**Clinical question.**

In adult and pediatric patients with cardiac arrest (out-of-hospital and in-hospital) (P), does the provision of airway maneuvers by bystanders (I) as opposed to no such maneuvers (C), improve outcome (O) (e.g. ROSC, survival)?

<table>
<thead>
<tr>
<th>Is this question addressing an intervention/therapy, prognosis or diagnosis?</th>
<th>Intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td>State if this is a proposed new topic or revision of existing worksheet</td>
<td>Revision</td>
</tr>
</tbody>
</table>

**Conflict of interest specific to this question**

Do any of the authors listed above have conflict of interest disclosures relevant to this worksheet? None

**Search strategy (including electronic databases searched).**

PubMed search strategy is as follows:

1. "cardiopulmonary resuscitation"[mesh] OR "heart arrest"[mesh] OR "airway obstruction"[mesh]
2. "head tilt" OR "chin lift" OR "jaw thrust" OR "finger sweep"
3. airway OR open OR opening OR patency OR maneuver
4. airway[ti]
6. 2 AND 3
7. 4 AND 5
8. 1 AND 7
9. 6 OR 8

AHA EndNote library, Cochrane database for systematic reviews, Central Register of Controlled Trials, Embase and cited references of each study were also searched.

**State inclusion and exclusion criteria**

Inclusion criteria: 1) studies which primary focus was airway maneuvers, 2) studies can be extrapolated cardiac arrest situation, 3) studies written in English

Exclusion criteria: 1) studies about mechanism, 2) studied subject is neonate, 3) not applied to arrest victim, 4) old maneuvers before head-tilt, 5) breathing maneuver, 6) publication type is letter, reviews or editorials

**Number of articles/ sources meeting criteria for further review:**

Medline search revealed 186 responses. Among them, 18 articles were selected for detailed review. Further forward searches found 16 another articles.

Among the 34 articles, 14 were excluded as follow reasons: studies about mechanism (3), studied subject is neonate (1), not applied to arrest victim (2), old maneuvers before head-tilt (2), breathing maneuver (1), publication type is letter, reviews or editorials (5).

Finally, 20 articles were enrolled to evidence evaluation process.
# Summary of evidence

## Evidence Supporting Clinical Question

<table>
<thead>
<tr>
<th>Good</th>
<th>Fair</th>
<th>Poor</th>
</tr>
</thead>
</table>

### Level of evidence

* pediatric population  
  HT: head tilt  
  CL: chin lift  
  JT: jaw thrust  
  JL: jaw lift  
  NL: neck lift  
  TA: triple airway

A = Return of spontaneous circulation  
B = Survival of event  
C = Survival to hospital discharge  
D = Intact neurological survival  
E = Other endpoint  
N = Anesthetized patients

## Evidence Neutral to Clinical question

<table>
<thead>
<tr>
<th>Good</th>
<th>Fair</th>
<th>Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Level of evidence

* pediatric population  
  HT: head tilt  
  CL: chin lift  
  JT: jaw thrust

A = Return of spontaneous circulation  
B = Survival of event  
C = Survival to hospital discharge  
D = Intact neurological survival  
E = Other endpoint  
N = Anesthetized patients
Evidence Opposing Clinical Question

<table>
<thead>
<tr>
<th>Good</th>
<th>Fair</th>
<th>Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td>*Hartrey 1995 (FS) E</td>
<td></td>
<td></td>
</tr>
<tr>
<td>*Kabbani 1995 (FS) E</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Elam 1960 (TM) E</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

Level of evidence

* pediatric population    HT: head tilt    CL: chin lift    JT: jaw thrust    FS: finger sweep    TM: thumb in the mouth
A = Return of spontaneous circulation    C = Survival to hospital discharge    E = Other endpoint
B = Survival of event    D = Intact neurological survival    N = Anesthetized patients

REVIEWER’S FINAL COMMENTS AND ASSESSMENT OF BENEFIT / RISK:

Head tilt-chin lift maneuver in adult
The first comparative study for modern style airway maneuvers were reported in 1959 by Safar et al. They compared 4 airway positions for opening the airway in 80 adults and children with anesthesia. Outcome measure was degree of airway obstruction which measured by combination of noisy breathing and movement of breathing bag during respiration. Without the artificial airway, the result showed that head tilt plus jaw thrust was the best airway maneuver.

<table>
<thead>
<tr>
<th>airway maneuvers</th>
<th>same as</th>
<th>obstructed</th>
<th>partially obstructed</th>
<th>open</th>
</tr>
</thead>
<tbody>
<tr>
<td>flexion (chin down)</td>
<td>neck flexion</td>
<td>100%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>mid-position</td>
<td>neutral (control)</td>
<td>36%</td>
<td>54%</td>
<td>10%</td>
</tr>
<tr>
<td>extension (chin up)</td>
<td>head tilt+chin lift</td>
<td>5%</td>
<td>46%</td>
<td>49%</td>
</tr>
<tr>
<td>extension + support of mandible</td>
<td>head tilt +jaw thrust</td>
<td>1%</td>
<td>21%</td>
<td>78%</td>
</tr>
</tbody>
</table>

p<0.001 by chi square test (worksheet reviewer)

Elam et al (1960) reported the lay rescuer’s experience of successful resuscitation in 21 drowning patients (1~73 years). Rescuers had taught mouth-to-mouth method in which the rescuer’s thumb lifts upward under the victim’s lower teeth. But, 15 rescuers did not use the thumb-in-the-mouth technique. One third of the rescuers recalled backward tilting of the victim’s head. The intervals of asphyxia ranged from 2 to 10 minutes. Nineteen patients recovered without ill effects, two died after several hours of apparent survival. Less than 30 breaths were required to restore spontaneous breathing for 12 victims. Six others required artificial respiration for less than five minutes. All but four (81%) of the victims were observed to have cyanosis which cleared within minutes after resuscitation was started. They also reported that the thumb-in-the-mouth technique was attempted in only a few instances and was discontinued because the thumb was bitten in some cases.

Greene et al (1961) compared the degree of head extension for maintaining airway patency. The result showed that the head tilt-chin lift maneuver is required for airway patency.
Morikawa et al (1961) investigated airway patency in a non-randomized cross over study looking at the effect of 7 airway positions on radiological measures of airway patency. The data were analyzed by Wilcoxon signed rank test by the worksheet reviewer after deleting conscious control and occipital height data for clarity.

<table>
<thead>
<tr>
<th>smallest level to posterior pharyngeal wall</th>
<th>control</th>
<th>head tilt mouth open</th>
<th>head tilt mouth close</th>
<th>neutral, mouth open, jaw thrust</th>
</tr>
</thead>
<tbody>
<tr>
<td>tongue</td>
<td>5</td>
<td>11.1*</td>
<td>17.5*#</td>
<td>8.8*#@</td>
</tr>
<tr>
<td>epiglottis</td>
<td>1.9</td>
<td>8.9*</td>
<td>16.8*#</td>
<td>5.5*#@</td>
</tr>
<tr>
<td>soft palate</td>
<td>2.5</td>
<td>4.3*</td>
<td>5.7*#</td>
<td>4.2@</td>
</tr>
</tbody>
</table>

* p<0.05 compared to control, # p<0.05 compared to head tilt mouth open
@ p<0.05 compared to head tilt mouth close

Ruben et al (1961) compared chin lift (thumb hooked under teeth), jaw thrust, and head tilt-chin lift (one hand on vertex one pulling up chin) in 6 paralyzed patients. The head tilt-chin lift produced an average clearance of 16 mm, the chin lift a clearance of 15 mm, and the jaw thrust a clearance of 17 mm. The differences are not meaningful. The study also compared pharyngeal clearance produced by flexion and hyperextension of the head of 10 paralyzed patients. The result showed that hyperextension with chin up was provided the best clearance although statistical test was not performed (head flexed 2 mm, head extended 3 mm, head hyperextended 8 mm, hyperextension plus chin pulled up 16 mm).

Guildner (1976) compared neck lift, head tilt-chin lift, jaw thrust in 120 paralyzed adults and children. The result supported the head tilt-chin lift maneuver.

<table>
<thead>
<tr>
<th>effectiveness</th>
<th>neck lift</th>
<th>head tilt-chin lift</th>
<th>jaw thrust</th>
</tr>
</thead>
<tbody>
<tr>
<td>unable to ventilate</td>
<td>5.8%</td>
<td>0%</td>
<td>0.8%</td>
</tr>
<tr>
<td>inadequate ventilation</td>
<td>6.7%</td>
<td>1.7%</td>
<td>1.7%</td>
</tr>
<tr>
<td>adequate ventilation with difficulty</td>
<td>48.3%</td>
<td>7.5%</td>
<td>19%</td>
</tr>
<tr>
<td>easy ventilation</td>
<td>39.2%</td>
<td>90.8%</td>
<td>78%</td>
</tr>
</tbody>
</table>

N=120, p<0.05 by chi square test

Uzun et al (2005) studied the effect of jaw thrust in opening the obstructed airway using flexible fiberoptic endoscopy in patients with snoring symptom. Jaw thrust alone significantly relieved the obstruction at the tongue base and epiglottis levels. However, the omission of jaw thrust from repertoire of BLS skills maybe appropriate with current educational principles focusing on reducing the complexity of CPR.

Cheng et al (2009) performed prospective observational study to investigate the changes in view of the laryngopharyngeal tissues on the fiberoptic bronchoscope with 5 airway maneuvers. The viewing grades of anterior and posterior laryngopharyngeal tissue in patients with mouth opening ability were as follows:

<table>
<thead>
<tr>
<th>Grades* (anterior)</th>
<th>Neutral</th>
<th>Triple airway</th>
<th>Head tilt chin lift</th>
<th>Jaw thrust with opened mouth</th>
<th>Jaw thrust with teeth protrusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>--</td>
<td>A (70%) B (30%)</td>
<td>A (10%) B (35%) C (55%)</td>
<td>--</td>
<td>B (5%) C (65%)</td>
</tr>
<tr>
<td>2</td>
<td>--</td>
<td>--</td>
<td>C (30%)</td>
<td>C (30%)</td>
<td>C (30%)</td>
</tr>
<tr>
<td>3</td>
<td>C (10%)</td>
<td>--</td>
<td>--</td>
<td>C (55%)</td>
<td>--</td>
</tr>
</tbody>
</table>
In conclusion, the head tilt-chin lift maneuver has been widely accepted since the 1960s when this maneuver was developed. There is no new evidence to suggest current recommendation should be changed.

**Pediatric population**

Above conclusion can also applied to children because the study of Safar et al (1959), Elam et al (1960), and Guidner (1976) enrolled children in their studies.

Reber et al (1999) compared airway dimension using magnetic resonance imaging before and after the chin lift in children. The result showed significant differences.

<table>
<thead>
<tr>
<th>measures</th>
<th>location</th>
<th>baseline</th>
<th>chin lift</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anterioposterior</td>
<td>soft palate</td>
<td>6.7±2.8</td>
<td>9.9±3.8*</td>
</tr>
<tr>
<td>diameter (mm)</td>
<td>tongue</td>
<td>9.6±3.6</td>
<td>16.5±3.1*</td>
</tr>
<tr>
<td></td>
<td>epiglottis</td>
<td>4.6±2.5</td>
<td>13.1±2.8*</td>
</tr>
<tr>
<td>Transverse</td>
<td>soft palate</td>
<td>15.8±5.1</td>
<td>22.8±4.5*</td>
</tr>
<tr>
<td>diameter (mm)</td>
<td>tongue</td>
<td>13.5±4.9</td>
<td>18.7±5.3*</td>
</tr>
<tr>
<td></td>
<td>epiglottis</td>
<td>17.2±3.9</td>
<td>21.2±3.7*</td>
</tr>
<tr>
<td>Cross sectional area</td>
<td>soft palate</td>
<td>0.88±0.58</td>
<td>1.79±0.82*</td>
</tr>
<tr>
<td>(cm²)</td>
<td>tongue</td>
<td>1.15±0.45</td>
<td>2.99±1.3*</td>
</tr>
<tr>
<td></td>
<td>epiglottis</td>
<td>1.17±0.7</td>
<td>3.04±0.99*</td>
</tr>
</tbody>
</table>

* p<0.05 compared to baseline

Meier et al (2002) performed the non-randomized cross over study to investigate the effect of chin lift and jaw thrust on the size of the glottic opening and on stridor score in anesthetized spontaneously breathing children. Both the chin lift and the jaw thrust were significant compared to baselines according to the POGO and the stridor score.

<table>
<thead>
<tr>
<th></th>
<th>baseline 1</th>
<th>chin lift</th>
<th>baseline 2</th>
<th>jaw thrust</th>
</tr>
</thead>
<tbody>
<tr>
<td>POGO 100%</td>
<td>0%</td>
<td>30.7%</td>
<td>0%</td>
<td>31.4%</td>
</tr>
<tr>
<td>POGO&gt;50%</td>
<td>0%</td>
<td>26.9%</td>
<td>0%</td>
<td>34.2%</td>
</tr>
<tr>
<td>POGO&lt;50%</td>
<td>3.3%</td>
<td>38.4%</td>
<td>13.7%</td>
<td>28.5%</td>
</tr>
<tr>
<td>POGO 0%</td>
<td>96.6%</td>
<td>3.8%</td>
<td>86.2%</td>
<td>5.7%</td>
</tr>
<tr>
<td>stridor score*</td>
<td>2.0 (1.0/3.0)</td>
<td>2.0 (1.0/2.0)</td>
<td>2.0 (1.0/3.0)</td>
<td>1.0 (1.0/2.0)</td>
</tr>
</tbody>
</table>

* median (IQR)

However, some authors reported that chin lift had no effect compared to neutral position. Reber et al (2001) found that chin lift did not improve the patency of the airway in anesthetized, spontaneously breathing children with adenotonsillar hypertrophy. Moreover, Reber et al (2001, 1239p) reported that chin lift without additional CPAP should be used with caution for anesthetized children with adenotonsillar hypertrophy because it may convert partial airway obstruction into almost complete one.

Bruppacher et al (2001) evaluated the effect of common airway maneuvers on airway pressure and flow in children with adnoidal hyperplasia. The data showed that chin lift did not improve maximal inspiratory flow, minute ventilation and tidal volume compared to baseline. However, jaw thrust with or without CPAP significantly improved the respiratory variables.
There were several studies to evaluate the effect of jaw thrust in children (Bruppacher 2003; Meier 2002; Reber 2001; Reber 2001; von Ungern-Sternberg 2001) and infants (Hammer, 2001) or jaw lift maneuver (Roth, 1998). However, these were omitted for the agreement to current educational principles focusing on reducing the complexity of CPR.

**Blind finger sweep**

In addition to the danger of bite injury (Elam 1960), complications of blind finger sweep were reported in a 9-week-old baby (Hartrey 1995) and a 8-month-old female (Kabbani 1995). There were three additional forensic cases reports which had clear injury circumstances causing acute episode of choking by finger sweep (Abder-Rahman 2009). So, blind finger sweep should be discouraged.

**Acknowledgements:** None
Citation List

Level 5 (forensic case reports, not cardiac arrest situation), Fair, Opposing blind finger sweep.
A 12-month-old male, a 7-year-old girl, and a 11-month-old male were caused acute episode of choking by finger sweep.

Level 5 (children under anesthesia), Fair, Supporting jaw thrust.
Compared with baseline, maximal inspiratory flow and minute ventilation increased significantly during jaw thrust maneuver, but the chin lift maneuver did not result in improved ventilation (neutral to the question).

Level 5 study (under anesthesia), Fair, supportive triple airway maneuver and head tilt chin lift.
According to the extent of the lifting of the epiglottis and the upward-drag of the posterior laryngeal tissues, the ability of each technique to stretch the neck tissue should be ranked in the following order: triple airway, head tilt chin lift, jaw thrust with teeth protrusion, and jaw thrust with opened mouth.

Level 4 study (case series of 21 drowning victims), Poor (no statistical analysis), supportive to head-tilt, opposing to thumb-in-the-mouth.

Level 5 (under anesthesia), Poor (no statistical analysis), supporting 2-handed hyperextension of the head (head tilt-chin lift).

Level 5 (under anesthesia), Poor (subjective evaluation), supporting chin-lift(head tilt-chin lift) compared to neck lift or jaw thrust.

Level 5 (deeply sedated infants), Fair, Supporting jaw thrust.

Level 5 (case report, not cardiac arrest situation), Fair, Opposing blind finger sweep.

Level 5 (case report, not cardiac arrest situation), Fair, Opposing blind finger sweep.

Level 5 (children under anesthesia), Fair, supporting chin lift and jaw thrust.


Level 5 (under anesthesia), Poor (no statistical analysis), supporting head tilt-chin lift.

Head tilt-mouth closed associated with greatest airway patency at tongue and epiglottis level in all 10 patients.


Level 5 (children under anesthesia), Fair, supporting chin lift


Level 5 (children under anesthesia), Fair, supporting jaw thrust, neutral to chin lift.

Jaw thrust produces an improvement in pre-existing moderate and severe asynchronous thoraco-abdominal motions, but chin lift without CPAP should be used with caution.


Level 5 (children under anesthesia), Fair, neutral to chin lift and jaw thrust.

Chin lift and jaw thrust without CPAP have no effect on baseline stridor score (analyzed by worksheet author), and reduced the transverse distance during inspiration in 10 (42%) and 6 (25%) patients, respectively.


Level 5 (children under anesthesia), Fair, Supporting jaw lift compared to head tilt-chin lift in children. Mouth-to-mouth ventilation is impossible because rescuer’s thumb is located behind the victim’s lower teeth.


Level 5 (under anesthesia), Poor (unclear methodology), supporting head tilt-neck lift


Level 5 (under anesthesia), Poor (no statistical analysis), supporting head tilt-chin lift.


Level 5 (under anesthesia), Poor (no statistical analysis), supportive to neck extension (chin up) and support (forward displacement) of mandible. When the neck was in mid position (neutral), only 10% of the airway was open. With neck extension (chin up), 49% were open, and 78% were open with extension plus mandible support.

Level 5 (children under anesthesia), Fair, Opposing jaw thrust.
Upper airway obstruction increased when the jaw thrust was applied in two children with cervical masses.


Level 5 (under anesthesia), Fair, supporting jaw thrust.
The mean grade for epiglottis improved from 5.57 to 1.29 and from 2.67 to 1 for tongue base after jaw thrust.

Excluded references:
Boidin MP. Airway patency in the unconscious patient. Br J Anaesth 1985; 57(3): 306-10. This study was to determine whether obstruction of the upper airway was primarily a result of the tongue falling back, or if another mechanism was responsible in the unconscious patient.

Durga VK, Millns JP, Smith JE. Manoeuvres used to clear the airway during fiberoptic intubation. Br J Anaesth 2001; 87(2): 207-11. This study was to compare airway clearance produced by jaw thrust and lingual traction.


Elam JO, Ruben AM, Greene DG, Bittner TJ. Mouth-to-nose resuscitation during convulsive seizures. JAMA 1961; 176: 565-9. This study was to recommend mouth-to-nose breathing in patient with convulsion.


Paal P, von Goedecke A, Brugger H, Niederklapfer T, Lindner KH, Wenzel V. Head position for opening the upper airway. Anaesthesia 2007; 62(3): 227-30. This study was to determine head position angles reflecting maximal flexion, extension, and neutral position in conscious, supine adults.

Reiterer F, Abbasi S, Bhutani VK. Influence of head-neck posture on airflow and pulmonary mechanics in preterm neonates. Pediatr Pulmonol 1994; 17(3): 149-54. The influence of head-neck posture on airflow and pulmonary mechanics was evaluated in preterm neonates who had had respiratory distress syndrome.

Safar P. Ventilatory efficacy of mouth-to-mouth artificial respiration; airway obstruction during manual and mouth-to-mouth artificial respiration. JAMA 1958; 167(3): 335-41. Level 5 (under anesthesia), Poor (no statistical analysis), supporting head tilt-chin lift. But, not studying modern type airway maneuvers.


