Emergency Department Journal Meeting

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Acute Pulmonary Embolism

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Review Article
Current Concepts

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Diagnosis

Diagnosis

- Diagnostic workup：
  depend on the severity of the clinical presentation
  →hemodynamically stable or unstable
- Probability of pulmonary embolism
  Wells and revised Geneva scores
- Hemodynamically unstable：shock、SBP<90 mmHg、
  Pressure drop of ≥40 mmHg for >15 min
- Hemodynamic stability：
  - D-dimer testing
  - Multidetector computed tomography
  - Ventilation–perfusion scanning

Diagnosis - Hemodynamic stability

- **D-dimer**：increased D-dimer → specificity ↓
  ＊cancer, pregnant women, and hospitalized and elderly patients
- **Low or intermediate clinical probability**：
  normal results on D-dimer testing
  →avoids unnecessary further investigation
  ＊further investigation is avoided in about 50% of outpatients and 20% of inpatients
  ＊anticoagulant treatment is not given, the estimated 3-month risk of thromboembolism is 0.14%

Diagnosis - Hemodynamic stability

- **High clinical probability or high D-dimer level**
  → Multidetector CT
  ＊MDCT(-) / anticoagulation therapy(-) ：
  thromboembolic events is approximately 1.5% at 3 mo.
- CT pulmonary angiography + Lower-limb CT venography
  ：negative predictive value 95~97%
- High clinical probability & MDCT(-) ：
  the value of additional testing is controversial
  ＊Venous ultrasonography：DVT < 1%

Diagnosis - Hemodynamic stability

Pregnant women

- Missing a potentially fatal diagnosis
- Unnecessary anticoagulant treatment
- Multidetector CT：delivers a higher dose of radiation to the mother but a lower dose to the fetus than ventilation–perfusion lung scanning
- PIOPED III：magnetic resonance angiography
  → insufficient sensitivity & high rate of technically inadequate images

Diagnosis - Hemodynamic stability

Multidetector CT is not available (contraindication)

→ ventilation–perfusion scan

- Normal：rules out pulmonary embolism (negative predictive value of 97%)
- Findings：positive predictive value of 85 to 90%.

∗ PE R/O by image：3 months venous thromboembolism
CT：0.4%　Ventilation–perfusion scanning：1%

- Nondiagnostic ventilation–perfusion scan
  → Ultrasonography ：4% P't DVT

Diagnosis - Hemodynamic stability

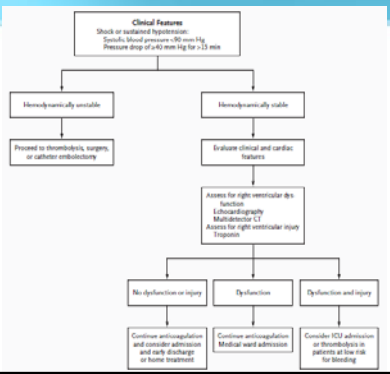
Venous ultrasonography

- Venous ultrasonography of the lower limbs is performed first：Chest MDCT can be avoided in about 10% suspect PE
- Stable + suspected PE + DVT(+ by echo)
  → anticoagulant treatment without further testing
- Pregnant women & contraindication to MDCT：
  →Venous ultrasonography → imaging tests

Diagnosis - Hemodynamic unstable

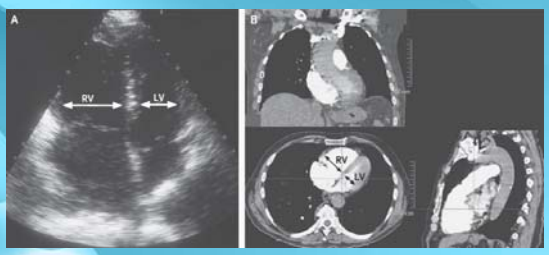
- MDCT：97% sensitivity (main pulmonary arteries)
- MDCT not available：echocardiography (RV dysfunction)
- Transesophageal echocardiography：emboli in the main pulmonary arteries
- Critically ill： thrombolytic therapy should be considered if there are unequivocal signs of RV overload on bedside echocardiography.
- ↓Conventional pulmonary angiography：reserved for the rare cases in which percutaneous embolectomy is indicated.

Risk Stratification



Risk Stratification

- Risk stratification is based on clinical features and markers of myocardial dysfunction or injury
- Mortality rate：unstable 58%、stable 15%
- **Hemodynamically stable P't**：
  RV dysfunction on echocardiography
  → mortality rate ↑
  ∗RV/LV diameter ratio < 1：100% **negative predictive**
  value for an uneventful outcome
  ∗Ventricular septal bowing：a predictor of death



RV **hypokinesis** and **dilatation** have been shown to be independent predictors of 30-day mortality among hemodynamically stable patients with pulmonary embolis

Risk Stratification - Hemodynamically stable

- **BNP** (B-type natriuretic peptide) and **pro-BNP**
  - elevation： ↑ risk of an adverse in-hospital outcome
  - normal：nearly 100% negative predictive
- **Troponin**：elevation

  increase in the short-term risk of death by a factor of 5.2

  increase in the risk of death by a factor of 9.4

  ＊RV dysfunction(echo) + elevated Troponin：particularly high risk for an adverse outcome

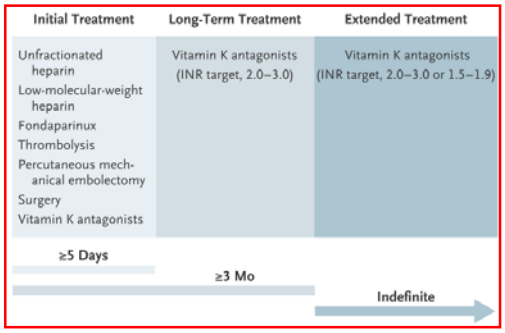
Risk Stratification - Hemodynamically stable

- RV dysfunction(-) and a normal troponin level → early discharge or even outpatient treatment

  Oposite：should be admitted
- RV dysfunction(+) and elevated troponin：the positive predictive value for an adverse outcome 10~20%

  ＊ ongoing study：assessing the benefit of thrombolysis as compared with anticoagulation

Treatment



Treatment

- Acute pulmonary embolism requires initial short-term therapy with a rapid-onset anticoagulant, followed by therapy with a vitamin K antagonist for at least 3 months
- High clinical probability of PE , anticoagulant treatment should be initiated while diagnostic confirmation is awaited

Treatment – Initial treatment

- **Low-molecular-weight heparin**
  - Enoxaparin (1 mg/kg ,BID)
  - Tinzaparin (175 U /kg , QD)
- **Fondaparinux**：<50kg(5mg,QD)；50~100kg(7.5mg,QD)
- **IV unfractionated heparin**：INR 1.5~2.5
  - initial bolus dose：80 IU /kg or 5000 IU
  - continuous infusion：18 IU /kg*hr
  - INR > 2：DC heparin at least 24 hrs
- GFR < 30 → unfractionated heparin
- Major bleeding complications： 3% during hospital

Treatment – Initial treatment

Intravenous thrombolysis (on stable p't)
compared with unfractionated heparin

- reduced the rate of clinical deterioration
- not reduced the mortality rate
- rapid resolution of RV dysfunction
- at 1 week, the degree of RV dysfunction was similar
- no clear advantage of catheter-directed thrombolysis

Treatment – Initial treatment

Hemodynamically unstable

- More aggressive treatment
- Pharmacologic or mechanical **thrombolysis**
  →faster resolution of thromboembolic obstruction than with anticoagulant therapy
- Untreated patients：mortality 60%
- Reduced mortality to less than 30% with prompt treatment
- Major bleeding was more common than anticoagulant therapy
- Contraindications ：intracranial disease, uncontrolled HTN and recent major surgery or trauma (3wks)

Treatment

- No conclusive findings from studies comparing different thrombolytic regimens in patients
- Short infusion times (<2hr)
  → rapid thrombolysis, less bleeding
- Intravenous unfractionated heparin is the only anticoagulant that has been used in conjunction with thrombolytic therapy
- Percutaneous mechanical / Surgical thrombectomy
  - high-risk patients with an contraindication to thrombolysis
  - refractory to thrombolytic treatment
- Percutaneous mechanical thrombectomy
  success rate 86%, major procedural complications of 2.4%

Treatment

Vena cava filters

- contraindications to anticoagulant treatment (time-limited)
- avoid thrombus extension and recurrence

Vitamin K antagonists

- initiated as soon as possible

Long-Term Management

- PE：risk for recurrent thromboembolic events
- Recurrent pulmonary embolism
  - receiving anticoagulant therapy：1% /year
  - DC anticoagulant therapy ：2~10% /year
- **Recurrence risk factors**：male sex, old age, and idiopathic or unprovoked PE (50%)
- **Temporary risk factor**：major surgery, immobilization
  → recurrence rate 3% after first pulmonary embolism

Long-Term Management

- Duration of long-term anticoagulation：
  - the risk of recurrence after DC vitamin K antagonists
  - the risk of bleeding during treatment
- In patients with PE secondary to a temporary (reversible) risk factor, therapy with vitamin K antagonists should be given for 3 months
- **Indefinite anticoagulation**：unprovoked PE, cancer first 3 to 6 months
  - Conventional-intensity warfarin therapy (INR target, 2.0 to 3.0)
  - low-intensity warfarin therapy (INR target, 1.5 to 1.9)

Long-Term Management

- Dabigatran：not require laboratory monitoring
  →as effective and safe as warfarin for the treatment of venous thromboembolism
- After an acute pulmonary embolism, patients should be monitored for **chronic thromboembolic pulmonary hypertension** (incidence 0.8~3.8 % in 2 years)

RESUSCITATION

Cricoid pressure and laryngeal manipulation in 402 pre-hospital emergency anaesthetics: Essential safety measure or a hindrance to rapid safe intubation?

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Abstract

- The first study to look at the effects of **cricoid pressure/laryngeal manipulation** on the laryngeal view and intubation success
- The results suggest that **cricoid pressure should be removed** if the laryngeal view obtained is not sufficient to allow immediate intubation. Further **manipulation of the larynx** is likely to improve the chances of successful tracheal tube placement.

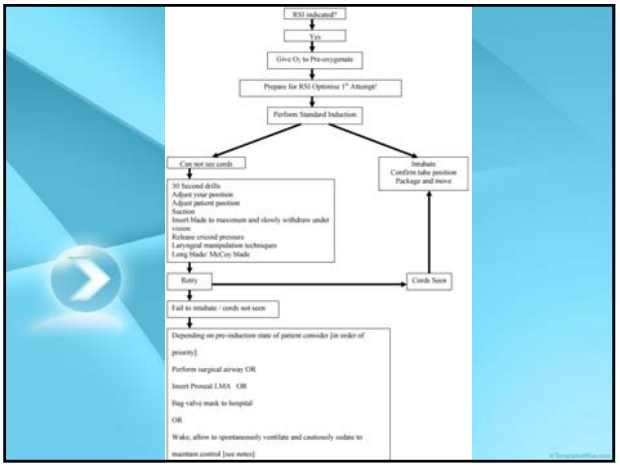
Introduction

Cricoid pressure (CP)

- As part of an RSI technique
- Enhancements for safe and effective emergency ETT
- 21 available studies：routine application of CP
  (The American College of Emergency Physicians and the National Association of EMS Physicians)
- Routine application of CP has been recently challenged
  - impaired laryngeal view
  - less effective bag mask ventilation
  - ？ Reduce incidence of aspiration/regurgitation

Methods

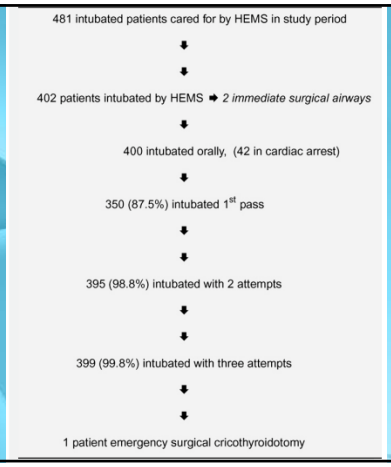
- Study setting：London HEMS (Helicopter Emergency Medical Services, pre-hospital trauma service
- Study interventions：anaesthesia SOP
  - All cases undergoing RSI
  - RSI：Etomidate → suxamethonium →morphine / midazolam → pancuronium
  - Intubations are performed using a gum elastic bougie
  - CP applied by a paramedic assistant
  - Cords are not seen / bougie cannot be passed
    →**remove CP、backwards upwards rightwards pressure (BURP) 、manipulate the larynx under direct vision (BLM)**



Methods

- Study design and selection of participants
  - prospectively collect：16-month period
  - executor：permanent consultant staff or senior trainees
- Methods of measurement and data collection
  - standardised paper questionnaire
  - grade of laryngeal view (Cormack-Lehane Scale)
  - intubation times
  - laryngeal manoeuvres type
  - improvement in laryngoscopy： Cormack-Lehane scale
- Statistical analysis：SAS® version 9.2

Results



Results

- 61 intubations (13.6%)：difficulty intubation

Effect of airway manoeuvres on laryngeal View	Removing CP (intubation = 22)	Performing BLM (intubation = 25)	Applying BURP (intubation = 14)
Improved laryngeal view	11/22 (50.0%)	15/25 (60.0%)	9/14 (64.3%)
Intubation successful	21/22(95.5%)	21/25(84.0%)	11/14(78.6%)
No effect on laryngeal view	9/22 (40.9%)	10/25 (40.0%)	5/14 (37.7%)
Worsened laryngeal view	0	0	0
Incomplete data	2 (9.1%)	0	0

Results

Comparison	Removing CP vs. applying BLM	Removing CP vs. applying BURP	Applying BLM vs. applying BURP
Difference	−10%+	−14%+	−4%+
Odds Ratio (OR)	0.67	+0.56	+0.83
95% CI for OR p-Value	(0.21, 2.12) p = 0.49	(0.14, 2.20) p = 0.40	(0.22, 3.22) p = 0.79

- Statistical analysis demonstrated **no significant difference** between these three methods (release of CP, BLM or BURP) for improving laryngeal view or facilitating intubation

Discussion

- 99.8% patients were successfully intubated
- 98.8% on the first or second attempt
- 61 intubations：laryngeal manipulation
- Vocal cords are not seen at laryngoscopy / ETT not successfully passed into the trachea
  - changing the positions of the patient and intubator
  - suctioning secretions/blood
  - sliding the blade into the oesophagus then slowly withdrawing

  →**removing CP, applying BURP or BLM under direct vision**

Discussion

- **BURP** was first described by Knill in 1993
  →assist in improving laryngeal view
- **BLM** involves the intubator manipulating the larynx under direct vision during laryngoscopy and an assistant holding the best position until the tracheal tube is passed under direct vision
- **Cricoid pressure**
  - reduce the risk of pulmonary aspiration (evidence?)
  - hamper bag mask ventilation
  - displaced oesophagus laterally rather than compressed and CP may reduce the barrier pressure

Discussion

- There was **no difference** in the improvement of laryngeal view or in facilitating intubation between removing CP, BLM and BURP.
- In a large cadaver study Levitan showed BLM was significantly more effective in improving laryngeal view than either BURP or CP
  →CP caused deterioration in view in 29% of cases
- CP in RSI is to prevent regurgitation of gastric contents
  →release of CP was associated with visible regurgitation in two patients with no episodes occurring when CP was in place

Limitations

- Data recorded was as remembered by the doctor and recorded anonymously
  →recall bias is inevitable
- Emergency doctors may be less familiar with the Cormack–Lehane score
  → pictorial representation of the laryngeal inlet on record
- Different paramedics may also apply CP/BURP very differently
- The SOP emphasizes speed of intubation over quality of laryngeal view

Conclusions

- Demonstrated that in patients who are difficult to intubate, the removal of CP, application of BLM and BURP are each associated with an improved laryngeal view and successful insertion of a tracheal tube in most cases
- A randomised trial is required to determine whether cricoid pressure provides more benefit than harm
- Our data support our current approach to pre-hospital RSI – cricoid pressure is performed routinely, but there is a low threshold for removal to improve laryngeal view and facilitate intubation.

Thanks for your attention!