The Walton Centre
NHS Foundation Trust

Excellence in Neuroscience

VANCOMYCIN CONTINUOUS INFUSION ADMINISTRATION WITHIN CRITICAL CARE

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1. Introduction

Vancomycin is a glycopeptide antibiotic with slow bactericidal effects of proliferating gram positive organisms. The efficacy of vancomycin depends on the time for which the serum concentration exceeds the minimum inhibitory concentration for the micro-organisms rather than the attainment of high peak concentrations. High peaks are not associated with improved bactericidal effects and may be associated with increased toxicity. Continuous infusions have been shown to be as efficacious as intermittent infusions with the advantage of faster attainment of target plasma concentrations and simplified monitoring.

2. Indication

Vancomycin is the glycopeptide of choice for empirical treatment on Horsley Critical Care. Teicoplanin should only be used on a Consultant Microbiologist advice.

3. Form

Strengths available: 500mg vial and 1g vial.

4. Reconstitution and dilution

Reconstitute with water for injection. Add 10mL to a 500mg vial and 20mL to a 1g vial. This gives a 50mg in 1mL solution.

Dilute further with sodium chloride 0.9% (glucose 5% can be used in patients with sodium restriction):

- For loading dose see 5.1.
- For continuous infusion via **central line**: dilute vancomycin to a concentration of **10mg/mL** e.g.:
  - To prepare the 2g in 200mL infusion withdraw 90mL from 250mL bag of an appropriate diluent and add 40mL (2g) of the reconstituted vancomycin solution.
  - To prepare 1g in 100mL infusion withdraw 20mL from 100mL bag of an appropriate diluent and add 20mL (1g) of the reconstituted vancomycin solution.
- For continuous infusion via **peripheral line**: dilute vancomycin to a concentration of **4mg/mL** e.g.:
  - To prepare 1g in 250mL infusion withdraw 20mL from a 250mL bag of an appropriate diluent and add 20mL (1g) of the reconstituted vancomycin solution.
  - To prepare 2g in 500mL infusion withdraw 40mL from a 500mL bag of an appropriate diluent and add 40mL (2g) of the reconstituted vancomycin solution.

Once reconstituted the infusion has a **24 hour expiry.**

5. Prescribing and administration

Vancomycin has a low pH and may cause venous irritation and tissue damage in cases of extravasation.

If a central venous access device is unavailable, administer via a large peripheral vein (green cannula or larger) monitoring insertion site closely using a recognised phlebitis scoring tool. Re-site cannula at first signs of inflammation.

Concentrations greater than 5mg/mL should always be given via central venous access.

5.1. Step 1 – Loading dose

All patients who have not received a dose of vancomycin within the last 24hours need a loading dose prior to starting the infusion.

The loading dose is based on **actual body weight**.

The dose should be made up in either sodium chloride 0.9% or glucose 5%. The appropriate loading dose should be prescribed on the once only section.

Actual Body Weight	Dose	Volume for PERIPHERAL administration	Volume for CENTRAL administration	Duration of Infusion
< 40kg	750mg	250mL	100mL	90 minutes
40-59 kg	1000mg	250mL	100mL	2 hours
60-90 kg	1500mg	500mL	250mL	3 hours
> 90kg	2000mg	500mL	250mL	4 hours

5.2. Step 2 – Continuous infusion

Start the continuous infusion immediately after completion of the loading dose. Prescribe on the continuous infusion section of the drug chart, and on the antibiotic section with words to the effect of 'see infusion chart'.

Calculate patient's creatinine clearance using Cockcroft-Gault equation:

$$CrCl = \frac{(140 - patients\ age) x\ weight\ in\ kg^{*}\ x\ 1.23\ (males) or\ 1.04\ (females)}{Serum\ creatinine}$$

*Actual body weight should be used except for obese patients (actual body weight >130% IBW) where ideal body weight (IBW) is used.

Males: IBW = 50kg + 2.3kg for each inch over 5 feet

Females: IBW = 45.5kg + 2.3kg for each inch over 5 feet

For **central line** administration: prescribe **10mg/mL** concentration
e.g. 1g vancomycin in 100mL or 2g in 200mL.

For **peripheral line** administration: prescribe **4mg/mL** concentration
e.g. 1g vancomycin in 250mL or 2g in 500mL

The continuous intravenous infusion rate should be based upon the patient's creatinine clearance, calculated using Cockcroft-Gault equation:

Creatinine Clearance (ml/min)	Infusion rate: PERIPHERAL Line (mL/hour)	Infusion rate: CENTRAL Line (mL/hour)	Dose of vancomycin administered (mg/hour)
>110	30	12	120
90-110	25	10	100
75-89	20	8	80
55-74	15	6	60
30-54	10	4	40
<20-29	5	2	20
CVVHD or during HD session*	10	4	40

*If your patient is on and off the CVVHD or HD then please amend the rate as appropriate. Examples below:

- An anuric patient is on 2mL/hr of central infusion and is started on a 4 hour session of HD: increase to 4mL/hr for the duration of HD then return to 2mL/hr.
- An anuric patient is on 10mL/hr of peripheral infusion whilst on CVVDH, but circuit clots: decrease the rate to 5mL/hr until the CVVHD is restart and then increase back to 10mL/hr.

Step 3 – Measuring levels and dose adjustment

A serum vancomycin level must be requested 12-24 hours after starting the infusion then with morning bloods DAILY, unless otherwise advised by a pharmacist.

The daily maintenance dose should be adjusted according to the level using the table below:

Vancomycin Level	Dose change	Rate change if PERIPHERAL (4mg/mL)	Rate change if CENTRAL (10mg/mL)
< 10mg/L	Increase by 40mg/hr consider IV bolus in addition; discuss with pharmacist	Increase by 10mL/hr	Increase by 4mL/hr
10-15mg/L	Increase by 20mg/hr	Increase by 5mL/hr	Increase by 2mL/hr
15-25mg/L*		No change	
>26-30mg/L	Decrease by 20mg/hr	Decrease by 5mL/hr	Decrease by 2mL/hr
>30mg/L	Stop infusion for 4 hours and re-check level. Decrease by 40mg/hr when level <25mg/L	When level<25mg/L decrease by 10mL/hr	When level <25mg/L decrease by 4mL/hr

* Some indications including CNS infections or MRSA bacteraemia may warrant a level at the higher end of the range (20-25mg/L) so the dose may be increased accordingly in agreement with pharmacy.

When changing the rate of infusion of vancomycin on the continuous infusion chart, the original vancomycin prescription must be crossed through by the prescriber, with a signature, date and time. The prescription can then be rewritten with the new adjusted dose.

6. Transfer to ward

- Continuous vancomycin infusions are used in critical care only.
- Patients should be converted to intermittent dosing before being transferred to ward areas.
- Dosing should be based on total daily dose of vancomycin.
- **It is preferable that this plan is made by the critical care pharmacist during working hours, bleep your pharmacist for advice on dosing and timing of next dose. If out of hours, please bleep the on call pharmacist.**

Doses up to 1g in 24 hours should be prescribed every 24 hours. Doses between 1g and 2.5g in 24 hours should be divided into two doses and prescribed every 12 hours. Doses over 2.5g should be divided into three doses and prescribed every 8 hours. Round the doses to the nearest 250mg.

Please see table below for when to prescribe the first intermittent dose and when to take the next level:

Last vancomycin level	**Converting to intermittent dosing**	**Re-check next vancomycin level**
15-20mg/L	Stop infusion at a suitable time and start intermittent dosing.	Pre-dose of the third or fourth intermittent dose, whichever is more suitable.*
20-25mg/L	Stop infusion and prescribe intermittent dosing 8-12hours later.	Pre-dose of the third or fourth intermittent dose, whichever is more suitable.*
<15mg/L >25mg/L	Contact pharmacy for advice.	

*if the patient is on once daily dosing then re-check the vancomycin level pre-dose of the second intermittent dose.

7. Contraindications and cautions

- Vancomycin should not be administered intramuscularly due to the risk of necrosis at the site of administration.
- Ototoxicity, which may be transitory or permanent has been reported in patients with prior deafness
- Rapid bolus administration (i.e. over several minutes) may be associated with exaggerated hypotension (including shock and, rarely, cardiac arrest), histamine like responses and maculopapular or erythematous rash (“red man's syndrome” or “red neck syndrome”).
- Vancomycin should be infused at a rate no greater than 10 mg/min and over a period not less than 60 minutes to avoid rapid infusion-related reactions
- Stevens-Johnson syndrome (SJS) has been reported with the use of vancomycin.

8. Requirements for prescribers

- Confirm if the patient has had any vancomycin within the previous 24hours.
- Ensure the correct loading dose is prescribed and given.
- Confirm whether the patient has central or peripheral access for the infusion.
- Ensure the correct continuous infusion rate is start based on the patient's CrCl using the Cockcroft-Gault equation.
- Document the range for the vancomycin levels to be aimed for.
- Ensure the vancomycin level is sent every morning for interpretation.
- Review levels daily and ensure the rate is amended if the dose needs to be adjusted based on levels, discuss with pharmacy if needed.
- Inform pharmacy that vancomycin is prescribed, this includes informing the on call pharmacist if vancomycin is started out of hours as they will monitor the drug levels and advise on adjustments accordingly.

9. Requirements for nurses

- Ensure the loading dose has been prescribed and given before starting the continuous infusion.
- Ensure it is documented if the infusion is for peripheral or central administration.
- Ensure the correct concentration is used for peripheral or central administration.
- Ensure the vancomycin level is sent every morning for interpretation.
- Monitor for any signs of extravasation.

10. Extravasation guidance

If there are any signs of injection site reaction or extravasation stop the infusion immediately and call a doctor. If extravasation has occurred then apply a cold pack for 30 minutes every 4 hours for 24 hours and apply hydrocortisone cream 1% every 6 hours for 7 days or as long as erythema persists.

11. References

1. Medusa injectable medicines guide – Vancomycin accessed July 2019
2. Summary Product Characteristics – Vancomycin 1000 mg powder for concentrate for solution for infusion, accessed via www.medicines.org.uk July 2019
3. 'Guidelines for the dosing and monitoring of continuous vancomycin infusion in adult patients within critical care and in the burns service' Chelsea and Westminster Hospital NHS Foundation Trust, July 2019.
4. Medusa injectable medicines guide – extravasation guidance accessed July 2019