**BC Cancer Protocol Summary for Treatment of Primary Intracerebral Lymphoma with High Dose Methotrexate and riTUXimab**

**Protocol Code**

LYHDMRP

**Tumour Group**

Lymphoma

**Contact Physician**

Dr. Diego Villa

**ELIGIBILITY:**

1. Age: 16 y or greater
2. Performance status: ECOG 0-3
3. **Diagnosis:** Biopsy proven diagnosis of primary CNS lymphoma (PCNSL) (with or without intraocular involvement) or classic radiologic picture with resolution on steroids.
4. Acceptable hematologic, renal and hepatic function

**EXCLUSIONS:**

1. Estimated glomerular filtration rate (GFR) or estimated creatinine clearance (CrCl) below 60 mL/min

\[
\text{Estimated creatinine clearance} = \frac{N \times (140 - \text{age}) \times \text{wt (kg)}}{\text{serum creatinine (micromol/L)}}
\]

   - \(N\) = 1.23 male
   - \(1.04\) female
2. Pleural effusion, ascites, full extremity edema.
3. Hemoglobin less than 90 g/L; neutrophils less than 1.5 x 10^9/L; platelets less than 75 x 10^9/L
4. AST, alkaline phosphatase or total bilirubin greater than twice upper limit of normal

**TESTS:**

- **Baseline and Pretreatment:**
  - CBC & diff, platelets, serum creatinine, lytes, bilirubin, AST, ALT, alkaline phosphatase, LDH
  - urine pH
  - Required, but results do not have to be available to proceed with first treatment; results must be checked before proceeding with further treatment: HBsAg, HBcoreAb
  - chest radiograph
  - CT brain with contrast or MRI with contrast (unless allergic to contrast)
  - Ocular slit lamp exam (ophthalmology consultation)
  - Baseline Folstein mini mental status exam (see Appendix 1)
  - ECOG performance status

- **During Treatment:**
  - Immediately pre-methotrexate and q6h: urine pH
  - Daily q am during treatment: serum creatinine, lytes
  - Daily q am starting day 2 (day of Methotrexate = day 1) Methotrexate levels (until less than 0.1 micromol/L; note date and time of withdrawal on the specimen)
Follow Up After Completion of Treatment:
- Reassess every 2 months x 1 year then every 3 months x 2 years, then every 6 months with imaging for suspected recurrence only, based on symptoms.
- History, physical, ECOG, Mini Mental Status Exam (MMSE) (to prospectively assess for neurotoxicity)
- Record site of relapse: local, neuraxial, ocular, meningeal, systemic.

PREMEDICATIONS:
For Methotrexate:
- ondansetron 8 mg PO or IV before Methotrexate
- prochlorperazine 10 mg PO after Methotrexate infusion completed and then 10 mg PO q4h PRN

For ritUXimab portion
- For intravenous infusion:
  - diphenhydrAMINE 50 mg PO prior to ritUXimab IV and then q 4 h during the IV infusion, if the infusion exceeds 4 h
  - acetaminophen 650-975 mg PO prior to ritUXimab IV and then q 4 h during the IV infusion, if the infusion exceeds 4 h
- For subcutaneous injection:
  - diphenhydrAMINE 50 mg PO prior to ritUXimab SC
  - acetaminophen 650-975 mg PO prior to ritUXimab SC

SUPPORTIVE MEDICATIONS:

<table>
<thead>
<tr>
<th>DRUG</th>
<th>DOSE</th>
<th>BC CANCER ADMINISTRATION GUIDELINES</th>
</tr>
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<tbody>
<tr>
<td>dexamethasone</td>
<td>4 mg QID x 1 week, followed by taper over 1 month as long as patient is clinically improving. (4 mg TID x 1 week, 4 mg BID x 1 week, 2 mg BID x 1 week)</td>
<td>PO</td>
</tr>
<tr>
<td>ranitidine</td>
<td>150 mg BID while on dexamethasone</td>
<td>PO</td>
</tr>
<tr>
<td>cotrimoxazole</td>
<td>1 DS tablet BID 3 x each week while on dexamethasone. <strong>Discontinue cotrimoxazole 48 hours before beginning chemotherapy and resume when the plasma methotrexate is, or is projected to be, less than 0.1 X 10^{-6} molar (note: micromoles/L = 10^{-6} molar). If allergic, do not use any antibiotic prophylaxis.</strong></td>
<td>PO</td>
</tr>
<tr>
<td>lamiVUDine (if HBsAg or HBcoreAb positive)</td>
<td>100 mg/day for the duration of chemotherapy and for six months afterwards</td>
<td>PO</td>
</tr>
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**TREATMENT:**

Patients must have GFR (or CrCl) greater than 60 mL/min and vigorous IV hydration and urine alkalinization to maintain urine pH above 7.¹

<table>
<thead>
<tr>
<th>ALKALINIZING REGIMEN AND PRE HYDRATION:</th>
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<tbody>
<tr>
<td>• IV 2/3 : 1/3 with sodium bicarbonate 100 mEq/L and potassium chloride 20 mEq/L at 125 mL/h x 4 h pre-methotrexate</td>
</tr>
<tr>
<td>• Oral sodium bicarbonate 3000 mg PO q4h until methotrexate level IS LESS THAN 0.1 micromol/L (start on admission to hospital or 0800 h of day planned for Methotrexate if already in hospital)</td>
</tr>
<tr>
<td>• Check urine pH before starting methotrexate. If pH less than 7, continue alkalinizing regimen until urine pH greater than or equal to 7 before starting methotrexate.</td>
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<tr>
<td>methotrexate</td>
<td>8 grams/m² (Day 1) prorated¶ to GFR or CrCl between 60 to 100 mL/min§</td>
<td>IV in 1000 mL NS over 4 hours</td>
</tr>
<tr>
<td>leucovorin</td>
<td>25 mg q6h (start Day 2)</td>
<td>Starting exactly 24 hours after start of Methotrexate infusion; IV for 4 doses then PO until Methotrexate level IS LESS THAN 0.1 micromol/L¶</td>
</tr>
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<tr>
<td>IV 2/3 : 1/3 with sodium bicarbonate 100 mEq/L and potassium chloride 20 mEq/L at 125 mL/h for 48 h after Methotrexate</td>
</tr>
<tr>
<td>riTUXimab† If first IV infusion tolerated (no severe reactions requiring early termination), subsequent doses can be given by SC administration</td>
</tr>
<tr>
<td>375 mg/m² on day 1 or 2 whenever possible but not later than 72 h after Methotrexate (note: given q 2 weekly x 4 doses)</td>
</tr>
<tr>
<td>1400 mg (fixed dose in 11.7 mL) on day 1 or 2 whenever possible but not later than 72 h after Methotrexate (note: given q 2 weekly x 4 doses)</td>
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**NOTE:** One staff Physician signature is required. Orders written by residents and fellows MUST be co-signed.

¶ Prorated dosing, e.g.
- GFR (or CrCl) greater than or equal to 100 mL/min, give 8 grams/m²
- GFR 85 mL/min, give 85% of 8 grams/m²
- GFR 60 mL/min, give 60% of 8 grams/m²
§ IMPORTANT NOTE: use the same renal function measure throughout the treatment course, i.e., if estimated GFR was used initially, subsequent dosing should be based on GFR and not CrCl.

*Start the (first dose) initial infusion at 50 mg/h and, after 1 hour, increase by 50 mg/h every 30 minutes until a rate of 400 mg/h is reached. For all subsequent treatments, infuse 50 mL (or 100 mL) of the dose over 30 minutes then infuse the remaining 200 mL (or 400 mL) (4/5) over 1 hour (total infusion time = 1 hour 30 min). Development of an allergic reaction may require a slower infusion rate. See hypersensitivity below.

If the peripheral blood lymphocyte count is above 30 x 10^9/L, the riTUXimab should be omitted from that cycle.

†Patients must receive first dose by IV infusion (using the IV formulation) because the risk of reactions is highest with the first infusion. IV administration allows for better management of reactions by slowing or stopping the infusion.

‡During treatment with subcutaneous riTUXimab, administer other subcutaneous drugs at alternative injection sites whenever possible.

Cycles are administered every two weeks. Note: riTUXimab is given for a total of 4 doses.

Repeat imaging should be done (CT or MRI) prior to 5th cycle.
- If complete remission is demonstrated, two more cycles should be given (total cycles = 6)
- If a partial remission (greater than or equal to a 50% reduction in the sum of the products of the diameters of the lesion(s) is demonstrated, give two more cycles, then repeat imaging. If there is ongoing improvement, continue treatment until maximum response achieved or ten cycles administered, whichever comes first.
- If progressive disease or stable disease is demonstrated, patient should go off protocol and be referred for radiotherapy.

If vitreous involvement is present (either alone or in association with parenchymal disease), the patient should be reassessed by the ophthalmologist monthly while on treatment, in order to assess for ongoing response. If there is no response or progressive disease, the patient should receive eye XRT.

¶ Methotrexate must be given in a hospital where rapid reporting of methotrexate levels is available. Plasma methotrexate levels are performed routinely each morning after starting the methotrexate infusion. At 24 hours, leucovorin rescue begins according to the protocol. A dose of leucovorin 25 mg q6h is used initially. The plasma methotrexate concentrations done on day 2 and day 3 are used to plot the initial slope of the curve on the Bleyer diagram below, but only the Methotrexate concentration done on day 3 should be used to increase the dose of leucovorin, if necessary. Leucovorin is continued until the plasma methotrexate is, or is projected to be, less than 0.1 X 10^-6 molar (note: micromoles/L = 10^-6 molar).
DOSE MODIFICATIONS:

1. **Renal Dysfunction:**
   - If GFR (or CrCl) less than 60 mL/min, reversible causes of renal dysfunction should be treated and the patient reassessed for suitability for this treatment once renal function improves.
   - Use the **same** renal function measure throughout the treatment course, i.e., if estimated GFR was used initially, subsequent dosing should be based on GFR and **not** CrCl.

2. **Mucositis** greater than or equal to Grade 3 (painful erythema, edema or ulcers and cannot eat), reduce methotrexate to 80% or prolong routine rescue for 2 more days (unless abnormal methotrexate levels).

PRECAUTIONS:

1. **Third space fluids:** Patients with clinically or radiologically detectable third space fluid (e.g. pleural effusion, ascites, full extremity pitting edema) should NOT be given high dose methotrexate.

2. **Renal elimination:** Patients with elevated serum creatinine or calculated GFR (or CrCl) below 60 mL/min should NOT receive high dose methotrexate. Avoid concomitant use of drugs that may inhibit renal elimination of methotrexate such as non-steroidal anti-inflammatories (NSAIDs), salicylates and sulfa drugs.

3. **Hypersensitivity:** ritUXimab can cause allergic type reactions during the IV infusion such as hypotension, wheezing, rash, flushing, alarm, pruritus, sneezing, cough, fever or faintness. Patients are to be under constant visual observation during all dose increases and for 30 minutes after infusion completed. Vital signs are not required unless symptomatic. Because transient hypotension may occur during infusion, consider withholding antihypertensive medications 12 hours prior to ritUXimab infusion. If an allergic reaction occurs, stop the infusion and the physician in charge should determine a safe time and rate to resume the infusion. A reasonable guideline is as follows. After recovery of symptoms, restart ritUXimab infusion at one infusion rate below the rate at which the reaction occurred and continue with escalation of infusion rates on the appropriate schedule above. If the infusion must be stopped a second time, restart after clearance of symptoms, at one infusion rate lower and continue at that rate without further escalation. Fatal cytokine release syndrome can occur (see below). See BC Cancer Hypersensitivity Guidelines.


Note: New laboratory method has a higher limit of detection and inaccuracies have been reported with methotrexate levels below 0.1 micromol/L.
4. **Fatal Cytokine Release Syndrome** has been reported with riTUXimab. It usually occurs within 1 to 2 hours of initiating the first infusion. Initially, it is characterized by severe dyspnea (often with bronchospasm and hypoxia) in addition to fever, chills, rigors, urticaria and angioedema. Pulmonary interstitial infiltrates or edema visible on chest x-ray may accompany acute respiratory failure. There may be features of tumour lysis syndrome such as hyperuricemia, hypocalcemia, acute renal failure and elevated LDH. For severe reactions, stop the infusion immediately and evaluate for tumour lysis syndrome and pulmonary infiltration. Aggressive symptomatic treatment is required. The infusion can be resumed at no more than one-half the previous rate once all symptoms have resolved, and laboratory values and chest x-ray findings have normalized.

5. **Neutropenia**: Fever or other evidence of infection must be assessed promptly and treated aggressively.

6. **Rare Severe Mucocutaneous Reactions**: (similar to Stevens-Johnson Syndrome) have been anecdotally reported with riTUXimab. If such a reaction occurs, riTUXimab should be discontinued.

7. **Gastrointestinal Obstruction or Perforation**: There have been rare reports of gastrointestinal obstruction or perforation, sometimes fatal, when riTUXimab is given in combination with other chemotherapy, occurring 1 to 12 weeks after treatment. Symptoms possibly indicative of such complications should be carefully investigated and appropriately treated.

8. **Hepatitis B Reactivation**: All lymphoma patients should be tested for both HBsAg and HBcoreAb. If either test is positive, such patients should be treated with LamivUDine during chemotherapy and for six months afterwards. Such patients should also be monitored with frequent liver function tests and hepatitis B virus DNA at least every two months. If the hepatitis B virus DNA level rises during this monitoring, management should be reviewed with an appropriate specialist with experience managing hepatitis and consideration given to halting chemotherapy.

9. **Possible interactions with proton pump inhibitors (e.g., pantoprazole, omeprazole, lansoprazole)** have been reported, resulting in elevated methotrexate levels and increased risk of methotrexate toxicity. Consider discontinuing proton pump inhibitors 1 day prior to methotrexate administration. If their use is required, closely monitor methotrexate levels and monitor for signs of methotrexate toxicity.

10. **Possible interaction with penicillins (e.g., amoxicillin, piperacillin, ticarcillin)**. Penicillins compete with methotrexate for excretion sites in the renal tubules resulting in increased serum methotrexate and toxicity. Primarily a concern with high-dose methotrexate and thus the combination should be avoided if possible.

11. **Medication Safety**: riTUXimab is formulated differently for IV versus subcutaneous administration. Use caution during prescribing, product selection, preparation and administration. IV formulation is supplied as 10 mg/mL solution which must be diluted prior to administration. Subcutaneous formulation is supplied as a fixed dose of 1400 mg/11.7 mL ready-to-use solution which contains hyaluronidase to facilitate injection.

12. **Increased drug absorption by hyaluronidase**: other subcutaneous medications should not be injected at the same site as subcutaneous riTUXimab. Increased systemic effects are unlikely to be clinically significant with topical applications of EMLA, hydrocortisone, or diphenhydramINE.

Call Dr. Diego Villa or tumour group delegate at (604) 877-6000 or 1-800-663-3333 with any problems or questions regarding this treatment program.

References:

APPENDIX 1:

Folstein's Mini-Mental Status Exam

1. Orientation (10 pts)
   - Time – Date, Year, Month, Day, Season
   - Place – Hospital, Floor, City, Province, Country

2. Registration (3 pts)
   - 3 objects – 1st repetition

3. Attention and Calculation (5 pts)
   - Serial 7’s or spell “world” backwards

4. Recall (3 pts)
   - recall 3 objects

5. Language (8 pts)
   - Naming – watch and pencil (2 pts)
   - Repetition – “No if’s, and’s, or but’s” (1 pt)
   - 3-stage command – “Take the paper in your right hand, fold it in half and put it on the floor” (3 pts)
   - Reading – “Close your eyes” (1 pt)
   - Writing – spontaneous sentence (1 pt)

6. Copying (1 pt)

TOTAL SCORE     ____ / 30