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[Intervention Review]

Bispectral index for improving intraoperative awareness and early postoperative recovery in adults

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ABSTRACT

Background

The use of clinical signs, or end-tidal anaesthetic gas (ETAG), may not be reliable in measuring the hypnotic component of anaesthesia and may lead to either overdosage or underdosage resulting in adverse effects because of too deep or too light anaesthesia. Intraoperative awareness, whilst uncommon, may lead to serious psychological disturbance, and alternative methods to monitor the depth of anaesthesia may reduce the incidence of serious events. Bispectral index (BIS) is a numerical scale based on electrical activity in the brain. Using a BIS monitor to guide the dose of anaesthetic may have advantages over clinical signs or ETAG. This is an update of a review last published in 2014.

Objectives

To assess the effectiveness of BIS to reduce the risk of intraoperative awareness and early recovery times from general anaesthesia in adults undergoing surgery.

Search methods

We searched CENTRAL, MEDLINE, Embase, and Web of Science on 26 March 2019. We searched clinical trial registers and grey literature, and handsearched reference lists of included studies and related reviews.

Selection criteria

We included randomized controlled trials (RCTs) and quasi-RCTs in which BIS was used to guide anaesthesia compared with standard practice which was either clinical signs or end-tidal anaesthetic gas (ETAG) to guide the anaesthetic dose. We included adult participants undergoing any type of surgery under general anaesthesia regardless of whether included participants had a high risk of intraoperative awareness. We included only studies in which investigators aimed to evaluate the effectiveness of BIS for its role in monitoring intraoperative depth of anaesthesia or potential improvements in early recovery times from anaesthesia.

Data collection and analysis

Two review authors independently assessed studies for inclusion, extracted data, and assessed risk of bias. We assessed the certainty of evidence with GRADE.

Main results

We included 52 studies with 41,331 participants; two studies were quasi-randomized and the remaining studies were RCTs. All studies included participants undergoing surgery under general anaesthesia. Three studies recruited only participants who were at high risk of intraoperative awareness, whilst two studies specifically recruited an unselected participant group. We analysed the data according to two comparison groups: BIS versus clinical signs; and BIS versus ETAG. Forty-eight studies used clinical signs as a comparison method, which included titration of anaesthesia according to criteria such as blood pressure or heart rate and, six studies used ETAG to guide anaesthesia. Whilst BIS target values differed between studies, all were within a range of values between 40 to 60.

BIS versus clinical signs

We found low-certainty evidence that BIS-guided anaesthesia may reduce the risk of intraoperative awareness in a surgical population that were unselected or at high risk of awareness (Peto odds ratio (OR) 0.36, 95% CI 0.21 to 0.60; I^2 = 61%; 27 studies; 9765 participants). However, events were rare with only five of 27 studies with reported incidences; we found that incidences of intraoperative awareness when BIS was used were three per 1000 (95% CI 2 to 6 per 1000) compared to nine per 1000 when anaesthesia was guided by clinical signs. Of the five studies with event data, one included participants at high risk of awareness and one included unselected participants, four used a structured questionnaire for assessment, and two used an adjudication process to identify confirmed or definite awareness.

Early recovery times were also improved when BIS was used. We found low-certainty evidence that BIS may reduce the time to eye opening by mean difference (MD) 1.78 minutes (95% CI -2.53 to -1.03 minutes; 22 studies; 1494 participants), the time to orientation by MD 3.18 minutes (95% CI -4.03 to -2.33 minutes; 6 studies; 273 participants), and the time to discharge from the postanaesthesia care unit (PACU) by MD 6.86 minutes (95% CI -11.72 to -2 minutes; 13 studies; 930 participants).

BIS versus ETAG

Again, events of intraoperative awareness were extremely rare, and we found no evidence of a difference in incidences of intraoperative awareness according to whether anaesthesia was guided by BIS or by ETAG in a surgical population at unselected or at high risk of awareness (Peto OR 1.13, 95% CI 0.56 to 2.26; I^2 = 37%; 5 studies; 26,572 participants; low-certainty evidence). Incidences of intraoperative awareness were one per 1000 in both groups. Only three of five studies reported events, two included participants at high risk of awareness and one included unselected participants, all used a structured questionnaire for assessment and an adjudication process to identify confirmed or definite awareness.

One large study (9376 participants) reported a reduced time to discharge from the PACU by a median of three minutes less, and we judged the certainty of this evidence to be low. No studies measured or reported the time to eye opening and the time to orientation.

Certainty of the evidence

We used GRADE to downgrade the evidence for all outcomes to low certainty. The incidence of intraoperative awareness is so infrequent such that, despite the inclusion of some large multi-centre studies in analyses, we believed that the effect estimates were imprecise. In addition, analyses included studies that we judged to have limitations owing to some assessments of high or unclear bias and in all studies, it was not possible to blind anaesthetists to the different methods of monitoring depth of anaesthesia.

Studies often did not report a clear definition of intraoperative awareness. Time points of measurement differed, and methods used to identify intraoperative awareness also differed and we expected that some assessment tools were more comprehensive than others.

Authors' conclusions

Intraoperative awareness is infrequent and, despite identifying a large number of eligible studies, evidence for the effectiveness of using BIS to guide anaesthetic depth is imprecise. We found that BIS-guided anaesthesia compared to clinical signs may reduce the risk of intraoperative awareness and improve early recovery times in people undergoing surgery under general anaesthesia but we found no evidence of a difference between BIS-guided anaesthesia and ETAG-guided anaesthesia. We found six studies awaiting classification and two ongoing studies; inclusion of these studies in future updates may increase the certainty of the evidence.

PLAIN LANGUAGE SUMMARY

Bispectral index (BIS) for improving intraoperative awareness and early postoperative recovery in adults

Background

During surgery under general anaesthesia, the anaesthetist will adjust the amount of anaesthetic drugs to ensure that the patient remains unconscious. This adjustment is made according to clinical signs, such as the patient's heart rate or blood pressure, or end-tidal anaesthetic gas (ETAG) for anaesthesia that is given as a gas, which is a measure of the amount of remaining gas after the patient breathes out. However, using these methods alone may increase the chance that the patient is given too little or too much anaesthetic. Intraoperative awareness, a distressing event in which a patient may become conscious enough to recall events during surgery, is very rare and may be caused by too little anaesthetic. Too much anaesthetic may lead to a longer time needed to reach full recovery. Bispectral index (BIS) is a measurement

scale based on the electrical activity in the brain, and by using a monitor of brain activity during anaesthesia, the anaesthetist may use this scale to inform the amount of anaesthesia to give to the patient.

This is an update of a review which was previously published in 2014.

Study characteristics

The evidence is current to 26 March 2019. We found 52 studies with 41,331 participants. Six studies are awaiting classification (because we did not have sufficient information to assess them), and two studies are ongoing. All studies included people having surgery under general anaesthesia. Three studies included only people who were at high risk of intraoperative awareness, and two studies included only people who were not selected according to high risk of intraoperative awareness. Forty-eight studies compared BIS-guided anaesthesia with anaesthesia guided by clinical signs, and six studies compared BIS-guided anaesthesia with ETAG-guided anaesthesia.

Key results

We found low-certainty evidence that BIS-guided anaesthesia may reduce the risk of intraoperative awareness. However, events were rare and only five of 27 studies reported incidences. When BIS-guided anaesthesia was used, we found three per 1000 fewer incidences of intraoperative awareness compared to nine per 1000 incidences when anaesthesia was guided by clinical signs. In addition, we found low-certainty evidence that BIS may improve recovery - the time for people to open their eyes was less, as was the time for orientation, and the time to be discharged from the post-anaesthesia care unit.

We found no evidence of a difference in incidences of intraoperative awareness according to whether anaesthesia was guided by BIS or by ETAG, although, again, there were few incidences of awareness (1 per 1000 in each group). Only one study that compared BIS with ETAG-guided anaesthesia measured recovery times; this low-certainty evidence showed that discharge from the postanaesthesia care unit was earlier if anaesthesia was BIS-guided. No studies that compared BIS with ETAG-guided anaesthesia measured the time to eye opening or the time to orientation.

Certainty of the evidence

We used GRADE to downgrade the evidence for all outcomes to low certainty. The incidence of intraoperative awareness is so rare and, even though we found some large studies, we concluded that the evidence was still imprecise. In addition, we judged many studies to have limitations because of high or unclear risks of bias. For example, all of the anaesthetists were aware of using an additional BIS monitor and we could not be certain how this affected the anaesthetists' standard practice.

In addition, we noted that some studies did not report a clear definition of intraoperative awareness. Time points of measurement differed, and the methods used to identify intraoperative awareness also differed and we expected that some assessment tools were more comprehensive than others.

Conclusion

Intraoperative awareness is rare, and despite finding a large number of eligible studies, evidence for the effectiveness of using BIS to guide anaesthetic depth is imprecise. We found low-certainty evidence that BIS-guided anaesthesia compared to anaesthesia guided by clinical signs may reduce the risk of intraoperative awareness and improve early recovery times in people having surgery under general anaesthesia. We found no evidence of a difference between BIS-guided anaesthesia and ETAG-guided anaesthesia, and we also judged this evidence to be low certainty.