Commentary

Recently published papers: An ancient debate, novel monitors and post ICU outcome in the elderly

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Abstract

Tracheostomies have been around for close to 3000 years, so one would hope that the controversies might have been thrashed out by now, but apparently not. Judging by some recent publications it would appear that we still do not know when or how to insert them. Monitoring is fundamental to critical care; two papers describe novel/modified techniques for assessing traumatic brain injury and cardiac output. The intensive care unit imposes a heavy treatment burden, particularly on the elderly. What impact does this have on the lives of the survivors?

Debate regarding the indications, timing and technique for tracheostomy seems to have been raging ever since the procedure itself was first described in ancient Egypt [1]. The topic is of global interest, with research from a number of continents published during the past few months. These recently published papers add new information to the 'round table' discussion that often goes with this controversial and topical subject.

The first report, that by Griffiths and coworkers [2], is a well researched systematic review and meta-analysis of five controlled studies that aimed to compare outcomes in critically ill patients undergoing artificial ventilation who received a tracheostomy early or late in their treatment. The total number of patients involved was 406. Early tracheostomy was defined as up to 7 days following intubation, and late was defined as any time thereafter, if at all. The results showed that the duration of artificial ventilation was significantly lower in the early group, as was the length of intensive care unit (ICU) stay. This has obvious implications for ICU service provision and patient care, assuming that patients leave the ICU to make equal recoveries in the two groups. However, it is difficult to analyze the impact of the results because there was significant heterogeneity between the inclusion and exclusion criteria of the studies. The authors acknowledge this limitation. The hospital and 30-day mortality rates were no different between the two groups, and the risk for hospital-acquired pneumonia was also unchanged.

A recent retrospective study conducted by Chia-Lin Hsu and coworkers [3] investigated the optimal timing of tracheostomy formation, its impact on weaning from artificial ventilation, and the outcomes in patients in a medical ICU at the 1500-bedded National Taiwan University Hospital. A total of 163 patients were included and divided into two groups: successful weaning and failure to wean. Interestingly, the study discusses rates of associated complications of both percutaneous tracheostomies (PTs) and surgical tracheostomies (STs). The results showed that patients undergoing tracheostomy more than 3 weeks after intubation had higher ICU mortality rates (28.3% versus 14.5%), higher rates of weaning failure (56.4% versus 30.2%) and longer ICU stays (14.2 days versus 10.8 days). These were all classed as statistically significant. This study also showed no difference in hospital mortality or nosocomial pneumonia during the weaning period. The authors concluded that tracheostomy after 21 days was associated with prolonged weaning, low weaning success rates and prolonged ICU stay.

In the third study, Blot and Melot [4] performed a retrospective analysis of the indications, timing and techniques of tracheostomy in 152 of the 708 French ICUs contacted. Although the study had a relatively low reply rate (21.5%), it raised several interesting points. First, their definition of early tracheostomy was any time during the first 3 weeks after intubation. Second, early tracheostomy was considered more often in nonteaching hospitals than in

CI = cardiac index; CT = computed tomography; Cv–aCO_2 = central venous–arterial carbon dioxide difference; GCS = Glasgow Coma Scale; HRQOL = health related quality of life; ICU = intensive care unit; Mv–aCO_2 = mixed venous–arterial carbon dioxide difference; PI = pulsatility index; PT = percutaneous tracheostomy; ST = surgical tracheostomy; TBI = traumatic brain injury; TCD = transcranial Doppler.

teaching hospitals. Finally, STs were preferred over PTs on surgical ICUs, and *vice versa* on medical ICUs. The authors concluded that long-term mechanical ventilation and failed extubation are the major indications for tracheostomy, and that tracheostomy is considered after a mean time of 3 weeks (later than recommended by several consensus conferences).

The final article relating to tracheostomies is that reported by Raghuraman and coworkers [5]. This prospective and retrospective observational study looked into the problem of tracheal stenosis caused by both PT and ST individually. The investigators studied 29 patients presenting with tracheal stenosis to a UK national referral centre for tracheal reconstruction. Following bronchoscopy preoperatively, they were able to assess the level, length and diameter of tracheal stenosis. This potentially life-threatening complication differs between the two groups in the above parameters, and therefore affects the treatment options available to the patient. The results showed that, compared with ST, PT caused tracheal stenosis closer to the vocal cords (1.6 cm versus 3.4 cm; $P = 0.04$) and the onset of tracheal stenosis occurred significantly quicker in the PT group (5 weeks versus 28.5 weeks). Other quoted studies [6,7] support the finding that PT resulted in the tracheal wall 'caving in' due to cartilage fracture significantly more often (50% versus $<$2%). However, the authors demonstrate no difference in diameter of stenosis. They suggest that good PT technique will significantly reduce this high complication rate. They also conclude that stenosis caused by PT occurred earlier and was more subglottic in nature compared with ST. This higher level of stenosis was more difficult to correct with surgery.

Considerable variety in the timing of tracheostomy formation and the technique employed continues to exist, with a number of other publications both supporting and opposing the reports discussed above. Intensive care practitioners clearly need further information and research to enable agreement to be reached on optimum tracheostomy care.

From these studies, we might be tempted to draw the following conclusions. First, early tracheostomy ($<$7 days) reduces the duration of artificial ventilation. Second, the length of ICU stay is reduced by early tracheostomy. Third, patients undergoing tracheostomy after 3 weeks have a higher mortality, longer duration of ventilation, reduced successful weaning and longer ICU stay. Finally, PT causes more subglottic stenosis, with a quicker onset than with ST. The much anticipated TracMan study is now underway in the UK and will hopefully shed much more light on some of these issues.

The vast majority of acute care hospitals in the UK are without on-site neurosurgical and neurointensive care facilities, necessitating expedient assessment of the brain-injured patient. Those with severe traumatic brain injury (TBI; i.e. those with Glasgow Coma Scale [GCS] score $<$9) should undergo prompt transfer to a neurosurgical centre unless the prognosis is deemed to be hopeless. For those with mild (GCS score 14–15) and moderate (GCS score 9–13) TBI, with no indication for immediate surgery, it may well be preferable that they stay in the admitting non-neurosurgical centre, given the demand on the all too few neurosurgical intensive care beds in the UK. Subsequent monitoring, and therefore management, of this group of patients for secondary neurological deterioration is often suboptimal, given the inability to institute 'gold standard' techniques such as intracranial pressure and jugular venous saturation monitoring, relying largely on clinical deterioration and computed tomography (CT). This is likely to have a deleterious effect on outcome. A study by Jaffres and coworkers [8] may represent a glimmer of light in this otherwise dark tunnel.

In a prospective cohort study ($n = 78$) set in the emergency room of a French district hospital, consecutive patients admitted with mild or moderate TBI underwent both CT and transcranial Doppler (TCD) studies within 12 hours of admission [8]. Patients were then assessed, based on objective predefined criteria, for neurological deterioration 7 days after admission. The study attempted to correlate deterioration with initial measured variables: TCD, CT of the head, and biochemical, haematological and clinical measures, including a variety of composite scoring systems. Seven (17%) patients from the mild TBI group suffered deterioration. Using univariate analysis the investigators demonstrated a significant difference in both CT findings and pulsatility index (PI), as measured using TCD, in this subgroup compared with those who did not deteriorate. The Injury Severity Score and maximal Head Abbreviated Injury Scale Score were also significantly different. In the moderate TBI group, 10 (28%) deteriorated. PI and CT scoring were again significantly different in this group, along with the scoring systems mentioned above, initial GCS score and use of vasoactive drugs.

Jaffres and coworkers [8] go on to discuss the mechanisms by which PI is inversely related to cerebral perfusion pressure, and suggest that an appropriate combination of CT classification of TBI and measurement of PI on admission may be used to identify those at risk for subsequent deterioration. However, they point out that the feasibility and practicalities of early TCD are not inconsequential and that no threshold value for PI was identified in this small study. This interesting thesis is surely worthy of investigation in further, larger studies.

We stay with a monitoring theme in the following report. Less invasive does not necessarily mean less useful, and Cuschieri and coworkers [9] – including Dr E Rivers, who utilized central venous oxygen saturations in early goal-directed therapy for severe sepsis [10] – investigated the correlation between central venous–arterial carbon dioxide difference ($Cv–aCO_2$), mixed venous–arterial carbon dioxide difference ($Mv–aCO_2$) and cardiac index (CI) in a group of mechanically ventilated patients with various diagnoses. For inclusion, patients needed to have a pulmonary artery catheter *in situ*. Simultaneous arterial, mixed venous and central venous blood samples were obtained, along with measurement of cardiac indices using the thermodilution technique. The group found excellent correlation between Cv–aCO_2 and Mv–aCO_2, with a correlation coefficient across all diagnoses and circulation types (high, low and normal) of 0.978. Furthermore, both were found to be inversely related to CI, with similar magnitudes of correlation, as compared with thermodilution-derived values. This was found to be true across different flow states. Although the relationship between Mv–aCO_2 and CI has long been recognized, as derived from the Fick principle, this study suggests an easier and less invasive way to apply the same concept and, in conjunction with centrally derived arteriovenous oxygen differences, this may be very useful in the early assessment of global tissue hypoxia.

Finally, a thought-provoking review, although one that is not terribly helpful on a practical level, was recently published in *Chest* [11]. Hennessy and colleagues carried out a thorough literature search on post-ICU outcomes of elderly patients. The elderly population, variously defined as >65 years, >70 years, >75 years or >85 years, is set to grow massively, and this will undoubtedly have major implications for service provision. Although many studies have scrutinized mortality rates from critical illness in the elderly, little is known about health-related quality of life (HRQOL) and functional status in the survivors. The investigators identified only 16 studies (involving a total of 3247 patients), only one of which was multicentred, addressing this issue. Encouragingly, the majority of these studies reported good HRQOL and functional status post-ICU, although some discordance was evident, suggesting a change in conceptualization of quality of life following critical illness. However, the authors were unable to pool results and draw any significant conclusions because of poor quality study designs and lack of consensus on how to measure HRQOL. They urge the need for further research, which must be well designed, prospective and use validated, reliable and responsive measures of HRQOL.

Competing interests

The author(s) declare that they have no competing interests.

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