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Quality and Patient Safety

QUALITY AND PATIENT SAFETY

Hypotension during induction of anaesthesia is neither a reliable nor a useful quality measure for comparison of anaesthetists' performance

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Abstract

Background. Identification of statistically reliable outcomes for comparison among anaesthetists is challenging. Time-weighted intraoperative mean arterial pressure <65 mm Hg (AUC_{65}) is associated with increased odds for myocardial damage. We explored retrospectively whether such hypotension before incision was statistically reliable for peer comparison.
Methods. We retrieved electronic data between 2006 and 2015 at a tertiary care, academic hospital in the USA for patients at risk for myocardial damage (inpatient after surgery, ASA physical status ≥III, ≥50 yr of age, and case duration ≥60 min). We determined the percentage of anaesthetists comparable based on caseload and case-mix. The AUC_{65} was compared amongst anaesthetists supervising ≥100 cases involving at-risk patients during the last 12 months.
Results. Only 14.1% [95% confidence interval (CI) 13.6–14.5%] of cases involved patients who were 'at risk' during the 10 yr study period. A yearly average of 49 (SD 6) anaesthetists supervised ≥100 cases of any type, of whom only 52% (95% CI 47.1–56.0%) supervised ≥100 cases involving at-risk patients. Thus, nearly half the anaesthetists would have been excluded from peer comparison. During the last 12 months, there were two outliers among 34 evaluable anaesthetists ($P<0.05$, controlling for false discovery). However, their contribution to total hypotension amongst cases for all patients was small, because hypotension was widely distributed (e.g. 80% of hypotension attributable to 61.8% of anaesthetists, 95% CI 59.8–63.7%). There was no relationship between the AUC_{65} and propofol induction dose.
Conclusions. The AUC_{65} of time-weighted pre-incision hypotension is not a suitable metric for comparing anaesthetists. There were few at-risk patients, half the anaesthetists were not evaluable because of their case-mix and caseload, and hypotension was widely distributed.

Key words: healthcare; hypotension; medical informatics computing; peer review

Peer comparison of adverse events among surgeons[1] is widespread, particularly for cardiothoracic surgery, with public reporting on-line.[2–6] The ostensible purpose of such activities is to improve the quality of patient care.[7] Identification of statistically reliable patient outcomes suitable for peer comparison of individual anaesthetists has been challenging. Difficulties in establishing suitable outcomes relate to the small numbers of major adverse events among patients of most anaesthetists during each

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Editor's key points

- Identification of statistically reliable patient outcomes suitable for comparison of individual anaesthetists' performance is challenging.
- Time-weighted arterial hypotension from induction of anaesthesia to surgical incision was retrospectively evaluated at a single US tertiary care hospital.
- In patients deemed high risk for myocardial damage, time-weighted pre-incision hypotension was not a suitable metric for comparing anaesthetists' performance.

monitoring period, inaccurate clinical coding of care and events limiting the applicability of retrospective analysis, and confounding effects from other medical professionals also caring for the patient (i.e. ambiguity as to who is 'responsible' for the adverse event).[8 9] Even for the relatively 'pure' anaesthesia metric of the pain score on arrival in the recovery room, anaesthetists cannot be compared in a valid manner.[10] As the results of peer comparison can be high-stakes (e.g. can cause personal or institutional embarrassment or have financial consequences), such comparisons should be done reliably and using valid metrics; otherwise, there is a high risk of false discovery of 'outliers' that represent only expected statistical variation.[8 11] Furthermore, attributing outcomes to an individual physician is not straightforward, as the entire medical team and institutional structures also contribute.

Even a modest decrease of intraoperative blood pressure of relatively brief duration is associated with increased odds for myocardial damage and 30 day mortality.[12–14] Thus, the degree of intraoperative hypotension is a potentially valid metric for peer comparison of anaesthetists. As the quantitative amount of hypotension is a continuous ('process') variable rather than the incidence of a rare event, it might also be reliable statistically.

Salmasi and colleagues[15] recently demonstrated that the associations between hypotension and myocardial injury were comparable whether using the relative reduction from the baseline mean arterial pressure (MAP) or an absolute mean MAP threshold. The same associations held for acute kidney injury.[15] These results simplify the process of data collection, because determining an accurate baseline blood pressure (i.e. from outpatient records measured at several dates) is challenging from an informatics perspective. Given the increasing penetrance of anaesthesia information management systems (AIMS),[16–19] automated quantitative determination of intraoperative hypotension and reporting by e-mail after the case is completed would be practicable at many hospitals.[20]

The practice model at typical US hospitals involves supervising anaesthetists directing the care provided by one or two anaesthesia trainees or two to three nurse anaesthetists in different operating theatres. The supervising anaesthetists are ultimately responsible for the care delivered. The supervising anaesthetist is always present for induction of general anaesthesia or the performance of spinal or epidural anaesthesia. Therefore, intraoperative hypotension before incision might be a suitable metric for peer comparison among supervising anaesthetists. The US requirements for ongoing professional practice evaluation (i.e. peer review) from The Joint Commission specify that assessments must be made at least twice a year.[21] Such comparisons would also be applicable in practice models where anaesthetists mostly perform their own cases, rather than supervise other anaesthesia providers.

The objective of this study was to determine whether a peer comparison programme quantifying hypotension before incision could have sufficient statistical reliability to be useful to detect differences even under deliberately idealized mathematical conditions. Our secondary objective was to determine whether there were any relationships between the average doses of propofol or treatment with phenylephrine or ephedrine during induction by the supervising anaesthetists and their average amount of hypotension. Our secondary objective was investigated because if e-mail feedback were to be provided to anaesthetists, our goal would be to provide guidance for quality improvement.[20]

Methods

The Institutional Review Board at Thomas Jefferson University determined on December 21, 2016 that this study qualified as exempt human subjects research under 45 CFR 45.101(b). Data were extracted from all cases in the hospital's AIMS database (Innovian®; Dräger, Telford, PA, USA) between January 1, 2006 and October 31, 2016. No patient identifiers were collected.

Data extraction

For all cases performed from January 1, 2006 to October 31, 2016 we retrieved the following information: (i) a de-identified code for the supervising anaesthetist who was present at the start of the case. (ii) the patient's American Society of Anesthesiologists (ASA) physical status (ASA PS); (iii) the patient's age (in years); (iv) the duration of surgery from incision to surgery end; and (v) postoperative status as inpatient or discharged to home. In addition, for all cases performed between November 1, 2015 and October 31, 2016 we retrieved the following data from the 'pre-incision interval' between entering the operating theatre and surgical incision: (vi) the MAPs and diastolic pressures with time stamps from automated oscillometric devices or from indwelling arterial catheters, if present; and (vii) total doses of propofol, phenylephrine, and ephedrine.

Eligible patients

We identified patients at increased risk for postoperative myocardial injury based on the study by Salsami and colleagues.[15] In that study, all patients had inpatient postoperative care. Among the patients suffering myocardial injury, 89% had an ASA PS of ≥III, average age was 67 (SD 17) yr, and average surgical time was 5.1 h.[15] Thus, we included cases for peer comparison if the patient received care as an inpatient after surgery, had ASA PS of ≥III, was ≥50 yr of age, and the cases lasted >60 min. We excluded patients not meeting these inclusion criteria from peer comparisons because there was inadequate evidence to show that the omitted population was at risk for myocardial injury at the levels of hypotension found in the previous study.[15] Supporting our decision to exclude relatively low-risk patients from comparison among anaesthetists, it was previously shown that there was no reduction in 90 day mortality when all patients were randomized to have their anaesthesia provider receive an electronic alert when the MAP was <75 mm Hg and bispectral index (BIS) was <45 (double low).[11]

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