TRACHEOSTOMY: SUDDEN DEATH FROM DELAYED AIR EMBOLISM

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Air Embolism

Air embolism results from the aspiration of a small or large volume of air through any operative rent in the venous circulation. It is liable to occur during any operation in the neck. In the unique case recorded here, it occurred in the early post-operative period.

The deep inspiratory movements of the chest produce a marked negative venous pressure in the veins of the neck, predisposing to the sudden indrawing of a large volume of air through any accidental tear, into the venous circulation. Such a condition is apt to obtain in the presence of respiratory obstruction and the resultant extreme distension of the cervical veins.

If the volume of air sucked into the vein exceeds 100 c.c., sudden death will result. (In the rabbit, an injection of 5 c.c. of air into a vein in the ear is used to kill the animal instantaneously.) If the volume of air drawn in is smaller than 100 c.c., definite clinical symptoms are produced. If the volume is very little, no noticeable or detectable effects will be observed.

The air enters the pulmonary circulation, the chambers of the right heart (where a large air lock is the cause of death), the pulmonary arteries and arterioles. At autopsy, air bubbles are visible in the cerebral arteries, but not in the veins.

Air Embolism following Tracheostomy

Death from air embolism, in the early post-operative period, after a successful tracheostomy, is an extremely rare sequel to this operation.

The following case of such an unhappy incident is recorded as unless the cause of the sudden death had been ascertained at the autopsy, it might have remained obscure.

The infant, aged 18 months, sat up and suddenly dropped dead a few hours after a successful tracheostomy for acute laryngeal obstruction. Autopsy revealed the cause to be air embolism. (Another unusual cause—a bilateral pneumothorax—has already been recorded.)

Tracheostomy for Acute Laryngeal Obstruction in an Infant, with Complete Relief; Sudden Unexpected Death a Few Hours After Operation Due to Delayed Air Embolism

An infant, aged 18 months, developed acute laryngeal obstruction, the inspiratory stridor being severe at rest. It was completely relieved by a tracheostomy, performed under general anaesthesia, through an endo-tracheal tube. The upper part of the trachea was exposed through a long midline incision, the isthmus of the thyroid gland being divided. The veins of the neck were greatly

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engorged and the haemorrhage was profuse, but completely controlled. The tracheal airway and bronchi were normal, dry and free from exudate. Towards the end of the operation, the infant coughed. This was followed by a profuse venous haemorrhage from the lower part of the wound. It was controlled by gauze packing. The infant left the theatre in good condition, breathing freely through the tracheostomy tube but coughing occasionally. Four hours later, the child (who had been sedated with paraldehyde and whose condition hitherto was good) sat up and without any premonitory warning, suddenly dropped dead.

At the autopsy, the laryngeal obstruction had been relieved completely:
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there was congestion of the larynx and trachea. The lungs were not collapsed: there was no pneumothorax or any subcutaneous emphysema. Death was due to air embolism. The right chamber of the heart contained a great deal of air: the arteries of the cortex of the brain were filled with air bubbles.

Comment: The coughing after tracheostomy must have dislodged a ligature from the plexus of the veins in the lower part of the incision, exposing a rent through which a large volume of air was drawn in suddenly into the venous circulation, as the infant took a deep inspiration prior to coughing.

To avoid such a grim complication, all venous haemorrhage, especially from the lower end of the incision, must be completely controlled. A non-slipping ligature should be used, e.g. silk or thread.

The difficulties and dangers of operations in the neck in the presence of great venous congestion have been described vividly by Hamilton Bailey (“Emergency Surgery”).

“Under general anaesthesia, particularly when the airway is not entirely free, intra-venous pressure rises: diminutive veins wax proud. Many tributaries become formidable vessels, the internal jugular vein and veins of kindred girth billow into mighty bags of blood that collapse suddenly on inspiration, almost at once to rise again and well nigh burst should the patient cough . . . the surgical initiate . . . should resolve that his index finger will reflexly enter the wound to plug a breach, at lightning speed . . . to stem the haemorrhagic deluge and guard against the very real danger of air embolism. . . .”

The Point of Entry of the Air into the Vein

The inferior thyroid veins, two in number, extend from the lower border of the isthmus of the thyroid in the midline and form a plexus in front of the trachea. “From this plexus the left vein descends and joins the left innominate trunk, and the right vein passes obliquely downwards, and to the right . . . to open into the right innominate vein, at its junction with the superior vena cava; frequently the two veins open by a common trunk in the latter situation” (Gray’s Anatomy).

Doubtless, this plexus was the point of origin of the entry of the air.

To avoid this tragic contretemps, the inferior thyroid vein should be seized horizontally by forceps, ligatured above and below and divided between.

If the left innominate vein is situated in an abnormally high situation and is engorged, injury to it may be unavoidable.

Tracheostomy above the thyroid isthmus would be the safer standard procedure.