

## HIGHLIGHTS OF PRESCRIBING INFORMATION

These highlights do not include all the information needed to use LONSURF safely and effectively. See full prescribing information for LONSURF.

**LONSURF (trifluridine and tipiracil) tablets, for oral use**

**Initial U.S. Approval: 2015**

### RECENT MAJOR CHANGES

Indications and Usage (1.2)	2/2019
Recommended Dosage (2.1)	2/2019
Warnings and Precaution (5.1)	2/2019

### INDICATIONS AND USAGE

LONSURF is a combination of trifluridine, a nucleoside metabolic inhibitor, and tipiracil, a thymidine phosphorylase inhibitor, indicated for the treatment of adult patients with:

- metastatic colorectal cancer who have been previously treated with fluoropyrimidine-, oxaliplatin- and irinotecan-based chemotherapy, an anti-VEGF biological therapy, and if RAS wild-type, an anti-EGFR therapy. (1.1)
- metastatic gastric or gastroesophageal junction adenocarcinoma previously treated with at least two prior lines of chemotherapy that included a fluoropyrimidine, a platinum, either a taxane or irinotecan, and if appropriate, HER2/neu-targeted therapy. (1.2)

### DOSAGE AND ADMINISTRATION

- Recommended Dosage:** 35 mg/m<sup>2</sup>/dose orally twice daily with food on Days 1 through 5 and Days 8 through 12 of each 28-day cycle. (2.1)

### DOSAGE FORMS AND STRENGTHS

Tablets:

- 15 mg trifluridine/6.14 mg tipiracil (3)
- 20 mg trifluridine/8.19 mg tipiracil (3)

### CONTRAINDICATIONS

None. (4)

### WARNINGS AND PRECAUTIONS

- Severe Myelosuppression:** Obtain complete blood counts prior to and on Day 15 of each cycle. Withhold and resume at next lower LONSURF dosage as recommended. (2.1, 5.1)
- Embryo-Fetal Toxicity:** Can cause fetal harm. Advise females of reproductive potential of the potential risk to a fetus and to use effective contraception. (5.2, 8.1, 8.3)

### ADVERSE REACTIONS

The most common adverse reactions or laboratory abnormalities (≥10%) are anemia, neutropenia, fatigue/asthenia, nausea, thrombocytopenia, decreased appetite, diarrhea, vomiting, and pyrexia (6.1)

**To report SUSPECTED ADVERSE REACTIONS, contact Taiho Oncology, Inc. at 1-844-878-2446 or FDA at 1-800-FDA-1088 or [www.fda.gov/medwatch](http://www.fda.gov/medwatch).**

### USE IN SPECIFIC POPULATIONS

- Lactation:** Advise not to breastfeed. (8.2)
- Geriatric Use:** Grade 3 or 4 neutropenia and thrombocytopenia and Grade 3 anemia occurred more commonly in patients 65 years or older. (8.5)
- Hepatic Impairment:** Do not initiate LONSURF in patients with baseline moderate or severe hepatic impairment. (8.7)
- Renal Impairment:** Reduce LONSURF dose in patients with severe renal impairment. (8.6)

See 17 for PATIENT COUNSELING INFORMATION and FDA-approved patient labeling

Revised: 12 /2019

## FULL PRESCRIBING INFORMATION: CONTENTS\*

### 1 INDICATIONS AND USAGE

- 1.1 Metastatic Colorectal Cancer
- 1.2 Metastatic Gastric Cancer

### 2 DOSAGE AND ADMINISTRATION

- 2.1 Recommended Dosage
- 2.2 Dosage Modifications for Adverse Reactions
- 2.3 Recommended Dosage for Renal Impairment

### 3 DOSAGE FORMS AND STRENGTHS

### 4 CONTRAINDICATIONS

### 5 WARNINGS AND PRECAUTIONS

- 5.1 Severe Myelosuppression
- 5.2 Embryo-Fetal Toxicity

### 6 ADVERSE REACTIONS

- 6.1 Clinical Trials Experience

### 8 USE IN SPECIFIC POPULATIONS

- 8.1 Pregnancy
- 8.2 Lactation
- 8.3 Females and Males of Reproductive Potential
- 8.4 Pediatric Use

- 8.5 Geriatric Use

- 8.6 Renal Impairment

- 8.7 Hepatic Impairment

### 11 DESCRIPTION

### 12 CLINICAL PHARMACOLOGY

- 12.1 Mechanism of Action
- 12.2 Pharmacodynamics
- 12.3 Pharmacokinetics

### 13 NONCLINICAL TOXICOLOGY

- 13.1 Carcinogenesis, Mutagenesis, Impairment of Fertility

### 14 CLINICAL STUDIES

- 14.1 Metastatic Colorectal Cancer
- 14.2 Metastatic Gastric Cancer

### 15 REFERENCES

### 16 HOW SUPPLIED/STORAGE AND HANDLING

### 17 PATIENT COUNSELING INFORMATION

\*Sections or subsections omitted from the full prescribing information are not listed.

## **FULL PRESCRIBING INFORMATION**

### **1 INDICATIONS AND USAGE**

#### **1.1 Metastatic Colorectal Cancer**

LONSURF is indicated for the treatment of adult patients with metastatic colorectal cancer previously treated with fluoropyrimidine-, oxaliplatin- and irinotecan-based chemotherapy, an anti-VEGF biological therapy, and if RAS wild-type, an anti-EGFR therapy.

#### **1.2 Metastatic Gastric Cancer**

LONSURF is indicated for the treatment of adult patients with metastatic gastric or gastroesophageal junction adenocarcinoma previously treated with at least two prior lines of chemotherapy that included a fluoropyrimidine, a platinum, either a taxane or irinotecan, and if appropriate, HER2/neu-targeted therapy.

### **2 DOSAGE AND ADMINISTRATION**

#### **2.1 Recommended Dosage**

The recommended dosage of LONSURF is 35 mg/m<sup>2</sup> up to a maximum of 80 mg per dose (based on the trifluridine component) orally twice daily with food on Days 1 through 5 and Days 8 through 12 of each 28-day cycle until disease progression or unacceptable toxicity. Round dose to the nearest 5 mg increment.

Instruct patients to swallow LONSURF tablets whole.

Instruct patients not to retake doses of LONSURF that are vomited or missed and to continue with the next scheduled dose.

LONSURF is a cytotoxic drug. Follow applicable special handling and disposal procedures.<sup>1</sup>

[Table 1](#) shows the calculated initial daily dose based on body surface area (BSA).

**Table 1 Recommended Dosage According to Body Surface Area (BSA)**

BSA (m <sup>2</sup> )	Total daily dose (mg)	Dose (mg) administered twice daily	Tablets per dose	
			15mg	20mg
< 1.07	70	35	1	1
1.07 - 1.22	80	40	0	2
1.23 - 1.37	90	45	3	0
1.38 - 1.52	100	50	2	1
1.53 - 1.68	110	55	1	2
1.69 - 1.83	120	60	0	3
1.84 - 1.98	130	65	3	1
1.99 - 2.14	140	70	2	2
2.15 - 2.29	150	75	1	3
≥2.30	160	80	0	4

## 2.2 Dosage Modifications for Adverse Reactions

Obtain complete blood cell counts prior to and on Day 15 of each cycle [see *Warnings and Precautions (5.1)*].

Do not initiate the cycle of LONSURF until:

- Absolute neutrophil count (ANC) greater than or equal to 1,500/mm<sup>3</sup> or febrile neutropenia is resolved
- Platelets greater than or equal to 75,000/mm<sup>3</sup>
- Grade 3 or 4 non-hematological adverse reactions are resolved to Grade 0 or 1

Within a treatment cycle, withhold LONSURF for any of the following:

- Absolute neutrophil count (ANC) less than 500/mm<sup>3</sup> or febrile neutropenia
- Platelets less than 50,000/mm<sup>3</sup>
- Grade 3 or 4 non-hematologic adverse reaction

After recovery, resume LONSURF after reducing the dose by 5 mg/m<sup>2</sup>/dose from the previous dose, if the following occur:

- Febrile neutropenia
- Uncomplicated Grade 4 neutropenia (which has recovered to greater than or equal to 1,500/mm<sup>3</sup>) or thrombocytopenia (which has recovered to greater than or equal to 75,000/mm<sup>3</sup>) that results in more than 1 week delay in start of next cycle
- Non-hematologic Grade 3 or Grade 4 adverse reaction except for Grade 3 nausea and/or vomiting controlled by antiemetic therapy or Grade 3 diarrhea responsive to antidiarrheal medication

A maximum of 3 dose reductions are permitted. Permanently discontinue LONSURF in patients who are unable to tolerate a dose of 20 mg/m<sup>2</sup> orally twice daily. Do not escalate LONSURF dosage after it has been reduced.

## 2.3 Recommended Dosage for Renal Impairment

### Severe Renal Impairment

In patients with severe renal impairment [creatinine clearance (CL<sub>cr</sub>) of 15 to 29 mL/min as determined by the Cockcroft-Gault formula], the recommended dosage is 20 mg/m<sup>2</sup> (based on the trifluridine component) orally twice daily with food on Days 1 through 5 and Days 8 through 12 of each 28-day cycle (Table 2) [see *Use in Specific Populations* (8.6) and *Clinical Pharmacology* (12.3)]. Reduce dose to 15 mg/m<sup>2</sup> twice daily in patients with severe renal impairment who are unable to tolerate a dose of 20 mg/m<sup>2</sup> twice daily (Table 2). Permanently discontinue LONSURF in patients who are unable to tolerate a dose of 15 mg/m<sup>2</sup> twice daily.

**Table 2 Recommended Dosage for Severe Renal Impairment According to BSA**

BSA (m <sup>2</sup> )	Total daily dose (mg)	Dose (mg) administered twice daily	Tablets per dose	
			15mg	20mg
For a dose of 20 mg/m <sup>2</sup> twice daily:				
< 1.14	40	20	0	1
1.14 – 1.34	50	25*	2 in the evening*	1 in the morning*
1.35 – 1.59	60	30	2	0
1.60 – 1.94	70	35	1	1
1.95 – 2.09	80	40	0	2
2.10 – 2.34	90	45	3	0
≥ 2.35	100	50	2	1
For a dose of 15 mg/m <sup>2</sup> twice daily:				
< 1.15	30	15	1	0
1.15 – 1.49	40	20	0	1
1.50 – 1.84	50	25*	2 in the evening*	1 in the morning*
1.85 – 2.09	60	30	2	0
2.10 – 2.34	70	35	1	1
≥ 2.35	80	40	0	2

\* For a total daily dose of 50 mg, instruct patients to take 1 x 20-mg tablet in the morning and 2 x 15-mg tablets in the evening.

## 3 DOSAGE FORMS AND STRENGTHS

Tablets:

- 15 mg trifluridine/6.14 mg tipiracil: white, biconvex, round, film-coated, imprinted with '15' on one side, and '102' and '15 mg' on the other side, in gray ink.
- 20 mg trifluridine/8.19 mg tipiracil: pale red, biconvex, round, film-coated, imprinted with '20' on one side, and '102' and '20 mg' on the other side, in gray ink.

## 4 CONTRAINDICATIONS

None.

## 5 WARNINGS AND PRECAUTIONS

### 5.1 Severe Myelosuppression

In the 868 patients who received LONSURF in RECOURSE and TAGS, LONSURF caused severe and life-threatening myelosuppression (Grade 3-4) consisting of anemia (18%), neutropenia (38%), thrombocytopenia (5%) and febrile neutropenia (3%). Two patients (0.2%) died due to neutropenic infection/sepsis and four other patients (0.5%) died due to septic shock. A total of 12% of LONSURF-treated patients received granulocyte-colony stimulating factors.

Obtain complete blood counts prior to and on Day 15 of each cycle of LONSURF and more frequently as clinically indicated. Withhold LONSURF for severe myelosuppression and resume at the next lower dosage [see *Dosage and Administration* (2.2)].

### 5.2 Embryo-Fetal Toxicity

Based on animal studies and its mechanism of action, LONSURF can cause fetal harm when administered to a pregnant woman. Trifluridine/tipiracil caused embryo-fetal lethality and embryo-fetal toxicity in pregnant rats when orally administered during gestation at dosage levels resulting in exposures lower than those achieved at the recommended dosage of 35 mg/m<sup>2</sup> twice daily. Advise pregnant women of the potential risk to the fetus. Advise females of reproductive potential to use an effective method of contraception during treatment with LONSURF and for at least 6 months after the final dose [see *Use in Specific Populations* (8.1, 8.3)].

## 6 ADVERSE REACTIONS

The following clinically significant adverse reactions are described elsewhere in the labeling:

- Severe Myelosuppression [see *Warnings and Precautions* (5.1)]

### 6.1 Clinical Trials Experience

Because clinical trials are conducted under widely varying conditions, adverse reaction rates observed in the clinical trials of a drug cannot be directly compared to rates in the clinical trials of another drug and may not reflect the rates observed in practice.

The data in the WARNINGS AND PRECAUTIONS section and below reflect exposure to LONSURF at the recommended dose in 533 patients with metastatic colorectal cancer in RECOURSE and 335 patients with metastatic gastric cancer in TAGS. Among the 868 patients who received LONSURF, 11% were exposed for 6 months or longer and 1% were exposed for 12 months or longer. The most common adverse reactions or laboratory abnormalities (≥10%) are anemia, neutropenia, fatigue/asthenia, nausea, thrombocytopenia, decreased appetite, diarrhea, vomiting, and pyrexia.

#### Metastatic Colorectal Cancer

The safety of LONSURF was evaluated in RECOURSE, a randomized (2:1), double-blind, placebo-controlled trial in patients with previously treated metastatic colorectal cancer [*see Clinical Studies (14.1)*]. Patients received LONSURF 35 mg/m<sup>2</sup>/dose (n=533) or placebo (n=265) twice daily on Days 1 through 5 and Days 8 through 12 of each 28-day cycle. In RECOURSE, 12% of patients received LONSURF for more than 6 months and 1% of patients received LONSURF for more than 1 year.

The study population characteristics were: median age 63 years; 61% male; 57% White, 35% Asian, and 1% Black.

The most common adverse reactions or laboratory abnormalities ( $\geq 10\%$  in incidence) in patients treated with LONSURF at a rate that exceeds the rate in patients receiving placebo were anemia, neutropenia, asthenia/fatigue, nausea, thrombocytopenia, decreased appetite, diarrhea, vomiting, abdominal pain, and pyrexia.

In RECOURSE, 3.6% of patients discontinued LONSURF for an adverse reaction and 14% of patients required a dose reduction. The most common adverse reactions or laboratory abnormalities leading to dose reduction were neutropenia, anemia, febrile neutropenia, fatigue, and diarrhea.

[Tables 3](#) and [4](#) list the adverse reactions and laboratory abnormalities (graded using CTCAE v4.03), respectively, observed in RECOURSE.

**Table 3 Adverse Reactions ( $\geq 5\%$ ) in Patients Receiving LONSURF and at a Higher Incidence ( $>2\%$ ) than in Patients Receiving Placebo in RECOURSE**

Adverse Reactions	LONSURF (N=533)		Placebo (N=265)	
	All Grades (%)	Grades 3-4* (%)	All Grades (%)	Grades 3-4* (%)
<b>General</b>				
Asthenia/fatigue	52	7	35	9
Pyrexia	19	1	14	<1
<b>Gastrointestinal</b>				
Nausea	48	2	24	1
Diarrhea	32	3	12	<1
Vomiting	28	2	14	<1
Abdominal pain	21	2	18	4
Stomatitis	8	<1	6	0
<b>Metabolism and nutrition</b>				
Decreased appetite	39	4	29	5
<b>Infections<sup>†</sup></b>	27	6	16	5
<b>Nervous system</b>				
Dysgeusia	7	0	2	0
<b>Skin and subcutaneous tissue</b>				
Alopecia	7	0	1	0

\*No Grade 4 definition for nausea, abdominal pain, or fatigue in National Cancer Institute Common Terminology

<sup>†</sup>Incidence reflects 64 preferred terms in the Infections and Infestations system organ class.

**Table 4 Laboratory Abnormalities in RECURSE**

Laboratory Parameter*	LONSURF		Placebo	
	All Grades (%)	Grades 3-4 (%)	All Grades (%)	Grades 3-4 (%)
<b>Hematologic</b>				
Anemia <sup>†</sup>	77	18	33	3
Neutropenia	67	38	1	0
Thrombocytopenia	42	5	8	<1

\* Worst Grade at least one grade higher than baseline, with percentages based on number of patients with post-baseline samples, which may be <533 (LONSURF) or 265 (placebo)

<sup>†</sup> One Grade 4 anemia adverse reaction based on clinical criteria was reported

In RECURSE, pulmonary emboli occurred more frequently in LONSURF-treated patients (2%) compared to no patients on placebo.

#### Metastatic Gastric Cancer

The safety of LONSURF was evaluated in TAGS, an international, randomized (2:1), double-blind, placebo-controlled trial in patients with metastatic gastric or gastroesophageal junction (GEJ) adenocarcinoma who were previously treated with at least 2 prior chemotherapy regimens for advanced disease [see *Clinical Studies* (14.2)]. Previous treatments must have included a fluoropyrimidine, a platinum, and either a taxane or irinotecan. Patients with HER2/neu-positive tumors must have received prior HER2/neu-targeted therapy, if available. Adjuvant chemotherapy could be counted as one prior regimen in patients who had recurrence during or within 6 months of completion of the adjuvant chemotherapy. Patients received LONSURF 35 mg/m<sup>2</sup>/dose (n=335) or placebo (n=168) twice daily on Days 1 through 5 and Days 8 through 12 of each 28-day cycle with best supportive care. In TAGS, 10% of patients received LONSURF for more than 6 months and 0.9% of patients received LONSURF for more than 1 year.

The study population characteristics were: median age 63 years (24 to 89 years); 73% male; 70% White, 16% Asian, and 1% Black.

The most common adverse reactions or laboratory abnormalities (≥10% in incidence) in patients treated with LONSURF at a rate that exceeds the rate in patients receiving placebo were neutropenia, anemia, nausea, decreased appetite, thrombocytopenia, vomiting, and diarrhea.

In TAGS, 13% of patients discontinued LONSURF for an adverse reaction and 11% of patients required a dose reduction. The most common adverse reactions or laboratory abnormalities leading to dose reduction were neutropenia, anemia, febrile neutropenia, and diarrhea.

Tables 5 and 6 list the adverse reactions and laboratory abnormalities (graded using CTCAE v4.03), respectively, observed in TAGS.



**Table 5 Adverse Reactions (≥5%) in Patients Receiving LONSURF and at a Higher Incidence (>2%) than in Patients Receiving Placebo in TAGS**

Adverse Reactions	LONSURF (N=335)		Placebo (N=168)	
	All Grades (%)	Grades 3-4* (%)	All Grades (%)	Grades 3-4* (%)
<b>Gastrointestinal</b>				
Nausea	37	3	32	3
Vomiting	25	4	20	2
Diarrhea	23	3	14	2
<b>Metabolism and nutrition</b>				
Decreased appetite	34	9	31	7
<b>Infections<sup>†</sup></b>	23	5	16	5

\*No Grade 4 definition for nausea or fatigue in NCI CTCAE, version 4.03.

<sup>†</sup>Incidence reflects 46 preferred terms in the Infections and Infestations system organ class.

**Table 6 Laboratory Abnormalities in TAGS**

Laboratory Parameter*	LONSURF		Placebo	
	All Grades (%)	Grades 3-4 (%)	All Grades (%)	Grades 3-4 (%)
<b>Hematologic</b>				
Neutropenia	66	38	4	0
Anemia <sup>†</sup>	63	19	38	7
Thrombocytopenia	34	6	9	0

\*Worst Grade at least one Grade higher than baseline, with percent based on number of patients with post-baseline samples which may be <335 (LONSURF) or 168 (placebo)

<sup>†</sup> Anemia: No Grade 4 definition in CTCAE, v4.03

In TAGS, pulmonary emboli occurred more frequently in LONSURF-treated patients (3.1%) compared to 1.8% for patients on placebo.

### Additional Clinical Experience

Interstitial lung disease was reported in 15 (0.2%) patients, 3 of which were fatal, among approximately 7,000 patients exposed to LONSURF in clinical studies and clinical practice settings in Asia.

## **8 USE IN SPECIFIC POPULATIONS**

### **8.1 Pregnancy**

#### Risk Summary

Based on animal data and its mechanism of action [see *Clinical Pharmacology* (12.2)], LONSURF can cause fetal harm. LONSURF caused embryo-fetal lethality and embryo-fetal toxicity in pregnant rats when given during gestation at doses resulting in exposures lower than or similar to human exposures at the recommended clinical dose (*see Data*). There are no available data on LONSURF use in pregnant women. Advise pregnant women of the potential risk to a fetus.

In the U.S. general population, the estimated background risk of major birth defects and miscarriage in clinically recognized pregnancies is 2-4% and 15-20%, respectively.

#### Data

##### *Animal Data*

Trifluridine/tipiracil was administered orally once daily to female rats during organogenesis at dose levels of 15, 50, and 150 mg/kg [trifluridine (FTD) equivalent]. Decreased fetal weight was observed at FTD doses  $\geq 50$  mg/kg (approximately 0.33 times the FTD exposure at the clinical dose of 35 mg/m<sup>2</sup> twice daily). At the FTD dose of 150 mg/kg (approximately 0.92 times the FTD exposure at the clinical dose of 35 mg/m<sup>2</sup> twice daily) embryoletality and structural anomalies (kinked tail, cleft palate, ectrodactyly, anasarca, alterations in great vessels, and skeletal anomalies) were observed.

### **8.2 Lactation**

#### Risk Summary

There are no data on the presence of trifluridine, tipiracil or its metabolites in human milk or its effects on the breastfed child or on milk production. In nursing rats, trifluridine and tipiracil or their metabolites were present in breast milk (*see Data*). Because of the potential for serious adverse reactions in breastfed children, advise women not to breastfeed during treatment with LONSURF and for 1 day following the final dose.

#### Data

Radioactivity was excreted in the milk of nursing rats dosed with trifluridine/tipiracil containing <sup>14</sup>C-FTD or <sup>14</sup>C-tipiracil (TPI). Levels of FTD-derived radioactivity were as high as approximately 50% of the exposure in maternal plasma an hour after dosing with trifluridine/tipiracil and were approximately the same as those in maternal plasma for up to 12 hours following dosing. Exposure to TPI-derived radioactivity was higher in milk than in

maternal plasma beginning 2 hours after dosing and continuing for at least 12 hours following administration of trifluridine/tipiracil.

### **8.3 Females and Males of Reproductive Potential**

#### **Pregnancy Testing**

Verify pregnancy status in females of reproductive potential prior to initiating LONSURF [see *Use in Specific Populations (8.1)*].

#### **Contraception**

LONSURF can cause fetal harm when administered to a pregnant woman [see *Use in Specific Populations (8.1)*].

#### *Females*

Advise females of reproductive potential to use effective contraception during treatment with LONSURF and for at least 6 months after the final dose.

#### *Males*

Because of the potential for genotoxicity, advise males with female partners of reproductive potential to use condoms during treatment with LONSURF and for at least 3 months after the final dose [see *Nonclinical Toxicology (13.1)*].

### **8.4 Pediatric Use**

Safety and effectiveness of LONSURF in pediatric patients have not been established.

#### **Juvenile Animal Toxicity Data**

Dental toxicity including whitening, breakage, and malocclusion (degeneration and disarrangement in the ameloblasts, papillary layer cells and odontoblasts) were observed in rats treated with trifluridine/tipiracil at doses  $\geq 50$  mg/kg (approximately 0.33 times the exposure at the clinical dose of 35 mg/m<sup>2</sup> twice daily).

### **8.5 Geriatric Use**

In RECOURSE and TAGS, 868 patients received LONSURF; 45% were 65 years of age or over, while 10% were 75 and over. No overall differences in effectiveness were observed in patients 65 or older versus younger patients. Patients 65 years of age or older who received LONSURF had a higher incidence of the following hematologic laboratory abnormalities compared to patients younger than 65 years: Grade 3 or 4 neutropenia (46% vs. 32%), Grade 3 anemia (22% vs. 16%), and Grade 3 or 4 thrombocytopenia (7% vs. 4%).

### **8.6 Renal Impairment**

No dose adjustment is recommended for patients with mild or moderate renal impairment (CL<sub>Cr</sub> of 30 to 89 mL/min as determined by the Cockcroft-Gault formula). Reduce the dose of LONSURF for patients with severe renal impairment (CL<sub>Cr</sub> of 15 to 29 mL/min) [see *Dosage and Administration (2.3)*]. The pharmacokinetics of trifluridine and tipiracil have not been studied in patients with end stage renal disease.

## 8.7 Hepatic Impairment

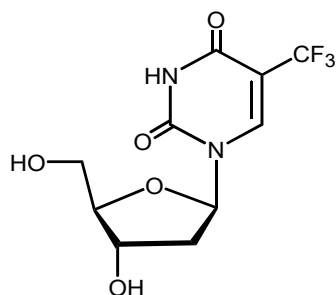
No adjustment to the starting dosage of LONSURF is recommended for patients with mild hepatic impairment. Do not initiate LONSURF in patients with baseline moderate or severe (total bilirubin >1.5 times ULN and any AST) hepatic impairment [see *Clinical Pharmacology* (12.3)].

## 11 DESCRIPTION

LONSURF contains trifluridine and tipiracil hydrochloride at a molar ratio of 1:0.5.

### Trifluridine

Trifluridine, a nucleoside metabolic inhibitor, is described chemically as 2'-deoxy-5-(trifluoromethyl) uridine and has the following structural formula:

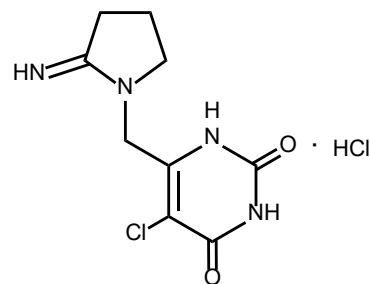


Trifluridine has a molecular formula C<sub>10</sub>H<sub>11</sub>F<sub>3</sub>N<sub>2</sub>O<sub>5</sub> and a molecular weight of 296.20.

Trifluridine is a white crystalline powder, soluble in water, ethanol, 0.01 mol/L hydrochloric acid, 0.01 mol/L sodium hydroxide solution; freely soluble in methanol, acetone; sparingly soluble in 2-propanol, acetonitrile; slightly soluble in diethyl ether; and very slightly soluble in isopropyl ether.

### Tipiracil hydrochloride

Tipiracil hydrochloride, a thymidine phosphorylase inhibitor, is described chemically as 5-chloro-6-[(2-iminopyrrolidin-1-yl)methyl]pyrimidine-2,4-(1*H*,3*H*)-dione monohydrochloride or 2,4(1*H*,3*H*)-Pyrimidinedione, 5-chloro-6-[(2-imino-1-pyrrolidinyl)methyl]-, hydrochloride (1:1) and has the following structural formula:



Tipiracil hydrochloride has a molecular formula C<sub>9</sub>H<sub>11</sub>ClN<sub>4</sub>O<sub>2</sub>•HCl and a molecular weight of 279.12. Tipiracil hydrochloride is a white crystalline powder, soluble in water, 0.01 mol/L hydrochloric acid, and 0.01 mol/L sodium hydroxide; slightly soluble in methanol; very slightly soluble in ethanol; and practically insoluble in acetonitrile, 2-propanol, acetone, diisopropyl ether, and diethyl ether.

LONSURF (trifluridine and tipiracil) tablets for oral use contain 15 mg of trifluridine and 6.14 mg of tipiracil equivalent to 7.065 mg of tipiracil hydrochloride or 20 mg of trifluridine and 8.19 mg of tipiracil equivalent to 9.420 mg of tipiracil hydrochloride.

LONSURF tablets contain the following inactive ingredients: lactose monohydrate, pregelatinized starch, stearic acid, hypromellose, polyethylene glycol, titanium dioxide, ferric oxide, and magnesium stearate. The tablets are imprinted with ink containing shellac, ferric oxide red, ferric oxide yellow, titanium dioxide, FD&C Blue No. 2 Aluminum Lake, carnauba wax, and talc.

## **12 CLINICAL PHARMACOLOGY**

### **12.1 Mechanism of Action**

LONSURF consists of a thymidine-based nucleoside analog, trifluridine, and the thymidine phosphorylase inhibitor, tipiracil, at a molar ratio 1:0.5 (weight ratio, 1:0.471). Inclusion of tipiracil increases trifluridine exposure by inhibiting its metabolism by thymidine phosphorylase.

Following uptake into cancer cells, trifluridine is incorporated into DNA, interferes with DNA synthesis and inhibits cell proliferation. Trifluridine/tipiracil demonstrated anti-tumor activity against *KRAS* wild-type and mutant human colorectal cancer xenografts in mice.

### **12.2 Pharmacodynamics**

#### Cardiac Electrophysiology

LONSURF administered to 42 patients with advanced solid tumors at the recommended dosage had no large effect (i.e. >20 ms) in the mean QTc interval when compared to placebo and no exposure-QT relationship was identified. Two of 42 patients (4.8%) had QTc >500 msec and 2.4% had a QTc increase from baseline >60 msec.

### **12.3 Pharmacokinetics**

After twice daily dosing of LONSURF, systemic exposure (AUC) of trifluridine increased more than dose-proportionally over the dose range of 15 mg/m<sup>2</sup> (0.43 times the recommended dose) to 35 mg/m<sup>2</sup>.

The accumulation of trifluridine was 3-fold for AUC<sub>0-12hr</sub> and 2-fold for C<sub>max</sub> at steady state while no accumulation was observed for tipiracil.

Administration of a single dose of LONSURF 35 mg/m<sup>2</sup> increased the mean AUC<sub>0-last</sub> of trifluridine by 37-fold and C<sub>max</sub> by 22-fold with reduced variability compared to administration of a single dose of trifluridine 35 mg/m<sup>2</sup> alone.

### Absorption

Following a single oral administration of LONSURF at 35 mg/m<sup>2</sup> in patients with cancer, the mean time to peak plasma concentration (T<sub>max</sub>) of trifluridine was around 2 hours.

### *Food Effect*

A standardized high-fat, high-calorie meal decreased trifluridine C<sub>max</sub>, tipiracil C<sub>max</sub> and AUC by approximately 40%, but did not change trifluridine AUC compared to those in a fasting state in patients with cancer following administration of a single dose of LONSURF 35 mg/m<sup>2</sup>.

### Distribution

Trifluridine mainly binds to human serum albumin. The in vitro protein binding of trifluridine in human plasma is >96%, independent of drug concentration and presence of tipiracil. Plasma protein binding of tipiracil is below 8%.

### Elimination

After administration of LONSURF 35 mg/m<sup>2</sup>, the mean elimination half-life (t<sub>1/2</sub>) of trifluridine was 1.4 hours and of tipiracil was 2.1 hours after a single dose. The mean elimination half-life at steady state of trifluridine was 2.1 hours and of tipiracil was 2.4 hours.

### *Metabolism*

Trifluridine and tipiracil are not metabolized by cytochrome P450 (CYP) enzymes. Trifluridine is mainly eliminated by metabolism via thymidine phosphorylase to form an inactive metabolite, 5-(trifluoromethyl) uracil (FTY). No other major metabolites were detected in plasma or urine.

### *Excretion*

After single oral administration of LONSURF (60 mg) with [<sup>14</sup>C]-trifluridine, the total cumulative excretion of radioactivity was 60% of the administered dose. The majority of recovered radioactivity was eliminated into urine (55% of the dose) as FTY and trifluridine glucuronide isomers within 24 hours and the excretion into feces and expired air was <3% for both. The unchanged trifluridine was <3% of administered dose recovered in the urine and feces.

After single oral administration of LONSURF (60 mg) with [<sup>14</sup>C]-tipiracil hydrochloride, recovered radioactivity was 77% of the dose, which consisted of 27% urinary excretion and 50% fecal excretion. Tipiracil was the major component and 6-HMU was the major metabolite in urine, and feces.

### Specific Populations

Based on the population pharmacokinetic analysis, there is no clinically relevant effect of age, sex, or race (White or Asian) on the pharmacokinetics of trifluridine or tipiracil.

### *Patients with Renal Impairment*

In a dedicated renal impairment study, all patients received LONSURF 35 mg/m<sup>2</sup> twice daily except for patients with severe renal impairment who received 20 mg/m<sup>2</sup> twice daily. Mild renal impairment (CL<sub>cr</sub> of 60 to 89 mL/min as determined by the Cockcroft-Gault formula) had no clinically important effect on steady-state AUC<sub>0-last</sub> of trifluridine and tipiracil. Moderate renal impairment (CL<sub>cr</sub> of 30 to 59 mL/min) increased steady-state AUC<sub>0-last</sub> of trifluridine by 56% and tipiracil by 139% compared to normal renal function (CL<sub>cr</sub> ≥ 90 mL/min). Severe renal

impairment (CLcr of 15 to 29 mL/min) increased the dose-normalized steady-state AUC<sub>0-last</sub> of trifluridine by 140% and tipiracil by 614% compared to normal renal function. The pharmacokinetics of trifluridine and tipiracil have not been studied in patients with end stage renal disease.

#### *Patients with Hepatic Impairment*

No clinically important differences in the mean exposures of trifluridine and tipiracil were observed between patients with mild hepatic impairment (total bilirubin  $\leq$  ULN and AST  $>$  ULN or total bilirubin  $<1$  to 1.5 times ULN and any AST) to moderate hepatic impairment (total bilirubin  $>1.5$  to 3 times ULN and any AST) and patients with normal hepatic function (total bilirubin and AST  $\leq$  ULN); however, 5 of 6 patients with moderate hepatic impairment experienced Grade 3 or 4 increased bilirubin levels. The pharmacokinetics of trifluridine and tipiracil have not been studied in patients with severe hepatic impairment [see *Dosage Modifications* (2.2), *Use in Specific Populations* (8.6)].

#### Drug Interaction Studies

In vitro studies indicated that trifluridine, tipiracil, and FTY did not inhibit the CYP enzymes and had no inductive effect on CYP1A2, CYP2B6, or CYP3A4/5.

In vitro studies indicated that trifluridine was not an inhibitor of or substrate for human uptake and efflux transporters.

## **13 NONCLINICAL TOXICOLOGY**

### **13.1 Carcinogenesis, Mutagenesis, Impairment of Fertility**

No long-term studies evaluating the carcinogenic potential of trifluridine/tipiracil in animals have been performed. Trifluridine/tipiracil was genotoxic in a reverse mutation test in bacteria, a chromosomal aberration test in mammalian-cultured cells, and a micronucleus test in mice.

Animal studies did not indicate an effect of trifluridine/tipiracil on male fertility in rats. Dose-related increases in the corpus luteum count and implanted embryo count were observed, but female fertility was not affected.

## **14 CLINICAL STUDIES**

### **14.1 Metastatic Colorectal Cancer**

The efficacy of LONSURF was evaluated in RECURSE (NCT01607957), an international, randomized, double-blind, placebo-controlled study conducted in patients with previously treated metastatic colorectal cancer (mCRC). Key eligibility criteria included prior treatment with at least 2 lines of standard chemotherapy for metastatic CRC, ECOG performance status (PS) 0-1, absence of brain metastasis, and absence of ascites requiring drainage in the past four weeks. Patients were randomized 2:1 to receive LONSURF 35 mg/m<sup>2</sup> or matching placebo orally twice daily after meals on Days 1-5 and 8-12 of each 28-day cycle until disease progression or unacceptable toxicity. Randomization was stratified by KRAS status (wild-type vs. mutant), time since diagnosis of first metastasis ( $<18$  months vs.  $\geq 18$  months), and region (Japan vs. US,

Europe and Australia). The major efficacy outcome measure was overall survival (OS) and an additional efficacy outcome measure was progression-free survival (PFS).

A total of 800 patients were randomized to LONSURF (N=534) with best supportive care (BSC) or matching placebo (N=266) plus BSC. The median age was 63 years, 61% were male, 58% and 35% were White and Asian respectively, and all patients had baseline ECOG PS of 0 or 1. The primary site of disease was colon (62%) or rectum (38%). KRAS status was wild-type (49%) or mutant (51%) at study entry. All patients received prior treatment with fluoropyrimidine-, oxaliplatin-, and irinotecan-based chemotherapy. All but one patient received bevacizumab and all but two patients with KRAS wild-type tumors received panitumumab or cetuximab.

Efficacy results are summarized in [Table 7](#) and [Figure 1](#).

**Table 7 Efficacy Results from RECOURSE**

	LONSURF (N=534)	Placebo (N=266)
Overall Survival		
Number of deaths, N (%)	364 (68)	210 (79)
Median OS (months) <sup>a</sup> (95% CI) <sup>b</sup>	7.1 (6.5, 7.8)	5.3 (4.6, 6.0)
Hazard ratio (95% CI)	0.68 (0.58, 0.81)	
p-value <sup>c</sup>	<0.001	
Progression-Free Survival		
Number of events, N (%)	472 (88)	251 (94)
Hazard ratio (95% CI)	0.47 (0.40, 0.55)	
p-value <sup>c</sup>	<0.001	

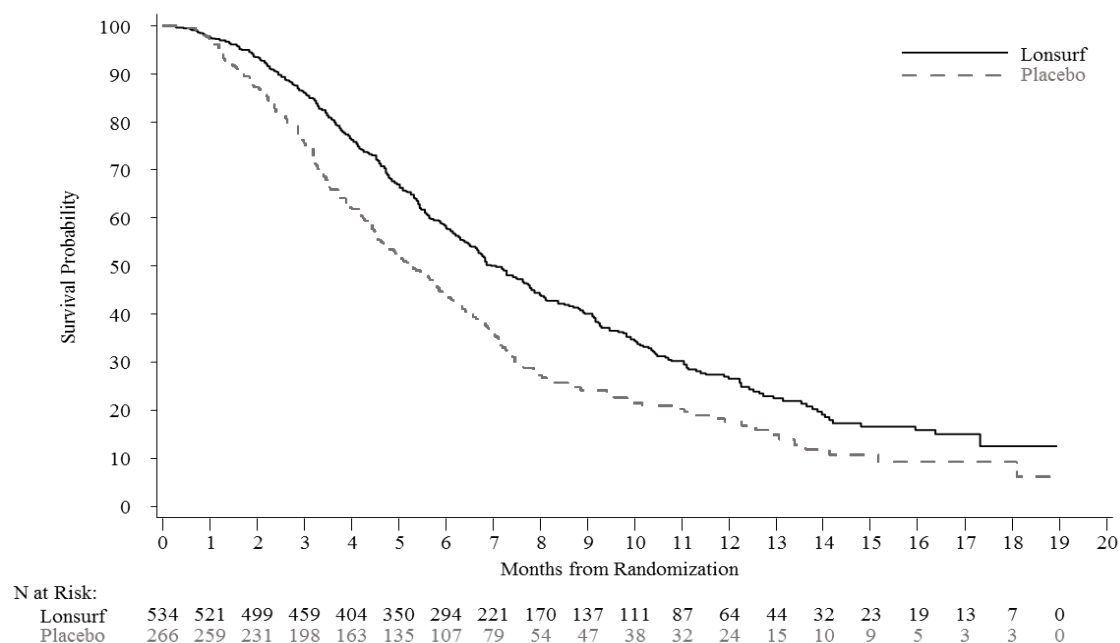
<sup>a</sup> Kaplan-Meier estimates

<sup>b</sup> Methodology of Brookmeyer and Crowley

<sup>c</sup> Stratified log-rank test (strata: KRAS status, time since diagnosis of first metastasis, region), 2-sided



**Figure 1 Kaplan-Meier Curves of Overall Survival in RECOURSE**



## 14.2 Metastatic Gastric Cancer

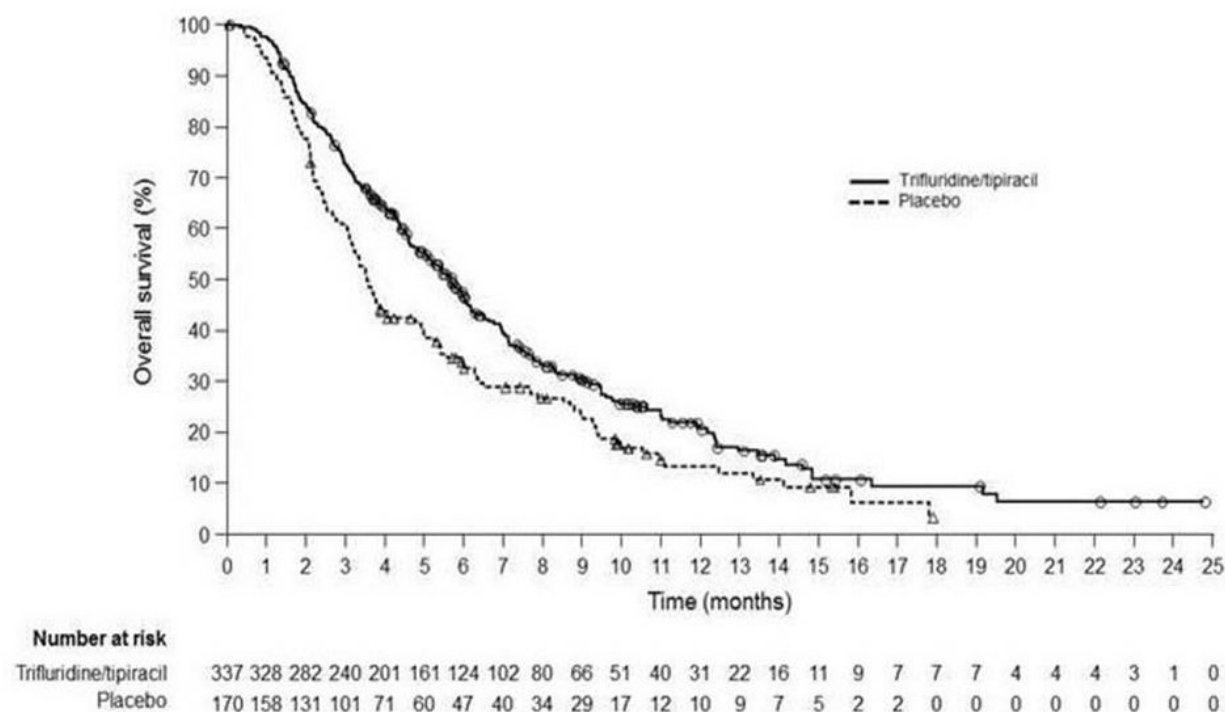
The efficacy of LONSURF was evaluated in TAGS (NCT02500043), an international, randomized, double-blind, placebo-controlled study in patients with metastatic gastric or gastroesophageal junction (GEJ) adenocarcinoma previously treated with at least 2 prior regimens for advanced disease. Previous treatments must have included a fluoropyrimidine, a platinum, and either a taxane or irinotecan. Patients with HER2/neu-positive tumors must have received prior HER2/neu-targeted therapy, if available. Adjuvant chemotherapy could be counted as one prior regimen in patients who had recurrence during or within 6 months of completion of the adjuvant chemotherapy. Other key eligibility criteria included ECOG performance status (PS) 0 or 1. Patients were randomized 2:1 to receive LONSURF 35 mg/m<sup>2</sup> orally twice daily on Days 1-5 and 8-12 of each 28-day cycle with best supportive care (BSC) or matching placebo with BSC until disease progression or unacceptable toxicity. Randomization was stratified by ECOG PS at baseline (0 vs. 1), prior ramucirumab (yes vs. no), and geographic region (Japan vs. rest of world). The major efficacy outcome measure was OS and an additional outcome measure was PFS.

A total of 507 patients were randomized to LONSURF (N=337) or placebo (N=170). The median age was 63 years, 73% were male, 70% and 16% were White and Asian respectively, and 38% had a baseline ECOG PS of 0. Seventy-one percent of patients had gastric tumors, 29% had GEJ tumors, and two patients had gastric/GEJ tumors. All patients received platinum-based chemotherapy, 99% received fluoropyrimidine-based therapy, 91% received a taxane, 55% received irinotecan, and 33% received ramucirumab. The HER2 status was negative in 62%, positive in 19%, and unknown in 20% of patients. Among the 94 patients with HER2 positive tumors, 89% received prior anti-HER2 therapy.

Efficacy results are summarized in [Table 8](#) and [Figure 2](#).

**Table 8 Efficacy Results from TAGS**

	LONSURF (N=337)	Placebo (N=170)
Overall Survival		
Number of deaths, N (%)	244 (72)	140 (82)
Median OS (months) <sup>a</sup> (95% CI) <sup>b</sup>	5.7 (4.8, 6.2)	3.6 (3.1, 4.1)
Hazard ratio (95% CI)	0.69 (0.56, 0.85)	
p-value <sup>c</sup>	0.0006	
Progression-Free Survival		
Number of events, N (%)	287 (85)	156 (92)
Hazard ratio (95% CI)	0.56 (0.46, 0.68)	
p-value <sup>c</sup>	<0.0001	

<sup>a</sup> Kaplan-Meier estimates<sup>b</sup> Methodology of Brookmeyer and Crowley<sup>c</sup> Stratified log-rank test (strata: ECOG PS, prior ramucirumab treatment, region), 2-sided**Figure 2 Kaplan-Meier Curves of Overall Survival in TAGS****15 REFERENCES**

1. “OSHA Hazardous Drugs”. OSHA. <http://www.osha.gov/SLTC/hazardousdrugs/index.html>

## 16 HOW SUPPLIED/STORAGE AND HANDLING

LONSURF 15 mg/6.14 mg tablets are supplied as white, biconvex, round, film-coated tablet, imprinted with '15' on one side, and '102' and '15 mg' on the other side, in gray ink. The tablets are packaged in HDPE bottles with child resistant closures in the following presentations:

- 20 count: NDC 64842-1025-1
- 40 count: NDC 64842-1025-2
- 60 count: NDC 64842-1025-3

LONSURF 20 mg/8.19 mg tablets are supplied as pale red, biconvex, round, film-coated tablet, imprinted with '20' on one side, and '102' and '20 mg' on the other side, in gray ink. The tablets are packaged in HDPE bottles with child resistant closures in the following presentations:

- 20 count: NDC 64842-1020-1
- 40 count: NDC 64842-1020-2
- 60 count: NDC 64842-1020-3

Store at 20°C to 25°C (68°F to 77°F); excursions are permitted from 15°C to 30°C (59°F to 86°F) [See USP Controlled Room Temperature].

LONSURF is a cytotoxic drug. Follow applicable special handling and disposal procedures.<sup>1</sup>

If stored outside of original bottle, discard after 30 days.

## 17 PATIENT COUNSELING INFORMATION

Advise the patient to read the FDA-approved patient labeling ([Patient Information](#)).

### Severe Myelosuppression

Advise patients to immediately contact their healthcare provider if they experience signs or symptoms of infection and advise patients to keep all appointments for blood tests [*see Warnings and Precautions (5.1)*].

### Gastrointestinal Toxicity

Advise patients to contact their healthcare provider for severe or persistent nausea, vomiting, diarrhea, or abdominal pain [*see Adverse Reactions (6.1)*].

### Administration Instructions

Advise patients that LONSURF is available in two strengths and they may receive both strength tablets to provide the prescribed dosage.

Advise patients to take LONSURF with food [*see Dosage and Administration (2.1)*].

Advise patients that anyone else who handles their medication should wear gloves [*see References (15)*].

### Embryo-Fetal Toxicity

Advise pregnant women and females of reproductive potential of the potential risk to the fetus. Advise females to inform their healthcare provider of a known or suspected pregnancy [*see Warnings and Precautions (5.2), Use in Specific Populations (8.3)*].

Advise female patients of reproductive potential to use effective contraception during treatment with LONSURF and for at least 6 months after the final dose [*see Warnings and Precautions (5.2), Use in Specific Populations (8.3)*].

Advise males with female partners of reproductive potential to use condoms during treatment with LONSURF and for at least 3 months after the final dose [*see Use in Specific Populations (8.3), Nonclinical Toxicology (13.1)*].

### Lactation

Advise women not to breastfeed during treatment with LONSURF and for 1 day following the final dose [*see Use in Specific Populations (8.2)*].

Manufactured by: Taiho Pharmaceutical Co., Ltd., Japan

Manufactured for: Taiho Oncology, Inc., Princeton, NJ 08540 USA

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