

## PRODUCT INFORMATION

### Composition

Each 5 mL contains lactulose 3.3 g, and lesser amounts of other sugars including lactose, galactose, tagatose and epilactose.

### Description

Lactulose solution is an aqueous solution of lactulose (4-O-β-D-galacto-pyranosyl-D-fructose) and other sugars including lactose, galactose, tagatose and epilactose.

Actilax solution is a sweet, colourless to slightly brownish-yellow, clear or slightly opalescent solution.

$C_{12}H_{22}O_{11}$

Mol. Wt. 342.3

### Pharmacology

*Therapeutic category.* Laxative

*Portal-Systemic Encephalopathy* (hepatic encephalopathy; "hepatic coma"). Portal-Systemic Encephalopathy (PSE) is a neuropsychiatric syndrome from a disorder of cerebral function, which can complicate all forms of liver disease. The major sites of cerebral involvement are the cortex, extra-pyramidal system and cerebellum. Clinical features include intellectual deterioration, disturbances of consciousness and neurological abnormalities.

It is generally accepted that PSE involves exposure of the brain to nitrogenous substances arising from the gut from bacterial metabolism of protein, with ammonia being implicated most commonly, together with an alteration of the pattern of amino acids entering the central nervous system.

The basic action of lactulose in PSE is aimed at reducing "nitrogenous intoxication" by decreasing blood ammonia concentration. Lactulose is degraded in the large bowel by bacterial flora, mainly to acetic and lactic acids, thus reducing the intraluminal pH to below 5. This acidification of colonic contents results in the retention of ammonia as the ammonium ion  $[NH_4]^+$ . In effect, ammonia, amines and various amides, and other basic nitrogenous substances are thus trapped, reducing their absorption into the blood. Since the colonic contents are more acid than the blood, ammonia can be expected to migrate from the blood into the colon to form the ammonium ion. Lowering of faecal pH is also thought to suppress urease producing organisms, and to foster the growth of saccharolytic bacteria (*Lactobacillus acidophilus*) rather than *E. coli*, a more efficient ammonia producing bacterium. The diarrhoeal action of lactulose is synergistic in expelling the trapped ammonium ion from the colon.

Thus, of several proposals, the therapeutic action of lactulose in ameliorating the symptoms of PSE is considered to be the result of the following:

1. Reduction of faecal pH leading to a reduced ammonia absorption via non-ionic diffusion and/or diffusion of ammonia from the blood into the gut. The trapped ammonia is then excreted in the stools.
2. Suppression of urease producing organisms.
3. Induction of an osmotic type of diarrhoea which diminishes faecal stasis with reduction of nitrogenous substances for ammonia production. Decreased absorption of ammonia from the gut also results from shortening intestinal transit time.

The actual mechanism may be a combination of these effects.

In the treatment of chronic portal-systemic encephalopathy, controlled studies have shown that lactulose therapy reduces the blood ammonia levels by 25 to 50%; this is generally paralleled by an improvement in the patients' mental state and by an improvement in EEG patterns. The clinical response has been observed in about 75% of patients, which is at least as satisfactory as that resulting from neomycin therapy, with the added benefit that an increase in patients' protein tolerance is frequently observed with lactulose therapy. Lactulose is an effective alternative to neomycin, particularly in patients with hearing problems or renal disease, and when long-term use is anticipated.

### **Pharmacokinetics**

Experimental data on lactulose given orally to humans indicate that lactulose is poorly absorbed from the gastrointestinal tract and no enzymes capable of hydrolysis of lactulose into its component monosaccharides are known to be present in human gastrointestinal tissue. Lactulose reaches the colon virtually unchanged. There it is metabolised by colonic bacteria to low molecular weight acids, ie. lactic acid and other short chain carboxylic acids.

Lactulose given orally to humans results in only small amounts reaching the blood by absorption through the small intestine probably by a nonmediated diffusion mechanism. Otherwise small increases in blood sugar levels are probably attributable to the small amounts of galactose and lactose also present in Actilax solution. Urinary excretion has been determined to be 3% or less and is essentially complete within 24 hours. A small quantity of lactulose is probably hydrolysed in the colon into its constituent monosaccharides, galactose and fructose. The end result is a change in osmotic pressure and acidification of the colonic contents resulting in an increase in stool water content with resultant distension and softening of the stool which in turn promotes increased peristalsis and bowel evacuation.

*Metabolism in infants.* Administration of lactulose to infants fed with cow's milk produces a predominance of lactobacilli in the stools, thus simulating the intestinal flora following maternal milk feeding. Lactulose also appears to increase the production of lysozyme in infants receiving cow's milk.

## Indications

1. Treatment of acute, and prevention and treatment of chronic Portal-Systemic Encephalopathy (PSE), including the stages of hepatic precoma and coma.
2. Treatment of chronic and habitual constipation.

Controlled clinical studies in patients with a history of chronic constipation have shown that lactulose therapy causes a significant increase in the number of bowel movements per day and the number of days on which bowel movements occur.

## Contraindications

Since Actilax contains galactose (not more than 0.50 g/5 mL) and lactose (not more than 0.33 g/5 mL), it is contraindicated in patients who require a low galactose diet, and in patients with galactosaemia or disaccharidase deficiency or who are on a galactose and/or lactose free diet.

Contraindicated in patients with bowel obstruction.

## Precautions

A theoretical hazard may exist for patients treated with lactulose solution who may be required to undergo electrocautery procedures during proctoscopy or colonoscopy. If sugars reach the colon and bacterial breakdown causes hydrogen production, accumulation of hydrogen gas in significant concentration in the presence of an electrical spark may result in an explosive reaction. Although this complication has not been reported with lactulose, patients on lactulose therapy undergoing such procedures should have a thorough bowel cleansing with nonfermentable solution.

Actilax solution contains galactose and lactose and it should be used with caution in diabetics as blood glucose levels may be elevated, usually after extended use.

If used by lactose intolerant patients, the lactose content in the recommended dose should be taken into consideration.

Chronic misuse of laxatives may result in electrolyte imbalance, in particular serum potassium levels may be decreased. Elderly debilitated patients who receive Actilax solution for more than 6 months should have serum electrolytes measured periodically.

In the overall management of portal-systemic encephalopathy, it should be recognised that there is a pre-existing liver disease and efforts should be made to identify and treat the precipitating cause of hepatic coma. Thus, the overall management of hepatic encephalopathy should include dietary protein restriction, bowel cleansing and sterilisation, correction of electrolyte and fluid imbalance, provision of caloric and nutritional needs and treatment of underlying liver disease .

## Use in Pregnancy

Lactulose solution has been shown to be effective for the treatment of constipation associated with pregnancy when administered to women at different stages of pregnancy.

*Reproduction Studies:* Reproduction studies with daily oral doses of lactulose solution (50% w/w) up to 12 mL/kg in mice and rats and 6 mL/kg in rabbits have not revealed any evidence of an increased occurrence of foetal damage or other deleterious effects.

## Use in Lactation

There are no data on the secretion of lactulose in breast milk or the effect on the breastfed infant. Risk-benefit should be considered.

## Use in Children

It is recommended that if Actilax solution is given to infants and children, this should be done under medical supervision.

## Interactions

*Neomycin.* There have been conflicting reports about the concomitant use of neomycin and lactulose solution, although in some situations, the two drugs administered together are more effective than either one alone.

Theoretically, the elimination of certain colonic bacteria by neomycin and possibly other anti-infective agents may interfere with the desired degradation of lactulose and thus prevent the acidification of colonic contents. There have been some reports that lactulose fermenting bacteria are relatively resistant to neomycin, which might explain why a combination could work in some cases. Thus, the status of the lactulose-treated patient should be closely monitored in the event of concomitant oral antibiotic therapy.

Other laxatives should not be used, especially during the initial phase of therapy for PSE because the loose stools resulting from their use may falsely suggest that adequate dosage has been achieved.

Results of limited studies in rats and humans suggest that non-absorbable antacids administered concomitantly with lactulose may inhibit the desired decrease in faecal pH in the colon. The potential lack of desired effect of lactulose should be considered before a non-absorbable antacid is administered concomitantly with lactulose.

## Adverse Reactions

Initial dosing may produce gaseous distension with flatulence and intestinal cramps in about 20% of patients. These effects are usually mild and transient. Excessive dosage can lead to diarrhoea. If untreated potential complications of diarrhoea may include fluid loss, and electrolyte disturbances such as hypokalaemia and hypernatraemia. Less frequently, nausea, vomiting, anorexia and increased thirst have been reported.

Very rarely, infants receiving lactulose may develop dehydration and hyponatraemia.

## Dosage and Administration

**Portal-Systemic Encephalopathy.** The usual dosage is 30 to 45mL three or four times daily. The dosage may be adjusted every day or two to produce two or three soft stools daily.

Hourly doses of 30 to 45 mL of Actilax solution may be used to induce the rapid laxation indicated in the initial phase of the therapy of PSE. When the laxative effect has been achieved, the dose of Actilax may then be reduced to the recommended daily dose.

Improvement in the patient's condition may take 24 to 48 hours to occur. Continuous long-term therapy is indicated to lessen the severity and prevent the recurrence of PSE. The dose of Actilax for this purpose is the same as the recommended daily dose.

In the treatment of acute episodes of PSE, a rapid response is desirable. In such cases it is important to avoid underdosage, and 50 mL every 1 to 2 hours can be given if necessary until two loose bowel actions have occurred. Thereafter, doses may be reduced to usual doses (30 mL four times daily).

The administration of lactulose by retention enema is an alternative technique. This can be prepared by diluting lactulose solution, and is of considerable value especially in the unconscious patient. In such cases 300 mL of Actilax may be mixed with 700 mL of water or normal saline to be used as a retention enema; the enema is to be retained for 30 to 60 minutes, and repeated every 4 to 6 hours until the patient is able to take oral medication.

**Chronic constipation.** Dosage is individualised and depends somewhat on the severity of the constipation.

*Adults.* The usual initial dose is 15 to 30 mL daily. The dose may be increased to 45 mL daily if necessary. Since Actilax solution relieves constipation by producing a physiological change in the colon, it may take from 24 to 48 hours before normal defaecation occurs. After three days, the dose may be reduced to 10 to 25 mL daily for maintenance.

More serious constipation and/or constipation such as that caused by chemotherapy agents may require higher dosages.

*Children.* It is recommended that if Actilax is given to infants and children, this should be done under medical supervision. The usual initial daily doses (for the first three days) are as follows:

7 to 14 years: 15 mL

1 to 6 years: 10 mL

Infants under 1 year: 5 mL

Maintenance daily doses are as follows:

7 to 14 years: 10 mL

1 to 6 years: 5 to 10 mL

Infants under 1 year: 3 to 5 mL

*Note.* Actilax solution may be more acceptable when mixed with fruit juice, water or milk.

When experiencing constipation patients should be advised to drink plenty of water, and increase the fibre content in their diet.

## Overdosage

No toxicity in humans has been recorded to date. There have been no reports of accidental overdosage. In the event of acute overdosage it is expected that diarrhoea and abdominal cramps would be the major symptoms. Complications of diarrhoea may include fluid loss, and electrolyte disturbances, such as hypokalaemia and hypernatraemia, in which case treatment would consist of fluid and electrolyte replacement.

## Presentation

**Actilax**, lactulose 3.3 g/5 mL solution; 500 mL bottle.

## Poison Schedule

Nil

## Name and Address of the Sponsor

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*Approved by the Therapeutic Goods Administration on 2 July 2002*

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