

Kidney Venous Flow Data Help to Predict Cardiorenal Events in HF

In patients with heart failure (HF), baseline and follow-up changes in kidney venous flow (KVF) provide information on the risk of cardiorenal events, reports a study in the *Journal of the American Heart Association*.

The observational cohort study included 216 consecutive cardiology inpatients with HF who were referred for nephrology evaluation of diuretic resistance and abnormal kidney function. Sixty percent of patients were men; median age was 76 years. Approximately 69.4% of patients had advanced chronic kidney disease, with an estimated glomerular filtration rate (eGFR) of <45 mL/min/1.73 m²; 66% were receiving combined diuretic therapy.

Patients underwent Doppler spectral kidney assessments at baseline and 25–35 days later to assess patterns of intra-

KVF (IKVF) and kidney venous stasis index (KVSII). These values were analyzed for association with risk of cardiorenal events.

At up to 18 months' follow-up, 126 patients died or had worsening HF. Risk of these adverse outcomes was associated with baseline KVSII (hazard ratio [HR], 1.49 per 0.1-unit increase) and baseline IKVF pattern (HR, 2.47 per increase in severity from continuous to pulsatile to biphasic to monophasic).

On analysis of 92 patients, increases in both KVSII and IKVF pattern from the first to second Doppler examination were also associated with risk of worsening HF or death: HR, 3.00 and 6.73, respectively. Results were similar on analysis of individual cardiorenal outcomes, initiation of kidney re-

placement therapy, and decline in eGFR.

Many patients hospitalized for HF have residual congestion at discharge, which may lead to oliguria and worsening HF. Few studies have evaluated the impact of changes in Doppler-derived KVF in patients with HF.

The new findings suggest that initial and subsequent changes in Doppler-derived KVSII and IKVF are predictors of adverse cardiorenal events in hospitalized patients with HF. The researchers write, "Future studies should aim to assess and validate the prognostic ability of serial KVF assessments in HF management" [Husain-Syed F, et al. Changes in Doppler-derived kidney venous flow and adverse cardiorenal outcomes in patients with heart failure. *J Am Heart Assoc* 2023; 12:e030145. doi: 10.1161/JAHA.123.030145]. ■

JYNARQUE® (tolvaptan) tablets for oral use

Brief summary of PRESCRIBING INFORMATION. See full prescribing information for JYNARQUE.

WARNING: RISK OF SERIOUS LIVER INJURY

- JYNARQUE (tolvaptan) can cause serious and potentially fatal liver injury. Acute liver failure requiring liver transplantation has been reported.
- Measure ALT, AST and bilirubin before initiating treatment, at 2 weeks and 4 weeks after initiation, then monthly for the first 18 months and every 3 months thereafter. Prompt action in response to laboratory abnormalities, signs, or symptoms indicative of hepatic injury can mitigate, but not eliminate, the risk of serious hepatotoxicity.
- Because of the risks of serious liver injury, JYNARQUE is available only through a restricted distribution program under a Risk Evaluation and Mitigation Strategy (REMS) called the JYNARQUE REMS Program.

INDICATIONS AND USAGE: JYNARQUE is indicated to slow kidney function decline in adults at risk of rapidly progressing autosomal dominant polycystic kidney disease (ADPKD).

CONTRAINDICATIONS: JYNARQUE is contraindicated in patients:

- With a history, signs or symptoms of significant liver impairment or injury. This contraindication does not apply to uncomplicated polycystic liver disease.
- Taking strong CYP 3A inhibitors.
- With uncorrected abnormal blood sodium concentrations.
- Unable to sense or respond to thirst.
- Hypovolemia.
- Hypersensitivity (e.g., anaphylaxis, rash) to tolvaptan or any component of the product. Uncorrected urinary outflow obstruction.
- Anuria.

WARNINGS AND PRECAUTIONS

Serious Liver Injury: JYNARQUE can cause serious and potentially fatal liver injury. Acute liver failure requiring liver transplantation has been reported in the post-marketing ADPKD experience. Discontinuation in response to laboratory abnormalities or signs or symptoms of liver injury (such as fatigue, anorexia, nausea, right upper abdominal discomfort, vomiting, fever, rash, pruritus, icterus, dark urine or jaundice) can reduce the risk of severe hepatotoxicity.

To reduce the risk of significant or irreversible liver injury, assess ALT, AST and bilirubin prior to initiation of JYNARQUE, at 2 weeks and 4 weeks after initiation, then monthly for 18 months and every 3 months thereafter. At the onset of signs or symptoms consistent with hepatic injury or if ALT, AST, or bilirubin increase to >2 times ULN, immediately discontinue JYNARQUE, obtain repeat tests as soon as possible (within 48-72 hours), and continue testing as appropriate. If laboratory abnormalities stabilize or resolve, JYNARQUE may be reinitiated with increased frequency of monitoring as long as ALT and AST remain below 3 times ULN.

Do not restart JYNARQUE in patients who experience signs or symptoms consistent with hepatic injury or whose ALT or AST ever exceeds 3 times ULN during treatment with tolvaptan, unless there is another explanation for liver injury and the injury has resolved.

In patients with a stable, low baseline AST or ALT, an increase above 2 times baseline, even if less than 2 times upper limit of normal, may indicate early liver injury. Such elevations may warrant treatment suspension and prompt (48-72 hours) re-evaluation of liver test trends prior to reinitiating therapy with more frequent monitoring.

JYNARQUE REMS Program: JYNARQUE is available only through a restricted distribution program under a Risk Evaluation and Mitigation Strategy (REMS) called the JYNARQUE REMS Program, because of the risks of liver injury. Notable requirements of the JYNARQUE REMS Program include the following:

- Prescribers must be certified by enrolling in the REMS program.
- Prescribers must inform patients receiving JYNARQUE about the risk of hepatotoxicity associated with its use and how to recognize the signs and symptoms of hepatotoxicity and the appropriate actions to take if it occurs.
- Patients must enroll in the REMS program and comply with ongoing monitoring requirements.
- Pharmacies must be certified by enrolling in the REMS program and must only dispense to patients who are authorized to receive JYNARQUE.

Hypertatremia, Dehydration and Hypovolemia: JYNARQUE increases free water clearance and, as a result, may cause dehydration, hypovolemia and hypertatremia. Therefore, ensure adequate sodium concentrations are corrected prior to initiation of therapy.

Instruct patients to drink water when thirsty, and throughout the day and night if awake. Monitor for weight loss, tachycardia and hypotension because they may signal dehydration.

During JYNARQUE therapy, if serum sodium increases above normal range or the patient becomes hypovolemic or dehydrated and fluid intake cannot be increased, then suspend JYNARQUE until serum sodium, hydration status and volume status is within the normal range.

Co-Administration with Inhibitors of CYP 3A: Concomitant use of JYNARQUE with drugs that are moderate or strong CYP 3A inhibitors (e.g., ketoconazole, itraconazole, lopinavir/ritonavir, indinavir/ritonavir, ritonavir, and nelfinavir) increases tolvaptan exposure. Use with strong CYP 3A inhibitors is contraindicated; dose reduction of JYNARQUE is recommended for patients while taking moderate CYP 3A inhibitors.

ADVERSE REACTIONS

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. JYNARQUE has been studied in over 3000 patients with ADPKD. Long-term, placebo-controlled safety information of JYNARQUE in ADPKD is principally derived from two trials where 1,413 subjects received tolvaptan and 1,098 received placebo for at least 12 months across both studies. **TEMPO 3:4 -NCT00428948: A Phase 3, Double-Blind, Placebo-Controlled, Randomized Trial in Early, Rapidly-Progressing ADPKD:** The TEMPO3:4 trial employed a two-arm, 2:1 randomization to tolvaptan or placebo, titrated to a maximally-tolerated total daily dose of 60-120 mg. A total of 961 subjects with rapidly progressing ADPKD were randomized to JYNARQUE. Of these, 742 (77%) subjects who were treated with JYNARQUE remained on treatment for at least 3 years. The average daily dose in these subjects was 96 g daily.

Adverse events that led to discontinuation were reported for 15.4% (148/961) of subjects in the JYNARQUE group and 5.0% (24/483) of subjects in the placebo group. Aquaretic effects were the most common reasons for discontinuation of JYNARQUE. These included polyuria, polyuria, or nocturia in 63 (6.6%) subjects treated with JYNARQUE compared to 1 subject (0.2%) treated with placebo.

Table 1 lists the adverse reactions that occurred in at least 3% of ADPKD subjects treated with JYNARQUE and at least 1.5% more than on placebo.

Adverse Reaction	Tolvaptan (N=961)			Placebo (N=483)		
	Number of Subjects	Proportion (%) ^a	Annualized Rate ^b	Number of Subjects	Proportion (%) ^a	Annualized Rate ^b
Increased urination ^c	668	69.5	28.6	135	28.0	10.3
Thirst ^d	612	63.7	26.2	113	23.4	8.7
Dry mouth	154	16.0	6.6	60	12.4	4.6
Fatigue	131	13.6	5.6	47	9.7	3.6
Diarrhea	128	13.3	5.5	53	11.0	4.1

Table 1: TEMPO 3:4, Treatment Emergent Adverse Reactions in ≥3% of JYNARQUE Treated Subjects with Risk Difference ≥ 1.5%, Randomized Period

Adverse Reaction	Tolvaptan (N=961)			Placebo (N=483)		
	Number of Subjects	Proportion (%) ^a	Annualized Rate ^b	Number of Subjects	Proportion (%) ^a	Annualized Rate ^b
Dizziness	109	11.3	4.7	42	8.7	3.2
Dyspepsia	76	7.9	3.3	16	3.3	1.2
Decreased appetite	69	7.2	3.0	5	1.0	0.4
Abdominal distension	47	4.9	2.0	16	3.3	1.2
Dry skin	47	4.9	2.0	8	1.7	0.6
Rash	40	4.2	1.7	9	1.9	0.7
Hyperuricemia	37	3.9	1.6	9	1.9	0.7
Palpitations	34	3.5	1.5	6	1.2	0.5

^a100x (Number of subjects with an adverse event)/N

^b100x (Number of subjects with an adverse event/Total subject years of drug exposure)

^cThirst includes polydipsia and thirst

^dIncreased urination includes micturition urgency, nocturia, pollakiuria, polyuria

REPRISE -NCT02160145: A Phase 3, Randomized-Withdrawal, Placebo-Controlled, Double-Blind, Trial in Late Stage 2 to Early Stage 4 ADPKD: The REPRISE trial employed a 5-week single-blind titration and run-in period for JYNARQUE prior to the randomized double-blind period. During the JYNARQUE titration and run-in period, 126 (8.4%) of the 1496 subjects discontinued the study, 52 (3.5%) were due to aquaretic effects and 10 (0.7%) were due to liver test findings. Because of this run-in design, the adverse reaction rates observed during the randomized period are not described. **Liver Injury:** In the two double-blind, placebo-controlled trials, ALT elevations >3 times ULN were observed at an increased frequency with JYNARQUE compared with placebo (4.9% [80/1637] versus 1.1% [13/1166], respectively) within the first 18 months after initiating treatment and increases usually resolved within 1 to 4 months after discontinuing the drug.

Postmarketing Experience: The following adverse reactions have been identified during post-approval use of tolvaptan. Because these reactions are reported voluntarily from a population of uncertain size, it is not always possible to estimate their frequency reliably or establish a causal relationship to drug exposure.

Hepatobiliary Disorders: Liver failure requiring transplant

Immune System Disorders: Anaphylaxis

DRUG INTERACTIONS

CYP 3A Inhibitors and Inducers: CYP 3A Inhibitors: Tolvaptan's AUC was 5.4 times as large and C_{max} was 3.5 times as large after co-administration of tolvaptan and 200 mg ketoconazole. Larger doses of the strong CYP 3A inhibitor would be expected to produce larger increases in tolvaptan exposure. Concomitant use of tolvaptan with strong CYP 3A inhibitors is contraindicated. Dose reduction of JYNARQUE is recommended for patients while taking moderate CYP 3A inhibitors. Patients should avoid grapefruit juice beverages while taking JYNARQUE. **Strong CYP 3A Inducers:** Co-administration of JYNARQUE with strong CYP 3A inducers reduces exposure to JYNARQUE. Avoid concomitant use of JYNARQUE with strong CYP 3A inducers.

V₂-Receptor Agonist: As a V₂-receptor antagonist, tolvaptan will interfere with the V₂-agonist activity of desmopressin (dDAVP). Avoid concomitant use of JYNARQUE with a V₂-agonist.

USE IN SPECIFIC POPULATIONS

Pregnancy: Risk Summary: Available data with JYNARQUE use in pregnant women are insufficient to determine if there is a drug associated risk of adverse developmental outcomes. In embryo-fetal development studies, pregnant rats and rabbits received oral tolvaptan during organogenesis. At maternally non-toxic doses, tolvaptan did not cause any developmental toxicity in rats or in rabbits at exposures approximately 4- and 1-times, respectively, the human exposure at the maximum recommended human dose (MRHD) of 90/30 mg. However, effects on embryo-fetal development occurred in both species at maternally toxic doses. In rats, reduced fetal weights and delayed fetal ossification occurred at 17-times the human exposure. In rabbits, increased abortions, embryo-fetal death, fetal microphthalmia, open eyelids, cleft palate, brachymelia and skeletal malformations occurred at approximately 3-times the human exposure. Advise pregnant women of the potential risk to the fetus.

The estimated background risk of major birth defects and miscarriage for the indicated population is unknown. All pregnancies have a background risk of birth defect, loss, or other adverse outcomes. The estimated background risk of major birth defects and miscarriage in the U.S. general population is 2-4% and 15-20% of clinically recognized pregnancies, respectively.

Lactation: Risk Summary: There are no data on the presence of tolvaptan in human milk, the effects on the breastfed infant, or the effects on milk production. Tolvaptan is present in rat milk. When a drug is present in animal milk, it is possible that the drug will be present in human milk, but relative levels may vary. Because of the potential for serious adverse reactions, including liver toxicity, electrolyte abnormalities (e.g., hypertatremia), hypotension, and volume depletion in breastfed infants, advise women not to breastfeed during treatment with JYNARQUE.

Pediatric Use: Safety and effectiveness of JYNARQUE in pediatric patients have not been established.

Geriatric Use: Clinical studies of tolvaptan did not include sufficient numbers of subjects aged 65 years and over to determine whether they respond differently from younger subjects. Other reported clinical experience has not identified differences in responses between the elderly and younger patients. In general, dose selection for an elderly patient should be cautious, usually starting at the low end of the dosing range, reflecting the greater frequency of decreased hepatic, renal, or cardiac function, and of concomitant disease or other drug therapy.

Use in Patients with Hepatic Impairment: Because of the risk of serious liver injury, use is contraindicated in patients with a history, signs or symptoms of significant liver impairment or injury. This contraindication does not apply to uncomplicated polycystic liver disease which was present in 60% and 66% of patients in TEMPO 3:4 and REPRISE, respectively. No specific exclusion for hepatic impairment was implemented in TEMPO 3:4. However, REPRISE excluded patients with ADPKD who had hepatic impairment or liver function abnormalities other than that expected for ADPKD with typical cystic liver disease.

Use in Patients with Renal Impairment: Efficacy studies included patients with normal and reduced renal function. TEMPO 3:4 required patients to have an estimated creatinine clearance ≥60 mL/min, while REPRISE included patients with eGFR_{CR} ≥25 to 65 mL/min/1.73m².

OVERDOSAGE: Single oral doses up to 480 mg (4 times the maximum recommended daily dose) and multiple doses up to 300 mg once daily for 5 days have been well tolerated in trials in healthy subjects. There is no specific antidote for tolvaptan intoxication. The signs and symptoms of an acute overdose can be anticipated to be those of excessive pharmacologic effect: a rise in serum sodium concentration, polyuria, thirst, and dehydration/hypovolemia. In patients with suspected JYNARQUE overdose, assessment of vital signs, electrolyte concentrations, ECG and fluid status is recommended. Continue replacement of water and electrolytes until aquaretic abates. Dialysis may not be effective in removing JYNARQUE because of its high binding affinity for human plasma protein (>98%).

PATIENT COUNSELING INFORMATION

See FDA-Approved Patient Labeling (Medication Guide).

To report SUSPECTED ADVERSE REACTIONS, contact Otsuka America Pharmaceutical, Inc. at 1-800-438-9927 or FDA at 1-800-FDA-1088 or www.fda.gov/medwatch.

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BEST-Fluids Supports Balanced Crystalloids for Deceased Donor Transplant

Compared with saline solution, intravenous fluid therapy with a balanced crystalloid solution reduces the incidence of delayed graft function (DGF) after deceased donor kidney transplantation, reports a pragmatic randomized trial in *The Lancet*.

The double-blind Better Evidence for Selecting Transplant Fluids (BEST-Fluids) trial enrolled 808 patients undergoing deceased donor kidney transplantation at 16 hospitals in Australia and New Zealand between 2018 and 2020. The patients were 512 males and 296 females; mean age, 55 years; and four patients younger than 16 years old. Patients were randomly assigned to receive intravenous balanced crystalloid solution (Plasma-Lyte 148) or saline solution during surgery and up to 48 hours afterward. DGF, defined as need for dialysis within 7 days, was the main outcome of interest.

Incidence of DGF was 30% in the group assigned to balanced crystalloid solution compared with 40% in the saline group: adjusted relative risk, 0.74. The advantage of balance crystalloid solution persisted in sensitivity and subgroup analyses. The benefit appeared larger in patients receiving kidneys from donors after circulatory death compared with donors after brain death.

Secondary outcomes were similar between groups, including a ranked composite outcome of duration of DGF and creatinine reduction ratio on day 2. Serious adverse events occurred in three patients in the balanced crystalloid group and five in the saline group.

The choice of intravenous fluid therapy might affect the risk of DGF after deceased donor kidney transplant. Saline solution is the most common type of fluid therapy but may increase DGF risk due to its high sodium content. Previous data comparing balanced crystalloids with saline have shown low certainty of evidence.

The BEST-Fluids results show a reduced risk of DGF in deceased donor kidney recipients assigned to balanced crystalloid solution. Balanced crystalloids prevent approximately one case of DGF for every 10 patients treated, with no increase in serious adverse events or hyperkalemia. The investigators conclude: "Balanced crystalloid solution should be the standard-of-care intravenous fluid used in deceased donor kidney transplantation" [Collins MG, et al. Balanced crystalloid solution versus saline in deceased donor kidney transplantation (BEST-Fluids): A pragmatic, double-blind, randomised, controlled trial. *Lancet* 2023; 402:105–117. doi: 10.1016/S0140-6736(23)00642-6]. ■