



ULB

# Voies aériennes de l'enfant Un défi pour l'urgentiste ?

Dr Christine Fonteyne

Congrès REA 2009

Belgian Resuscitation Council

# Objectifs

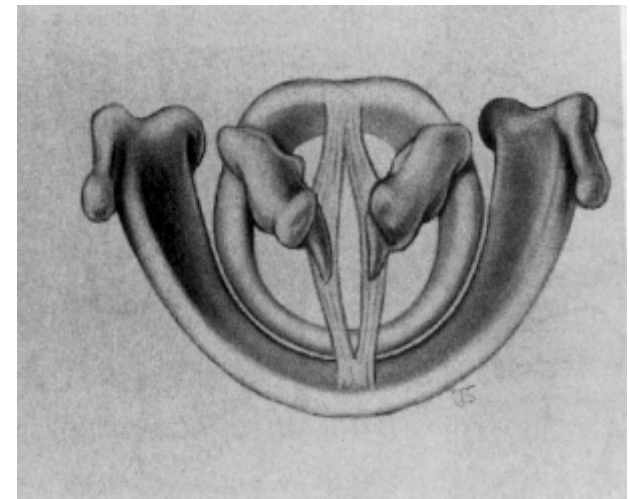
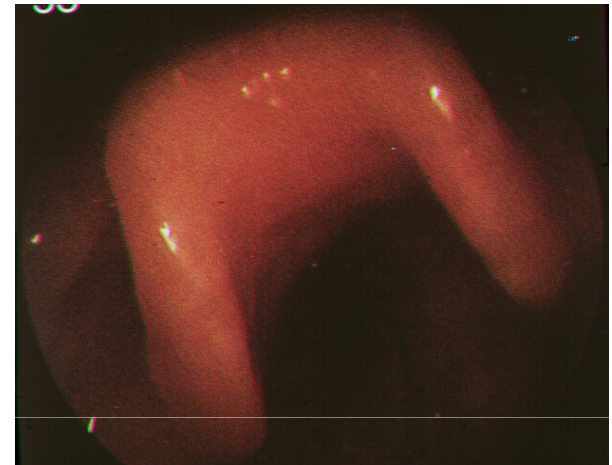
- Particularités anatomiques et physiologiques de l'enfant
- Importance du problème
- Comment reconnaître insuffisance respiratoire
- Le préhospitalier
- Techniques de prise en charge
- Techniques alternatives

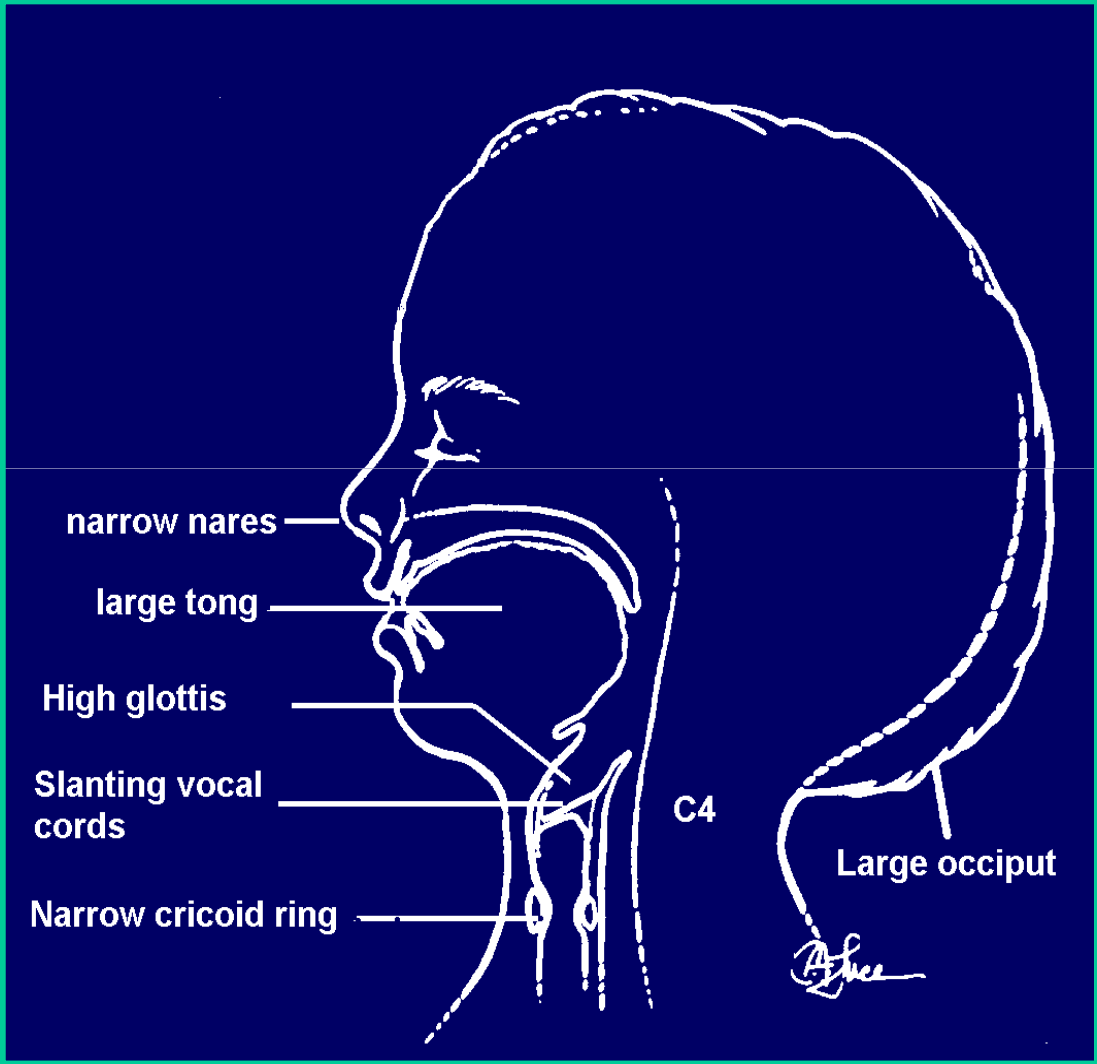
# Particularités physiologiques enfant

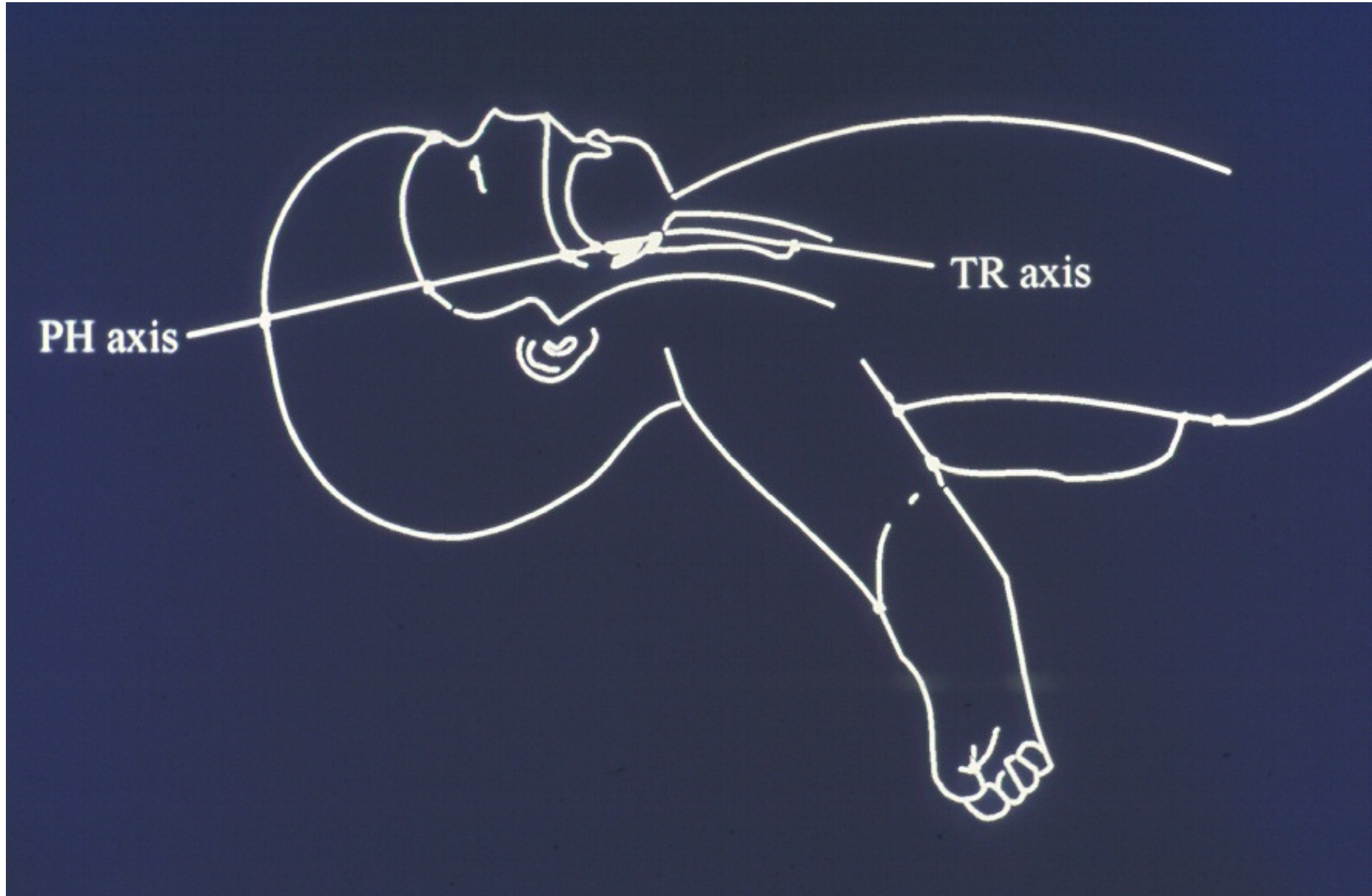
- Demande métabolique  
adulte : cons O<sub>2</sub> : 3 à 4 ml/kg/min  
enfant : cons O<sub>2</sub> : 6 à 8 ml/kg/min
- Réserve pulmonaire faible
- Immaturité centre respiratoire

# Anatomie VA enfant

- Occiput proéminent
- Grosse langue
- Petites narines
- Épiglote longue
- Trachée courte (4 à 5 cm)
- Larynx plus antérieur et plus céphalique (C4 vs C6)
- Cartilage cricoïde : portion la plus étroite du larynx
- VA plus étroites ( loi de Poiseuille)









# Anticiper VA difficiles

- Histoire clinique (parents)
- Caractéristiques anatomiques : ouverture bouche, macroglossie
- Immobilité colonne cervicale : trauma, congénital
- Petites mâchoires : syndromes
- Patients obèses
- Œdème laryngé ( infection, brûlure)
- Trauma facial



# Reconnaître insuffisance respiratoire

- **VA libres ? À risque?  
Obstruées?**
- **Fréquence Respiratoire +  
Volume courant + Travail  
respiratoire + Oxygénation**
- **Position enfant (obstruction  
VA)**
- **SpO<sub>2</sub>**
- **Sévérité/ décompensation**



# Les étapes de la prise en charge

- Étape 1 : ouverture voies aériennes
  - manoeuvre universelle ( différences nourrisson/ jeune enfant) vs antépulsion mâchoire inférieure
  - Aspiration FN, oropharynx
  - Canules oropharyngées (taille)
  - Tubes nasopharyngés (taille)
  - Oxygène (lunettes, masque)

# Les étapes de la prise en charge

- Etape 2 : ventilation masque et ballon
  - technique E+C
  - Pas d'hyperventilation
  - $V_t$  : 6 à 8 ml/kg
  - FR variable
  - Temps expiration
  - Dilatation estomac
  - Pression cricoïde



# Les étapes de la prise en charge

- Etape 3 : intubation trachéale
  - Préhospitalier : la controverse
  - challenge : choix matériel, technique
  - Séquence rapide intubation : pour qui ?  
Choix agents?

« Out-of-hospital pediatric intubation »  
To tube or not to tube ?



## « Out-of-hospital pediatric intubation »

- Succès plus faible et complications plus élevées que chez l'adulte :
  - Patients pédiatriques critiques sont rares en pré hospitalier
  - Expérience difficile à acquérir pendant et après la formation
  - SRI
  - Controverse sur le bénéfice de l'intubation pré hospitalière

# « Out-of-hospital pediatric intubation »

**Table 4.**

*Complications of prehospital pediatric intubation (N=269).*

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| <b>Complication Complexity</b> | <b>No. (%)</b> |
|--------------------------------|----------------|
| <b>Major</b>                   |                |
| Aspiration                     | 15 (5.6)       |
| Pneumothorax                   | 9 (3.3)        |
| Esophageal intubation          | 5 (1.9)        |
| <b>Minor</b>                   |                |
| Mainstem bronchus intubation   | 34 (12.6)      |
| Oral/dental trauma             | 2 (.7)         |

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# « Out-of-hospital pediatric intubation »

**Table 5.**

*Use of succinylcholine for intubation of pediatric prehospital patients.*

| Characteristics               | Succinylcholine Given | Succinylcholine Not Given | P*    |
|-------------------------------|-----------------------|---------------------------|-------|
|                               | No. (%) [N=167]       | No. (%) [N=188]           |       |
| <b>Age (years) [N=342]</b>    |                       |                           |       |
| <1                            | 9 (5.6)               | 88 (47.8)                 | <.001 |
| 1-4                           | 51 (32.2)             | 49 (26.6)                 |       |
| 5-9                           | 40 (25.3)             | 20 (10.9)                 |       |
| 10-15                         | 58 (36.7)             | 27 (14.7)                 |       |
| <b>Cardiac arrest (N=355)</b> |                       |                           |       |
| Absent                        | 155 (92.8)            | 44 (23.4)                 | <.001 |
| Present                       | 12 (7.2)              | 144 (76.6)                |       |
| <b>Diagnosis (N=348)</b>      |                       |                           |       |
| Medical                       | 42 (25.8)             | 111 (60.0)                | <.001 |
| Injury                        | 121 (74.2)            | 74 (40.0)                 |       |
| <b>Complications (N=269)</b>  |                       |                           |       |
| Present                       | 29 (18.1)             | 32 (29.3)                 | .03   |
| Absent                        | 131 (81.9)            | 77 (70.6)                 |       |

\* $\chi^2$  test for difference in proportions.

# Effect of Out-of-Hospital Pediatric Endotracheal Intubation on Survival and Neurological Outcome

A Controlled Clinical Trial

**Results** There was no significant difference in survival between the BVM group (123/404 [30%]) and the ETI group (110/416 [26%]) (odds ratio [OR], 0.82; 95% confidence interval [CI], 0.61-1.11) or in the rate of achieving a good neurological outcome (BVM, 92/404 [23%] vs ETI, 85/416 [20%]) (OR, 0.87; 95% CI, 0.62-1.22).

**Conclusion** These results indicate that the addition of out-of-hospital ETI to a paramedic scope of practice that already includes BVM did not improve survival or neurological outcome of pediatric patients treated in an urban EMS system.

Gausche *JAMA* 2000; 283(6): 783-790

# « Out-of-hospital pediatric intubation »

| Final diagnosis <sup>  </sup> |          |          |      |
|-------------------------------|----------|----------|------|
| SIDS                          | 59 (14)  | 82 (19)  | .049 |
| Submersion injury             | 56 (14)  | 43 (10)  | .13  |
| Head injury                   | 27 (7)   | 36 (9)   | .28  |
| Multiple trauma               | 37 (9)   | 51 (12)  | .15  |
| Foreign body aspiration       | 13 (3)   | 13 (3)   | .95  |
| Status epilepticus            | 38 (9)   | 33 (8)   | .47  |
| Child maltreatment            | 24 (6)   | 22 (5)   | .70  |
| Cardiopulmonary arrest        | 293 (71) | 303 (72) | .83  |
| Respiratory arrest            | 55 (13)  | 55 (13)  | .89  |
| Reactive airway disease       | 12 (3)   | 11 (3)   | .80  |

\*BVM indicates bag-valve-mask ventilation; ETI, endotracheal intubation; ED, emergency department; and SIDS, sudden infant death syndrome.

†Data were available for 382 patients in the BVM group and 392 in the ETI group.

‡Data were available for 403 patients in the BVM group and 416 patients in the ETI group.

§Information was not available for 84 patients.

||Data were available for 410 patients in the BVM group and 420 in the ETI group.

# « Out-of-hospital pediatric intubation »

**Table 5. Complications of Pediatric Airway Management for All Patients\***

|                    | No. (%) of Patients |                  | P Value |
|--------------------|---------------------|------------------|---------|
|                    | BVM<br>(n = 364)    | ETI<br>(n = 363) |         |
| None               | 194 (53)            | 187 (51)         | .60     |
| Gastric distention | 114 (31)            | 27 (7)           | .20     |
| Vomiting           | 50 (14)             | 52 (14)          | .82     |
| Aspiration         | 51 (14)             | 53 (15)          | .84     |
| Oral/airway trauma | 4 (1)               | 8 (2)            | .24     |

\*BVM indicates bag-valve-mask ventilation; ETI, endotracheal intubation. This information was missing for 103 patients and a given patient may have had more than 1 complication.

# « Out-of-hospital pediatric intubation »

**Table 3.** Outcomes by Patient Subgroup\*

|                                    | No. (%) of Patients |                     | OR (95% CI)             |
|------------------------------------|---------------------|---------------------|-------------------------|
|                                    | BVM                 | ETI                 |                         |
| <b>Survival by Final Diagnosis</b> |                     |                     |                         |
| SIDS                               | 0/58 (0)            | 0/80 (0)            | Undefined               |
| Submersion injury                  | 18/55 (33)          | 20/43 (47)          | 1.79 (0.78-4.07)        |
| Head injury                        | 8/25 (32)           | 9/36 (25)           | 0.71 (0.23-2.19)        |
| Multiple trauma                    | 7/37 (19)           | 12/51 (24)          | 1.32 (0.46-3.77)        |
| Foreign body aspiration            | 9/13 (69)           | 5/13 (38)           | 0.28 (0.06-1.41)        |
| Seizure                            | 35/37 (95)          | 26/32 (81)          | 0.25 (0.05-1.33)        |
| Child maltreatment                 | 10/24 (42)          | 3/22 (5)            | 0.07 (0.01-0.58)†       |
| Cardiopulmonary arrest             | 24/290 (8)          | 24/301 (8)          | 0.96 (0.53-1.73)        |
| Respiratory arrest                 | 46/54 (85)          | 33/54 (61)          | 0.27 (0.11-0.69)†       |
| Reactive airway disease            | 6/12 (50)           | 3/10 (30)           | 0.43 (0.07-2.50)        |
| <b>Overall</b>                     | <b>123/404 (30)</b> | <b>110/416 (26)</b> | <b>0.82 (0.61-1.11)</b> |

Gausche *JAMA* 2000; 283(6): 783-790

# « Out-of-hospital pediatric intubation »

| Good Neurological Outcome by Final Diagnosis‡ |             |             |                   |
|---|-------------|-------------|-------------------|
| SIDS  | 0/58 (0)    | 0/80 (0)    | Undefined         |
| Submersion injury                             | 12/55 (22)  | 15/43 (35)  | 1.92 (0.78-4.70)  |
| Head injury                                   | 2/25 (8)    | 4/36 (11)   | 1.44 (0.24-8.52)  |
| Multiple trauma                               | 2/37 (5)    | 6/51 (12)   | 2.33 (0.44-12.27) |
| Foreign body aspiration                       | 9/13 (69)   | 3/13 (23)   | 0.13 (0.02-0.76)† |
| Seizure                                       | 34/37 (92)  | 26/32 (81)  | 0.38 (0.09-1.68)  |
| Child maltreatment                            | 2/24 (8)    | 0/22 (0)    | 0.20 (0.01-4.40)  |
| Cardiopulmonary arrest                        | 10/290 (3)  | 15/301 (5)  | 1.47 (0.65-3.32)  |
| Respiratory arrest                            | 35/54 (65)  | 27/54 (50)  | 0.54 (0.25-1.18)  |
| Reactive airway disease                       | 6/12 (50)   | 3/10 (30)   | 0.43 (0.07-2.50)  |
| Overall                                       | 92/404 (23) | 85/416 (20) | 0.87 (0.62-1.22)  |

Gausche *JAMA* 2000; 283(6): 783-790

**Table.** Studies evaluating survival or neurologic outcome after out-of-hospital endotracheal intubation.\*

| Study                                     | Design   | Primary Population                                      | Primary Comparison (Group Sizes)   | Primary Finding  |
|---|--|---|--|--|
| Bochicchio et al, 2003 <sup>29</sup>      | Prospective observational; single trauma center (Baltimore); univariable/stratified                    | Severe TBI; ETI in field or ED                          | OOH-ETI (78) vs ED-ETI (113)   | Higher mortality (OR 2.1; 95% CI 0.9–5.0) <sup>††</sup> in OOH-ETI group   |
| Bulger et al, 2005 <sup>19</sup>          | Retrospective; single trauma center (Seattle); multivariable adjusted                                  | Severe TBI; RSI or ETI in field                         | OOH-RSI (775) vs OOH-ETI (302)   | Higher mortality (OR 1.6; 95% CI 1.0–2.4) and poorer neurologic outcome (1.7; 1.2–2.6) in OOH-ETI group  |
| Christensen and Hoyer, 2003 <sup>30</sup> | Retrospective; single mobile emergency unit with anesthetist (Denmark)                                 | All trauma; ETI in field with and without drugs         | OOH-ETI with (62) vs without (12) drugs  | Higher mortality (OR 15.2; 95% CI 1.9–673.2) <sup>††</sup> for OOH-ETI without drugs   |
| Cooper et al, 2001 <sup>31</sup>          | Retrospective; National Pediatric Trauma Registry; univariable   | Severe pediatric TBI                                    | OOH-ETI (479) vs OOH-BVM (99)  | No difference in mortality (OR 1.0; 95% CI 0.6–1.6) <sup>†</sup>   |
| Davis et al, 2003 <sup>20</sup>           | Prospective interventional series, historical controls; countywide (San Diego); multivariable adjusted | Severe TBI; RSI in field vs non-ETI historical controls | OOH-RSI (209) vs non-OOH-ETI (627)   | Higher mortality (OR 1.6; 95% CI 1.1–2.2) and poorer neurologic outcome (1.6; 1.2–2.3) in OOH-RSI group  |
| Davis et al, 2005 <sup>21</sup>           | Retrospective; countywide trauma registry (San Diego) multivariable adjusted                           | Severe TBI; ETI in field or ED                          | OOH-ETI (2,665) vs ED-ETI (2,220)  | Higher mortality (OR 2.1; 95% CI 1.8–2.5) <sup>†</sup> in OOH-ETI group  |
| DiRusso et al, 2005 <sup>32</sup>         | Retrospective; National Pediatric Trauma Registry; multivariable adjusted                              | All pediatric trauma                                    | OOH-ETI (1,928) vs non-trauma center ETI (1,647), trauma center ETI (1,874) and non-ETI (44,739) | Higher mortality for OOH-ETI vs non-trauma center ETI (OR 3.2; 95% CI 2.7–3.7) <sup>†§</sup> ; vs trauma center ETI (4.1; 3.5–4.8) <sup>†§</sup> ; vs non-ETI (142.0; 119.6–168.5) <sup>†§</sup> Poorer neurologic outcome for OOH-ETI vs non-trauma center or trauma center ETI <sup>  </sup> |
| Gausche et al, 2000 <sup>22</sup>         | Prospective controlled (pseudorandomized) interventional trial; countywide (Los Angeles)               | Pediatrics; ETI or BVM in field                         | OOH-ETI/BVM (420) vs OOH-BVM (410)   | No difference in mortality (OR 0.8; 95% CI 0.6–1.1) or neurologic outcome (0.9; 0.6–1.2)   |
| Lockey et al, 2001 <sup>23</sup>          | Retrospective; single air medical service (Great   | All trauma; ETI in field without drugs                  | Mortality of OOH-ETI without drugs (486)   | Low (0.2%) survival  |

|                                       |  |                                 |  |  |
|---------------------------------------|--|---------------------------------|--|--|
| Murray et al, 2000 <sup>24</sup>      | Retrospective; countywide trauma registry (Los Angeles); multivariable matched/adjusted              | Severe TBI                      | OOH-ETI (57) vs non-OOH-ETI (57)                                     | Higher mortality (OR 4.2; 95% CI 2.1–8.9) in OOH-ETI group   |
| Sloane et al, 2000 <sup>25</sup>      | Retrospective; single trauma center (San Diego); univariable   | Severe TBI; RSI in field or ED  | OOH-RSI (47) vs ED-RSI (267)   | No difference in mortality (OR 0.6; 95% CI 0.1–2.6) <sup>†</sup> or neurologic outcome (1.1; 0.2–3.8) <sup>†</sup>   |
| Stockinger et al, 2004 <sup>26</sup>  | Retrospective; single trauma center (New Orleans); univariable/stratified                            | All trauma; ETI or BVM in field | OOH-ETI (316) vs OOH-BVM (217)                                       | Higher mortality (OR 18.0; 95% CI 11.2–29.1) <sup>†</sup> in OOH-ETI group   |
| Suominen et al, 2000 <sup>33</sup>    | Retrospective; single trauma center (Finland); univariable   | Severe pediatric TBI            | OOH-ETI (24) vs non-trauma center ETI (13) vs trauma center ETI (22) | Lower mortality for OOH-ETI vs non-trauma center ETI (OR 0.1; 95% CI 0.002–1.1) <sup>††</sup> ; no difference vs trauma center ETI (3.7; 0.9–15.8) <sup>†</sup>      |
| Wang et al, 2004 <sup>27</sup>        | Retrospective; statewide trauma registry (Pennsylvania); multivariable and propensity-score adjusted | Severe TBI; ETI in field or ED  | OOH-ETI (1,797) vs ED-ETI (2,301)                                    | Higher mortality (OR 4.0, 95% CI 3.2–4.9), poorer neurologic outcome (1.6; 1.2–2.3), and poorer functional outcome (severe impairment 1.9; 1.3–2.5) in OOH-ETI group |
| Winchell and Hoyt, 1997 <sup>28</sup> | Retrospective; countywide trauma registry (San Diego); univariable/stratified                        | Blunt trauma, GCS score ≤8      | OOH-ETI (527) vs non-OOH-ETI (565)                                   | Lower mortality (OR 0.6; 95% CI 0.5–0.8) <sup>†</sup> in OOH-ETI group; no difference in neurologic outcome (1.4; 1.0–1.9) <sup>†</sup>                              |

BVM, Bag-valve-mask ventilation; ETI, endotracheal intubation; GCS, Glasgow Coma Scale; OOH, out-of-hospital; RSI, rapid sequence intubation; TBI, traumatic brain injury.

\*Only the primary findings (survival and neurologic outcome) are summarized; results of other outcomes and subgroup analyses are not presented.

Wang *Ann Emerg Med* 2006; 47:532-541

# Que dire ?

- Formation insuffisante sur les techniques d'intubations et les séquences rapides d'intubations
- Conditions difficiles par rapport milieu hospitalier
- Cas équivalents à des « Anesthésies à haut risque »
- Effets secondaires et complications

# Intubation trachéale

- Choix matériel
  - ballonnet vs sans ballonnet ? À tout âge, préhospitalier : sans ballonnet
  - Choix taille TET : utiliser taille inférieure (0,5 à 1) si ballonnet
  - Si ballonnet : manomètre (  $P < 20$  cm H<sub>2</sub>O)
  - Choix lame : droite ou courbe

# Intubation trachéale

- Technique
  - difficile chez nourrisson (vision)
  - Pratique sur mannequin et salle d'op
  - Orotrachéal
  - Vérification et Fixation
  - Monitoring : RC, RR, SpO<sub>2</sub>, ETCO<sub>2</sub>
  - DOPEE

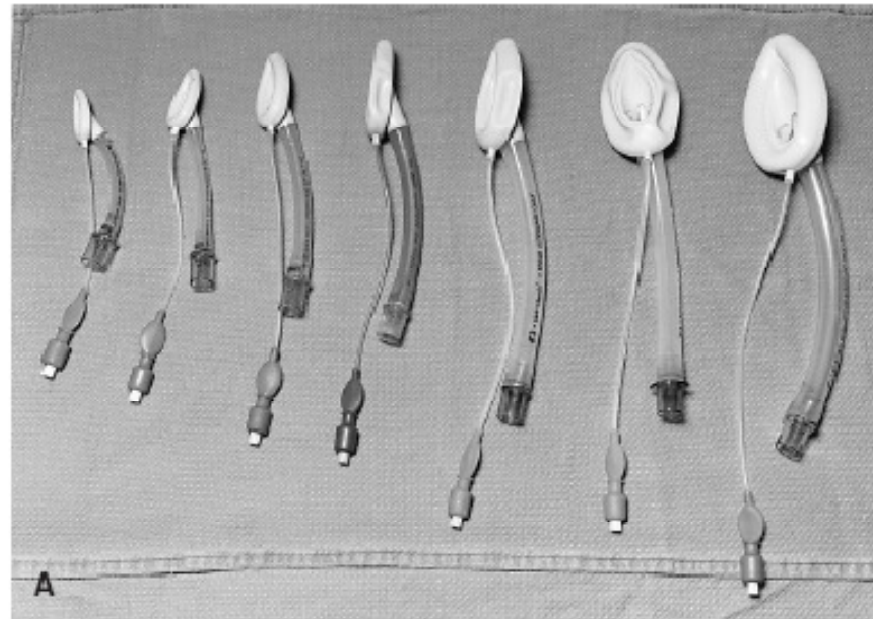
# Intubation trachéale

- Séquence Rapide Intubation
  - But : pas de ventilation pression positive ( inhalation contenu gastrique)
  - Connaître contre indications
  - Association agents sédatifs- analgésiques + curares à courte durée action

# Techniques alternatives

- Masques laryngés
- Combitube
- Glydescope
- Airtraq

# Masques Laryngés

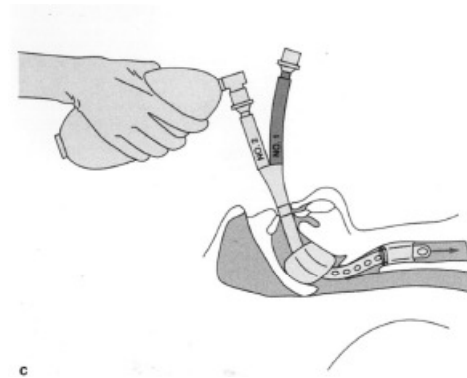
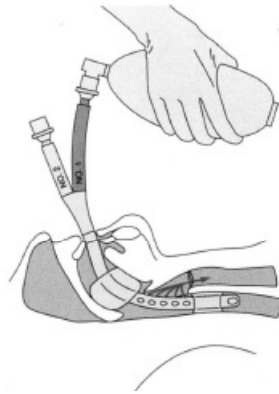
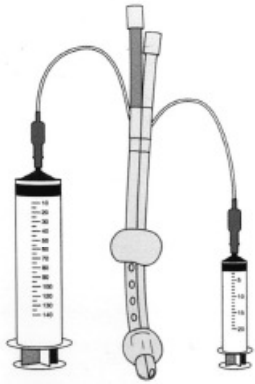


*Table 2*

Laryngeal mask airway sizes.

|          |      |
|----------|------|
| < 5 kg   | #1   |
| 5–10 kg  | #1.5 |
| 10–20 kg | #2   |
| 20–30 kg | #2.5 |
| 30–50 kg | #3   |

# Combitube



# Glidescope

- Version pédiatrique : 2005
- Lame MacInstosh modifiée+ vidéo sur lame
- Avantages : portable, insertion TET à vue, fibres optiques résistantes
- Inconvénients : coût, pratique, ouverture bouche
- Réservé à intrahospitalier

# Airtraq

- Tailles pédiatriques : à partir TET 2,5 mm (infant, paediatric, small)
- Glotte visible avec minimum technique
- Bons résultats préhospitalier avec minimum de pratique
- Utilité dans immobilisation colonne cervicale ou enfants difficiles à intuber (Pierre Robin)

# Conclusions

- Connaître particularités pédiatriques
- Reconnaître insuffisance respiratoire
- Préhospitalier : ventilation réussie vaut mieux qu'intubation difficile
- Techniques alternatives