Nursing aspects of inhaled nitric oxide therapy in neonates

Monika Sedlbauer
Practice Educator
Monika.Sedlbauer@gosh.nhs.uk

Great Ormond Street Hospital
NICU
Objective:

- Overview
- GOSH admissions 2014
- Side effects
- Nursing aspects
- Common problems
- Questions
Overview

- FDA approved iNO in 1999
- Improve oxygenation
- Reduces pulmonary hypertension
- Reduces need for ECMO (30 - 40%)
- No effect on overall mortality
Dosage:
- Up to 20ppm
- Higher doses are not recommended

Delivered directly into ventilator circuit
- Very short half life time
GOSH admissions

2014

139 patients for iNO therapy

NICU: n= 22
PICU: n= 17
CICU: n= 100
Side effects

- Nitrogen dioxide (NO2) production
- Methemoglobinemia
- Surfactant dysfunction
- Bleeding problems
- Withdrawal/ rebound effects
Nursing aspects

- Monitor and document:
  - Pre& post ductal spO2
  - Delivered FiO2
  - OI
  - paO2
  - NO
  - NO2
  - MetHb
Nursing aspects

Monitor and document:
- Amount of NO in cylinders
- Skin, secretions and urine for signs of bleeding
- Temperature
- Pain
  - PAT
- Extra analgesia, sedation, muscle relaxant?
Nursing aspects

- Avoid disconnection from ventilation system
  - Use inline suctioning
- Hand ventilation available and ready to use
- Minimal handling and clustering care
- Skin care
  - Repositioning
  - Repose mattress
  - Aderma®
Nursing aspects

Always check:

- If system is correctly connected
- If NO is prescribed
- If there is a spare, full NO cylinder available
- If parents are up to date and involved in care
Nursing aspects

Weaning of iNO

- Never stop suddenly
  - Weaning protocol at GOSH since 2011
    - Nurse lead
    - Reduced time of iNO used
    - More controlled
Weaning of iNO

Weaning starts when:
$\text{FiO}_2 \leq 0.6 \text{ AND } \text{PaO}_2 \geq 8 \text{ kPa AND } \text{SpO}_2 \geq 92\%$

- $\text{INO} > 20 \text{ ppm}$
  - Decrease $\text{INO}$ down to 20 ppm over 24h according to site standard practice
- $\text{INO} \leq 20 \text{ ppm}$
  - Use the following weaning protocol

$\text{FiO}_2 = 0.8$
- Progressively decrease $\text{FiO}_2$ down to 0.4 per step of 2% to 4% per hour

$\text{FiO}_2 = 0.4$
- $\text{PaO}_2 \geq 8 \text{ kPa}$

$\text{FiO}_2 = 0.4$
- $\text{FiO}_2 = 0.5$

$\text{O}_2$ must remain 82% and/or $\text{PaO}_2 \geq 8 \text{ kPa}$ before moving from one step to another

at least 1h for each step

T0h
- $\text{INO} = 20 \text{ ppm (at least 2h)}$

T2h
- $\text{INO} = 15 \text{ ppm (at least 2h)}$

T4h
- $\text{INO} = 10 \text{ ppm (at least 2h)}$

T6h
- $\text{INO} = 5 \text{ ppm}$

T7h
- $\text{INO} = 4 \text{ ppm}$

T8h
- $\text{INO} = 3 \text{ ppm}$

T9h
- $\text{INO} = 2 \text{ ppm}$

T10h
- $\text{INO} = 1 \text{ ppm}$

$\text{INO} \text{ removed}$

T11h
- $\text{INO removed}$
Weaning of iNO

Weaning starts when:

- $\text{FiO}_2 \leq 0.6$
- $\text{PaO}_2 \geq 8 \text{ kPa}$
- $\text{SpO}_2 \geq 92\%$
- ppm $\leq 20$ ppm
Weaning of iNO

- Wean iNO down by 5ppm every 2 hours

- Wean till you reach 5ppm, but only if:
  - $\text{PaO}_2 \geq 8 \text{ kPa}$ and/or
  - $\text{SpO}_2 \geq 92\%$
Weaning of iNO

- Progressively wean FiO2 down to 0.4 by 2-4% per hour, but **only** if
  - PaO$_2$ ≥ 8 kPa and/or
  - SpO$_2$ ≥ 92%
Weaning protocol

- Next steps, only if:
  - FiO2 ≤ 0.4
  - iNO 5ppm
  - PaO₂ ≥ 8 kPa and/or
  - SpO₂ ≥ 92%
Weaning protocol

- Wean iNO by 1ppm
- Hourly if tolerated
- Increase Fio2 to 0.5 in the hour when iNO is completely switched off
Setting up of iNO

- iNO and HFOV:
  - better than either alone in rescuing neonates with resp. failure
  - (Kinsella et al, J. Pediatrics, 1997)
Setting up of iNO

- Different NO systems in NICUs
- INOmax® very common
- Sensormedics 3100A + INOmax®
- Setting up system as per local policy
- Purge system before use
Common problems are....

- Not purged correctly
  - When to purge?

- Not connected correctly
  - Where and how to connect?

- No spare cylinders available if needed
  - Where to find full ones?
Common problems are....

- Not switched on completely
  - Risk of depressurising of system

- Cylinder valve defect
  - Gas delivery stops before cylinder is empty
    “Medicines and Healthcare Products Regulatory Agency Feb. 2015”

- Not switched off at therapy end
  - Reasons?
  - Cost
Setting up of iNO

Injector module

22F-22F connector

22M/15F connector

One way valve
Setting up of iNO

NO delivery system

Manual bagging system flow meter
Setting up iNO

- NO dose knob
- Bagging circuit
- Oxygen flow meter
Setting up of iNO

- Bagging circuit attached to separate NO cylinder (if INOmax® system is not used)

- Set ppm on INOmax® bagging system and start flow prior to bagging

- Always make sure you have spare cylinder
Questions?