High flow nasal Oxygen therapy

15.06.2017
Oxford Advanced Course: Newcastle

Learning points

• Update on BTS guidance – May 2017
• Help you understand the mechanism of action of high flow nasal oxygen therapy
• Help you think about the role of HFNOT in the management of dying patients
• Help you develop a policy for your service

Part 1: Oxygen
Oxygen - there is a problem

- Doctors and nurses have a poor understanding of how oxygen should be used
- Oxygen is often given without a prescription (2015 BTS audit - 42% of hospital patients using oxygen had no prescription)
- If there is a prescription, patients do not always receive what is specified on the prescription
- Where there is a prescription with target range
  - 69% of SpO2 results were within the target range
  - 9.5% below target range
  - 21.5% above target range

Learning points for me?

- Up to date with guidance?
- Housekeeping across my areas of clinical responsibility – what does that look like?
Basis of the BTS guideline: 
Prescribing by target oxygen saturation

Keep the oxygen saturation normal/near-normal for all patients except pre-defined groups who are at risk from hypercapnic respiratory failure

What is the minimum arterial oxygen level recommended in acute illness?

- **Target oxygen saturation**
  - Critical care consensus guidelines *Minimum 90%*
  - Surviving sepsis campaign Aim at *88-95%*
  - But these patients have intensive levels of nursing & monitoring

  This guideline recommends a minimum of *94%* for most patients – combines what is near normal and what is safe

What is a “normal” nocturnal oxygen saturation?

Healthy subjects in all age groups routinely desaturate to an average nadir of 90.4% during the night (SD 3.1%)

*Gries RE et al Chest 1996; 110: 1489-92*

*Therefore, be cautious in interpreting a single oximetry measurement from a sleeping patient. Watch the oximeter for a few minutes if in any doubt (if the patient is otherwise stable) because normal overnight dips are of short duration.*
Normal Range for Oxygen saturation

Normal range for healthy young adults is approximately 96-98% 
(Crapo AJRCCM, 1999;160:1525)

There is a slight fall with advancing age
A study of 871 subjects showed that age > 60 was associated with minor SpO2 reduction of 0.4%
An audit in Salford and Southend showed mean SpO2 of 96.7% with SD 1.9 in 320 stable hospital patients aged >70 without lung disease or heart failure (2 SD range 92.9 to 100%)
(O’Driscoll R et al Thorax 2008; 63(suppl VII): A126)

Take home figures & messages...

• 94 – 98%
• Remember the effect of aging
• Remember the night

Some patients are at risk of CO₂ retention and acidosis if given high dose oxygen

Chronic hypoxic lung disease
• COPD
• Severe Chronic Asthma
• Bronchiectasis
• Cystic Fibrosis
• Chest wall disease (Kyphoscoliosis, Thoracoplasty)
• Neuromuscular disease
• Morbid obesity and OHVS (Obesity Hypoventilation Syndrome)

* Blood gases should be checked for all such patients if they need oxygen
* Target saturation range is 88-92% if CO2 level is elevated (or if it was high in the past)

Safeguarding patients at risk of type 2 respiratory failure

- Lower target saturation range for these patients (88-92%)
- Education of patients and health care workers
- Use of controlled oxygen via Venturi masks or low flow nasal O2
- Use of oxygen alert cards
- Issue of personal Venturi masks to high-risk patients

Danger of Rebound Hypoxaemia

If you find a patient who is severely hypercapnic due to excessive oxygen therapy...... Do NOT stop oxygen therapy abruptly

The PaCO2 is very high which will cause low PAO2 as soon as oxygen is removed as demonstrated by the Alveolar Gas Equation (PAO2 = PIO2 – PaCO2/RER)

It is safest to step down to 35% oxygen if the patient is fully alert or call your Critical Care team to provide mechanical ventilation if the patient is drowsy
Take home figures & messages...

- Remember who can get hypercapnic respiratory failure
- Ask patients / families about alert cards AND organise them for patients
- For them 88 – 92% target saturation
- Remember do not stop the oxygen
- Question – ABGs in my inpatient unit?

Exposure to high concentrations of oxygen may be harmful

Risk to COPD patients
- Absorption Atelectasis even at FIO2 30-50%
- Intrapulmonary shunting
- Post-operative hypoxaemia
- Coronary vasoconstriction
- Increased Systemic Vascular Resistance
- Reduced Cardiac Index
- Possible reperfusion injury post MI
- Increased CK level in STEMI and increased infarct size on MR scan at 3 months
- Worsens systolic myocardial performance
- Association of hyperoxaemia with increased mortality in several ITU studies

This guideline recommends an upper limit of 98% for most patients.
Combination of what is normal and safe

Clinical features of hypoxaemia

- The effects are often non-specific
- Depends if onset is chronic or acute
Assessment – need to Measure

Respiratory system exam including Cyanosis (often not recognised and absent with anaemia)

SpO$_2$ – Oxygen saturation measured by pulse oximeter

Blood Gases - PaO$_2$, SaO$_2$
PaO$_2$ = Arterial oxygen partial pressure in blood gas specimen
SaO$_2$ = Arterial oxygen saturation measured in blood gases

Documentation

Oxygen therapy is only one element of resuscitation of a critically ill patient

The oxygen carrying power of blood may be increased by

- Safeguarding the airway
- Enhancing circulating volume
- Correcting severe anaemia
- Enhancing cardiac output
- Avoiding/Reversing Respiratory Depressants
- Increasing Fraction of Inspired Oxygen (FIO2)
- Establish the reason for Hypoxia and treat the underlying cause (e.g. Bronchospasm, LVF etc)
- Patient may need, CPAP or NIV or Invasive ventilation
Escalate Oxygen to reverse hypoxaemia

• Text from guidelines

Aims of emergency oxygen therapy

1. To correct potentially harmful hypoxaemia
2. To alleviate breathlessness (only if hypoxaemic)

Oxygen has not been proven to have any consistent effect on the sensation of breathlessness in non-hypoxaemic patients

Fallacies regarding oxygen therapy

John B Downs MD Respiratory care 2003;48:611-20

THE FALLACY: “Routine administration of supplemental oxygen is useful, harmless and clinically indicated.”

THE FACTS
• Little increase in oxygen-carrying capacity if SpO2 is normal
• Renders pulse oximetry worthless as a measure of ventilation
• May prevent early diagnosis & specific treatment of hypoventilation

The guideline only recommends supplemental oxygen when SpO2 is below the target range.
Oxygen use in palliative care

Most breathlessness in cancer patients is caused by specific issues such as airflow obstruction, infections or pleural effusions and the main issue is to treat the cause NOT Hypoxaemia

• Oxygen has been shown to relieve dyspnoea in hypoxaemic cancer patients but not if PaO2 is >7.3 kPa (saturation above about 90%)
• Morphine and Midazolam also relieve breathlessness and are probably more effective

Summarise the last 9 slides

• Oxygen is not a universal good
• Need to measure SpO2
• Document findings
• Treatment: Oxygen is a component of care of an acutely deteriorating patient – treat hypoxia
• What is our aim?
• Evidence in palliative care?

Devices
High Concentration Reservoir Mask (RM)

- Non re-breathing Reservoir Mask
- Critical illness / Trauma patients
- Post-cardiac or respiratory arrest
- Delivers O2 concentrations between 60 & 80% or above
- Effective for short term treatment

Nasal Cannulae (N)

- Recommended in the Guideline as suitable for most patients with both type I and II respiratory failure.
- 1-6L/min gives approx 24-50% FIO2
- FIO2 depends on oxygen flow rate and patient’s minute volume and inspiratory flow and pattern of breathing.
- Comfortable and easily tolerated
- No re-breathing
- Low cost product
- Preferred by patients (vs simple mask)

Venturi or Fixed Performance Masks (V)

- Aim to deliver constant oxygen concentration within and between breaths.
- 24-40% Venturi Masks operate accurately.
- A 60% Venturi mask gives ~50% FIO2
- With TACHYPNOEA (RR >30/min) the oxygen flow rate should be increased by above the minimum flow rate shown on the packaging - see next slide
- Increasing flow does not increase oxygen concentration because it is a fixed dose
Simple face mask (SM)
(Medium concentration, variable performance)

- Used for patients with type I respiratory failure.
- Delivers variable O2 concentration between 35% & 60%.
- Low cost product.
- Flow 5-10 L/min

Flow must be at least 5 L/min to avoid CO2 build up and resistance to breathing.

Titrating Oxygen up and down

This table below shows APPROXIMATE conversion values.

<table>
<thead>
<tr>
<th>Oxygen Concentration (%)</th>
<th>Flow Rate (L/min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100%</td>
<td>6-10</td>
</tr>
<tr>
<td>70%</td>
<td>5-9</td>
</tr>
<tr>
<td>50%</td>
<td>4-7</td>
</tr>
<tr>
<td>35%</td>
<td>3-5</td>
</tr>
<tr>
<td>21%</td>
<td>2-4</td>
</tr>
</tbody>
</table>

Reservoir mask at 15L oxygen flow
Self-rescue device

If necessary, fluids required seek senior medical input immediately.
FLOW CHART FOR OXYGEN ADMINISTRATION ON GENERAL WARDS IN HOSPITALS

- See target saturation in the patient’s drug chart. Choose the most suitable delivery system and flow rate
- Titrate oxygen up or down to maintain the target oxygen saturation
- The table below shows available options for stepping dosage up or down.
- The chart does NOT imply any equivalence of dose between Venturi masks and nasal cannulae.
- Allow at least 5 minutes at each dose before adjusting further upwards or downwards
- (except with major and sudden fall in saturation – falls ≥3% also require clinical review)
- Once your patient has adequate and stable saturation on minimal oxygen dose, consider discontinuation of oxygen therapy.

Pause and thoughts

High flow nasal oxygen therapy

HFNOT therapy is a medical device that delivers gas with a flow rate (up to 60 L/min), warmed to body temperature (34 – 37 degrees), pressure saturated for optimal humidification with accurately titrated oxygen content (21-100%) to spontaneously breathing patients.

The device has a compressor system providing the ability to mix room air and piped oxygen.

The device has an internal O2 analyser.

HFNOT is increasingly becoming the mechanism of choice in the management of patients with Type 1 respiratory failure
High flow humidified nasal oxygen (HFNOT)

It is mostly used in Intensive Care Units, High Dependency Units and other specialised areas

Mechanism of action

• Controlled FiO$_2$
• Pharyngeal dead space washout of CO$_2$
• Nasopharyngeal resistance decreased (wet)
• Positive end expiratory pressure
• Alveolar recruitment
• Mucociliary clearance improved
• Reduce the work of breathing
  • Reference

Advantages

• Reversal of hypoxaemia
• Reduced work of breathing
• Improved secretion clearance
• Avoidance of intubation
• Improved patient tolerance / comfort
• Unhindered feeding / speaking
Contraindications

• Irreversible Type 1 respiratory failure?
• Profound hypercapnic / Type 2 respiratory failure requiring NIV or intubation and mechanical ventilation e.g. pH < 7.35 with a PaCO2 > 6kPa
• Respiratory arrest or peri-arrest / apnoea
• Basal skull fractures
• Cerebro-spinal fluid leaks
• Nasal passage abnormalities or recent nasal surgery
• Nasal pharyngeal airway insitu
• Severe epistaxis (consider thrombocytopaenia and clotting abnormalities)

Beware of air outlets
They may be mistaken for oxygen outlets

Use a cover for air outlets or else remove the flow meter for air
Oxygen outlet when not in use

Best Practice
Discontinuation of HHFNC therapy may be considered when patient demonstrates:
- Correction of hypoxaemia
- Reduced work of breathing
- Ability to adequately clear secretions
- Non-compliance / request to cease therapy
- Advancement to other non-invasive or invasive respiratory therapy
Symptom control - literature

Summary
Humidified HFNC can provide adequate oxygenation and relieve dyspnea in carefully selected patients with hypoxemic respiratory failure. Data are scant on its use in patients nearing the end of life. Clinicians should be cautious about non-evidence-based use of HFNC in patients without a realistic path to recovery.

Symptom control

- Patients are comfortable on the device
- Reduced work of breathing
- Less dyspnoea
- Secretions are easier to manage

Palliative care practice: Asked about the units experience

Hui J et al

- HFNOT ‘is often initiated without adequate discussion with the patient and family and that weaning palliative patients off HFNOT can result in respiratory distress and suffering if symptoms are not adequately controlled by other means. In light of these concerns, a working group was established in Calgary to develop a Practice Support Document to ensure appropriate use of HFNOT in the palliative setting in Acute Care Facilities in Calgary, Alberta.
Proposal 1:

Unconscious dying patients

- HFNO therapy is not indicated for symptom management in dying patients. Where the patient is deeply unconscious the delivery device should be switched off and the nasal cannula should be removed.
- Where the patient seems aware at times a prn dose of opioid should be administered in advance of stopping the delivery device.
  - 1/6 to 1/4 of the total daily opioid dose or
  - Morphine 5mg SC if opioid naive or
  - Oxycodone 2.5 mg if opioid naive and CKD 4 or 5
- Should the patient become unexpectedly distressed within the first 10 minutes following removal then replace the device (same flow rate and FiO2). Seek help from the palliative care team

Should we continue HFNOT in unconscious dying patients?

A. Yes
B. No
C. Unsure

Cover with prns – does this sound reasonable?

A. Yes
B. No
C. Maybe
Proposal 2

Starting HFNOT for dying patients approaching the end of life
- Should never be started for symptom control
- The purpose is to delay dying
- Only to be used in patients with mental capacity
- Do not check SpO₂

Check SpO₂

A. Yes – duration of therapy
B. Yes – while stabilising
C. No
D. Maybe

Time to think if:
- Patient not meeting or maintaining the therapeutic goal/s stated on starting HFNO therapy
- Patient not progressing with rehabilitation
- Patient deteriorating week to week or day to day
- Progression of organ failure / multi-organ failure
- Respiratory distress on HFNO therapy
- The team are considering a DNA CPR alongside the balance of burdens, harms and benefit of other interventions
Time to talk:

- This is not an emergency and should not be done overnight
- Select a time to speak with the patient and their preferred family member or friend
- Develop an understanding of their knowledge of disease, prognosis, views on treatment, views on whether they think they are improving and what is important to them if they are not improving / dying
- Come to a decision as to whether the patient has capacity to decide about HFNO therapy. (If they do not have capacity to make this decision might there be things you could do to improve capacity – following the principles of the Mental Capacity Act. Does the patient have an Advance Decision to Refuse Treatment, a Lasting Power of Attorney for health or an IMCA)

Time to talk

- Discuss the balance of benefits of treatment as against the burdens and harms of that treatment
  - HFNO therapy will delay dying where dying is inevitable
  - Will need to remain on current ward and will be unable to return home
  - May develop pressure areas from nasal cannula
- Offer your diagnosis that the patient is approaching the end of their life
- Offer your view that the patient is no longer benefitting from HFNO therapy
- Discuss the other possibilities of managing symptoms using opioids, benzodiazepines, other means of providing air movement and position
- Offer the patient time to think and arrange a time to review

Discontinuing HFNO therapy:

- Give a prn dose of opioid 20 – 30 minutes in advance of stopping the delivery device.
  - 1/6 to 1/4 of the total daily opioid dose or
  - Morphine 5mg SC if opioid naïve or
  - Oxycodeone 2.5 mg if opioid naïve and CKD 4 or 5
  - Switch from HFNO therapy to nasal cannula at 4 L/minute and FiO\textsubscript{2} 24%
  - Monitor for 15 minutes – if the patient is comfortable reduce the flow rate to 2 L/minute and discontinue after an hour
  - Give regular 4 hourly opioid (oral or SC) and if necessary a benzodiazepine
  - Review the situation at 24 hours and calculate the total opioid dose needed in 24 hours (oral or SC)
Q4

Have you discontinued HFNOT
Never
Once
2 – 5
5 – 10
>10

Have you discontinued HFNOT
A. Never
B. Once
C. 2 – 5
D. 6 -10
E. >10

Any comments?
Policy

- Thank you for your input today
- Sharing the palliative care guidance for your comments
- Gather our experience for a year?

Thank you