herein, the gene obtained by subjecting the wild-type FGFR2 fusion gene to the above-mentioned mutation is also referred to as "KD mutant FGFR2 fusion gene"

[0035] Each of these retroviruses was infected to a mouse immortalized fibroblast cell line NIH3T3 cell to transfect the wild-type FGFR2 fusion gene or the KD mutant FGFR2 fusion gene into the cell, to obtain a cell line stably expressing the protein encoded by each fusion gene.

cDNA cloning:

pMXs vector (CellBiolabs), Plat-Eretrovirus packaging cell line (CellBiolabs)

[0036] Test Example 1: Immunoblot analysis

First, the wild-type FGFR2 fusion gene or KD mutant FGFR2 fusion gene was transfected into the mouse fibroblast cell line NIH3T3 using the retrovirus, and the obtained cell line was cultured in a liquid culture medium. The cultured cell line was subjected to serum starvation, and then treated with a culture medium containing an FGFR inhibitor before extracting the total proteins. Herein, the protein encoded by FGFR2-BICC1 type2, the protein encoded by FGFR2-TXLNA and the protein encoded by FGFR2-KCTD1 are shown in SEQ ID NOs: 6, 2 and 4, respectively.

[0037] For the obtained total proteins, the downstream signal of the fusion gene was analyzed by Western blot analysis using various antibodies.

Apparatus:
WesternBreeze chemilumiscent immunodetection kit (Lifetechnologies)
FGFR inhibitors:
BGJ398 (S2183, Selleck Chemicals), stored in 10 mM DMSO solution
PD173074 (S1264, Selleck Chemicals), stored in 10 mM DMSO solution
Compound A (stored in 20 mM DMSO solution)
Antibodies:
FLAG (#635691, Clontech Laboratories, Inc.)
phospho FGFR-Y653/654 (#3476, Cell Signaling Technology Japan, K.K.)
phospho AKT1-S473 (#4060, Cell Signaling Technology Japan, K.K.)
AKT-pan (#4691, Cell Signaling Technology Japan, K.K.)
phospho STAT3-Y705 (#9145, Cell Signaling Technology Japan, K.K.)
STAT3 (#610189, Becton Dickinson and Company)
phospho MAPK-T202/Y204 (#9106, Cell Signaling Technology Japan, K.K.)
MAPK (#4695, Cell Signaling Technology Japan, K.K.)
beta-actin (#A5441, Sigma-Aldrich Co. LLC).
Antibody array:
PathScan RTK signaling antibody array (Chemiluminescent Readout) (#7982, Cell Signaling Technology Japan, K.K.)

[0038] The obtained results are shown in Figure 2. As shown in Figure 2, it was found that the phosphorylation of the MAPK gene (activation of the MAPK gene) occurred depending on the FGFR2 kinase activity. That is, the NIH3T3 cell transfected with the FGFR2 fusion gene had anchorage independent growth capacity. In Figure 2, "wild" means the wild-type FGFR2 fusion gene, and "KD" means the KD mutant FGFR2 fusion gene.

[0039] Next, the NIH3T3 cell line transfected with the FGFR2 fusion gene was subjected to Western blot analysis after adding the FGFR inhibitor to the cell line (the final concentration of the FGFR inhibitor: 0.2 μM or 0.5 μM) and extracting the total proteins similarly.

[0040] The obtained results are shown in Figure 3. As shown in Figure 3, by treatment with the FGFR inhibitor, phosphorylation of FGFR was suppressed, and the phosphorylation of MAPK was significantly suppressed. In Figure 3, "BG" refers to BGJ398, "PD" refers to PD173074, and "E9"

refers to Compound A. Specifically, for example, "BG-0.2" means that BGJ398 was added so that the final concentration was 0.2 μM.

[0041] Furthermore, the total proteins were similarly extracted from the NIH3T3 cell line not transfected with the FGFR2 fusion gene and from the NIH3T3 cell line transfected with the FGFR2-BICC1 type2, FGFR2-TXLNA or FGFR2-KCTD1. 90 μg of the total proteins extracted was used to analyze the expressed protein with the PathScan (R) array.

[0042] As shown in Figure 4, the phosphorylated Akt (pAkt-S473), phosphorylated MAPK (pMAPK-T202/Y204) and phosphorylated S6 ribosomal protein (pS6-S235/236) were detected.

[0043] Test Example 2: Colony formation assay

Using the following apparatus, the activity of FGFR inhibitors on the transformation capacity of FGFR2 fusion polypeptide was evaluated. That is, the NIH3T3 cell line transfected with the FGFR2 fusion gene was seeded in a soft agar culture medium (the concentration of agar in the culture medium: 4 mg/mL), and an FGFR inhibitor was added to the culture medium (the final concentration of the FGFR inhibitor: 0.2 μM), and the anchorage independent colony forming capacity was evaluated.

Apparatus:

CytoSelect 96-Well Cell Transformation Assay kit (CBA-130, CellBiolabs)

FGFR inhibitors:

BGJ398 (S2183, Selleck Chemicals), stored in 10 mM DMSO solution

PD173074 (S1264, Selleck Chemicals), stored in 10 mM DMSO solution

Compound A (stored in 20 mM DMSO solution)

[0044] The obtained results are shown in Figure 5 and Figure 6. As shown in Figure 5 and Figure 6, among the FGFR2 fusion genes, the anchorage independent growth of the NIH3T3 cells transfected with the FGFR2-TXLNA and FGFR2-KCTD1 was significantly suppressed by the addition of the FGFR inhibitor. On the other hand, the anchorage independent growth of the NIH3T3 cell transfected with FGFR2-BICC1 type2 was little suppressed when using BGJ398 or PD173074 as an FGFR inhibitor, while it was significantly suppressed when using Compound A as an FGFR inhibitor. In Figure 5 and Figure6, "BG" refers to BGJ398, "PD" refers to PD173074, and

"E9" refers to Compound A.

[0045] As shown in Figure 7, when BGJ398 or PD173074 was increased so that the final concentration was 1.0 μM, the anchorage independent growth was suppressed. In Figure 7, "BG" refers to BGJ398, and "PD" refers to PD173074.

[0046] Test Example 3: Calculation of IC_{50} values by Colony formation assay

Various NIH3T3 cell lines transfected with the FGFR2 fusion gene were cultured and maintained with D-MEM (Wako Pure Chemical Industries) culture medium containing 10% FBS and penicillin/streptomycin (Wako Pure Chemical Industries) in a 5% CO_2 incubator (37°C). To each well of a 96-well plate (Sumitomo Bakelite) was added 50 μL of D-MEM medium (SIGMA) (containing 10% FBS and penicillin/streptomycin) containing 0.66% agar culture medium (DIFCO Agar Noble, Japan Becton Dickinson). The cell suspension prepared so that the cell number was 4×10^4 cells/mL (prepared so that the cell number of FGFR2-TXLNA expressing cells was 8×10^4 cells/mL) was mixed with 0.66% agar medium solution in equal amounts, and the layers of 50 μL each of the resulting mixture were piled up and set by cooling at 4°C for about 30 minutes. After returning the plate to room temperature, layers of 50 μL each of 0.66% agar medium solution were further piled up. 50 μL of Compound A diluted with DMEM culture medium containing 10% FBS was added to each well, and cultured in the 5% CO_2 incubator (37°C) for 14 days. 10 μL of cytometry kit (Cell Counting Kit-8, DOJINDO LABORATORIES) was added to each well and cultured in the 5% CO_2 incubator (37°C) for 1 to 2 hours to result in color development. Absorbance at 450nm was measured by a multi-label reader (ARVO, PerkinElmer, Inc.). The absorbance in the presence of Compound A was determined assuming that the absorbance in the absence of Compound A was 100% and the absorbance of the well free of cells was 0%. The concentration of Compound A necessary to inhibit cell growth by 50% (IC_{50} value) was determined and shown in Table 1.

[0047] [Table 1]

Name of Cell Line	IC_{50} (nM)
FGFR2-BICC1 type2	17.3
FGFR2-TXLNA	1.3
FGFR2-KCTD1	5.0

[0048] Test Example 4: Antitumor activity in subcutaneously transplanted model mice

(1) Preparation of subcutaneously transplanted model mice

The NIH3T3 cell line transfected with each FGFR2 fusion gene (FGFR2-BICC1 type2, FGFR2-KCTD1, FGFR2-TXLNA) was cultured in DMEM culture media containing 10% FBS and penicillin/streptomycin.

D-PBS (-) (Wako Pure Chemical Industries) was added to the obtained culture media so that the cell number was 1×10^7 cells/mL to prepare each cell suspension.

100 μL each of these cell suspensions was transplanted subcutaneously in the right flank region of 7-week-old nude mice (strain: BALB/cAJcl-nu/nu, female, CLEA Japan, Inc.) to prepare FGFR2-BICC1 type2 transplant model mice, FGFR2-KCTD1 transplant model mice and FGFR2-TXLNA transplant model mice. Six days after the transplantation, the width and length of the tumor were measured with a digital caliper (trade name: Digimatic (TM) Caliper, Mitutoyo Corporation). The tumor volume was calculated based on the width and length of the tumor by the following calculation formula.

Tumor volume (mm^3) = length (mm) × width (mm) × width (mm)/2

(2) Preparation of Compound A solution

Compound A was dissolved in water for injection and stored at 4°C under protection from light until just before administration. The solution was prepared so that the dosage of Compound A was 6.25, 12.5, 25 and 50 mg/kg when administered to a mouse at a dose of 20 mL/kg.

(3) Administration of drug solution

Based on the tumor volume on the first day of administration, the mice were grouped so that mean values of the tumor volume of the groups were nearly equal to each other. The number of mice per group was 5. The

Compound A solution was continuously administered orally to the mice in the Compound A administration group once a day at a dosage of 20 mL/kg. On the other hand, only the solvent (water for injection) was similarly administered to the mice in the control group. The Administration was carried out to FGFR2-BICC1 type2 or FGFR2-KCTD1 transplant model mice for 7 days and to FGFR2-TXLNA transplant model mice for 11 days.

On the first day and the last day of the administration, body weight was measured for each mice in the control group and the Compound A administration group. The ratio of the body weight on the last day to the body weight on the first day (relative body weight: RBW) was calculated. When the RBW of the Compound A administration group/the RBW of the control group was 0.9 or more, the dosage was judged as safe. The corresponding dosage was 6.25, 12.5, 25 and 50 mg/kg.

The tumor volume was also measured on the last day of administration. Percentage of the tumor volume of the mice in the Compound A administration group to the tumor volume of the mice in the control group (T/C) (%) was calculated.

[0049] The results of T/C (%) in each transplant model mice was shown in Table 2 to Table 4.

[Table 2]

FGFR2-BICC1 type 2 transplant model mice

Compound A	T/C (%)
6.25 mg/kg	80*
12.5 mg/kg	71**
25 mg/kg	68**
50 mg/kg	52**

Statistically significant *: $p<0.05$ **: $p<0.01$

[0050] [Table 3]

FGFR2-TXLNA transplant model mice

Compound A	T/C (%)
6.25 mg/kg	54**
12.5 mg/kg	43**
25 mg/kg	15**
50 mg/kg	6**

Statistically significant **: $p<0.01$

[0051] [Table 4]

FGFR2-KCTD1 transplant model mice

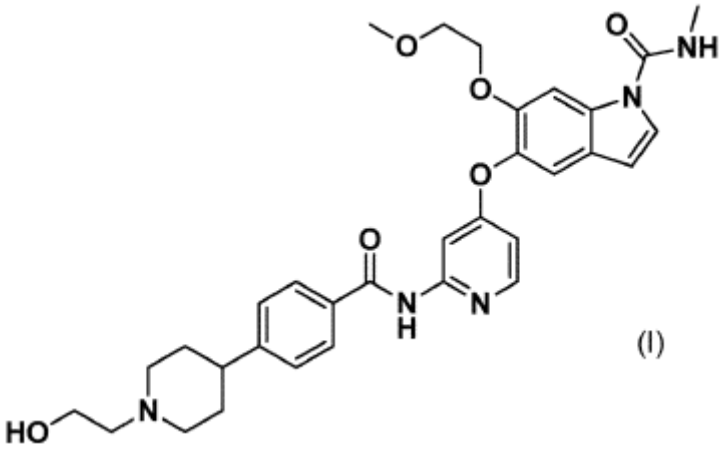
Compound A	T/C (%)
6.25 mg/kg	89
12.5 mg/kg	56
25 mg/kg	39*
50 mg/kg	19**

Statistically significant *: $p<0.05$ **: $p<0.01$

CLAIMS

1. A therapeutic agent for bile duct cancer comprising 5-((2-(4-(1-(2-hydroxyethyl)piperidin-4-yl)benzamide)pyridin-4-yl)oxy)-6-(2-methoxyethoxy)-N-methyl-1H-indole-1-carboxamide represented by the formula (I) or a pharmaceutically acceptable salt thereof.

[Chemical Formula 1]

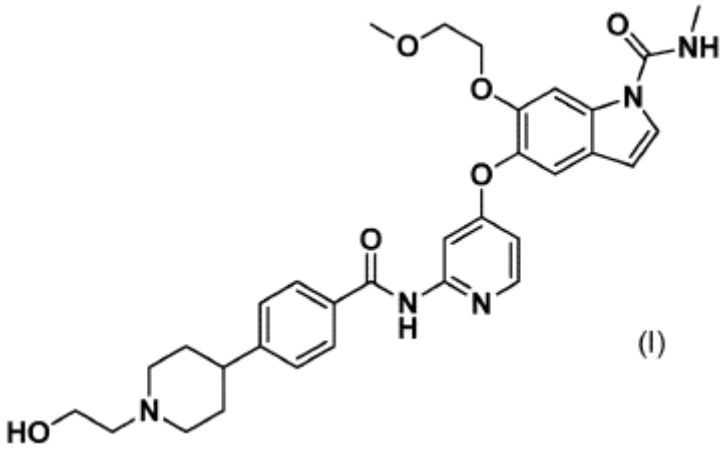


(I)

2. The therapeutic agent according to claim 1, wherein the bile duct cancer is intrahepatic bile duct cancer.

3. A pharmaceutical composition for the treatment of bile duct cancer, comprising 5-((2-(4-(1-(2-hydroxyethyl)piperidin-4-yl)benzamide)pyridin-4-yl)oxy)-6-(2-methoxyethoxy)-N-methyl-1H-indole-1-carboxamide represented by the formula (I) or a pharmaceutically acceptable salt thereof as an active ingredient.

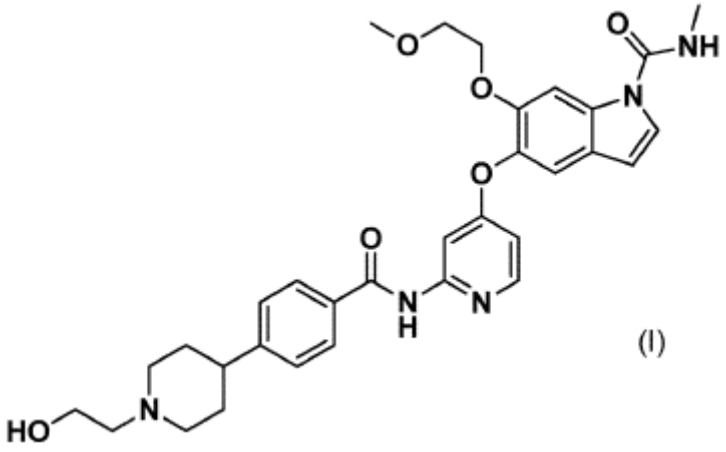
[Chemical Formula 2]



4. The pharmaceutical composition according to claim 3, wherein the bile duct cancer is intrahepatic bile duct cancer.

5. Use of 5-((2-(4-(1-(2-hydroxyethyl)piperidin-4-yl)benzamide)pyridin-4-yl)oxy)-6-(2-methoxyethoxy)-N-methyl-1H-indole-1-carboxamide represented by the formula (I) or a pharmaceutically acceptable salt thereof for the preparation of a therapeutic agent for bile duct cancer.

[Chemical Formula 5]



6. The use according to claim 5, wherein the bile duct cancer is intrahepatic bile duct cancer.