Evidence-based medicine in Anesthesiology

G. E. BEKKERING (*), W. NAGELS (**) and H. VERBEKE (***)

Abstract: Two decades ago, Evidence-Based Medicine (EBM) was introduced to improve the quality of medical care. Using EBM in practice can be seen as a cyclic process consisting of 5 steps. This paper explains how to apply these steps in anesthesiology. The EBM cycle involves: 1. Asking a relevant clinical question, 2. Finding evidence to answer the question, 3. Appraising the evidence, 4. Applying the findings to practice, which means integrating evidence, clinical experience and patient preferences, and 5. Reviewing these steps. Applying EMB requires effort and certain skills, for example searching for evidence and appraising the quality of the evidence. Also important is a reflective attitude towards the practitioner’s own practice. This paper aims at encouraging anesthesiologists to develop such skills and to implement the steps of EBM in their daily practice.

Key words: Evidence-based medicine; evidence-based practice; systematic review; anesthesiology.

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Steps in evidence-based practice

David Sackett, a pioneer in evidence-based practice, formulated the application of EBM as a cyclic process in 5 steps (4). These steps involve:

Step 1 - Asking relevant questions
Step 2 - Finding the most robust evidence to answer the question
Step 3 - Critically appraising the evidence
Step 4 - Applying the findings to clinical practice and the needs of the individual patient/client
Step 5 - Reviewing the first 4 steps and considering changes for the next time.

All steps will be explained below, illustrated by a case from clinical anesthesia practice.

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**STEP 1: ASKING RELEVANT QUESTIONS**

The cycle starts with a need to improve clinical practices/procedures. This is worded as a question about how to help a particular patient. It is very important to formulate a detailed and clearly worded question, because these terms are crucial for the subsequent steps. For example, these terms will be used when performing a literature search. In addition, a detailed question is more likely to lead to a useful answer. General questions, for example: ‘how do we reduce complications of anesthesia’ are not suitable for finding an evidence-based answer, because such questions are too broad.

A well-formulated question consists of 4 parts: 1) a detailed description of the patient population \(P\), 2) a description of the intervention \(I\), the diagnostic test or a risk factor to which a patient is exposed, 3) a description of the comparison intervention \(C\) or placebo, the standard diagnostic test, or the alternative exposure or control group, and 4) the clinical outcome measures \(O\). These elements can be remembered using ‘PICO’ as an acronym. Well formulating the question helps a practitioner finding useful and relevant data to answer the question accurately.

**Example:**

*In clinical practice, a patient with a history of severe postoperative vomiting may ask the anesthesiologist if there is a way to prevent such inconvenience. Based on his knowledge of the literature and using the PICO approach, the anesthesiologist could formulate the following question: Can preoperative administration of iv dexamethasone compared to placebo reduce the occurrence of postoperative nausea and vomiting?*

In this example, the four elements of the PICO acronym are:

- **Patient**: Patients undergoing general anesthesia
- **Intervention**: Iv dexamethasone
- **Control**: Placebo
- **Outcome**: Postoperative nausea and vomiting

**STEP 2: FINDING THE MOST ROBUST EVIDENCE TO ANSWER THE QUESTION**

In step 2, the practitioner searches for an answer using scientific evidence. Two issues are important here. First, the search should be wide enough and include all relevant high-quality evidence, and not only studies that support any previous assumptions. Second, the search should aim at identifying the highest level of evidence for the clinical question.

There are several sources of evidence. For practitioners, it is uneasy to keep up with all individual studies. It is the reason why reviews are increasingly important. Reviews provide an overview of what is known on a certain health care question, preclude practitioners from searching individual studies themselves, and, therefore, save time. An important difference exists between traditional and systematic reviews. Traditionally, reviews were written by an expert in the field. A traditional or narrative review lacks a method section. In addition, the studies in such a review are typically not assessed regarding their quality and method. For this reason, it is uneasy for readers to make their opinion about the quality of the included studies and of the review itself. For example, it is hard to know whether all relevant studies were included, and whether the quality of included studies is poor, moderate or excellent? A systematic review, in contrast, provides an overview of all available evidence for a clinical question. In addition, systematic reviews provide an overview of the methodological quality of each included study. Several systematic reviews also include a meta-analysis, which means that the authors statistically combine results of multiple relevant studies into a ‘pooled’ estimate. The pooled result is more precise than the result of each small study by themselves. A systematic review takes account of both the number of studies and the methodological quality of those studies when formulating conclusions. This allows readers judging the validity of those conclusions. A systematic review is considered as the highest level of evidence.

An important source of scientific evidence on medical interventions is the Cochrane library (5). It includes a database of systematic reviews (Cochrane Database of Systematic Reviews, CDSR). The Cochrane Collaboration requires reviewers who want to carry out a Cochrane systematic review to adhere to a uniform method, using the latest standards of review methodology. This is a guarantee of quality (see also Step 3. Critical appraisal of the evidence). One of the requirements is a regular update of the review. The Cochrane database of systematic reviews is therefore highly recommended as a source of reliable and up-to-date information on the effects of interventions for a large variety of medical and paramedical disciplines.
The Cochrane Library includes two additional sources that can be used for EBM. The first source is the Database of Abstracts of Reviews of Effects (DARE), which gives a summary and critical appraisal of (non-Cochrane) systematic reviews. The second source is the register of clinical controlled trials (CENTRAL). This register includes over 600,000 trials and is the largest database of clinical trials on the effects of medical interventions.

Continuation of our example:

To answer our question, we searched the Cochrane Library for systematic reviews. We found the following review: Drugs for preventing postoperative nausea and vomiting (6).

As this review was published in 2006, we searched for more recent ones.

In DARE, we found a systematic review from 2008: A review of the efficacy of dexamethasone in the prevention of postoperative nausea and vomiting (7)

A PUBMED-search using the MESH-terms: nausea, vomiting and general anesthesia, limited by 'reviews' revealed a more recent review published in 2010 and entitled "Nausea and vomiting after surgery under general anesthesia. An evidence-based review concerning risk assessment, prevention and treatment (8).

There are several sources that may assist anesthesiologists using evidence in their practice (See table below).

The following may be relevant:

- The Cochrane Anesthesia Review Group (CARG) is an international network of health care providers, researchers and consumers who work together to make, maintain and disseminate systematic reviews of randomized Clinical Trials (RCTs) in the field of Anesthesia (www.carg.cochrane.org/).
- The Belgian Center of Evidence-based Medicine (CEBAM) assists health care professionals to use relevant and valid scientific information and to integrate this into practice. Core tasks are to give lectures and organize courses. CEBAM also hosts a Digital Library for clinicians, a useful source for high-quality clinical information. (www.cebam.be)
- Bandolier is an independent EBM journal, for both health care providers and consumers. (www.medicine.ox.ac.uk/bandolier)
- The ‘Health On the Net Foundation (HON)’ was developed to assist patients and health care providers to find high quality, useful and reliable information on the Internet. The HON label acts as a label of quality for websites. (www.hon.ch/index.html)

STEP 3: CRITICALLY APPRAISING THE EVIDENCE

The third step is the critical appraisal and thoughtful evaluation of the evidence by the practitioner, followed by the selection of the best evidence. In this phase, the value of the results of the studies is assessed. In this respect, the validity (Is the study well-designed and performed ?) and reliability (Did the study include sufficient patients to make a precise estimate of effect ?) are important. It is also important to check for potential conflicts of interest.

For a practitioner, it is very challenging to read and critically appraise scientific studies. Readers of Cochrane reviews may be reassured that these reviews are of high methodological quality. For non-Cochrane reviews, the DARE database provides the reviews with a critical appraisal of the quality of this review. Using this source, a clinician is able to assess the quality of the scientific evidence in an efficient way. Unfortunately, the number of systematic reviews within anaesthesiology is limited and their conclusions are hampered by a lack of high-quality studies. In the future, an increase in the number of high quality studies is expected, as well as an increase in the number of systematic reviews that summarize these studies.

Continuation of our example:

The Cochrane review assessed the prevention of postoperative nausea and vomiting by drugs and the development of any side effects. This review included 737 studies and 103,237 participants. Eight drugs were found to prevent postoperative nausea and vomiting when compared to placebo. Evidence for side effects was sparse. Among the
eight drugs, dexamethasone (evaluated in 88 studies) was shown to substantially decrease the risk of postoperative nausea (RR 0.57, 95% CI 0.48-0.69) and vomiting (RR 0.51, 95% CI 0.46-0.57).

Because this review was published in 2006, and because the last search was performed in 2004, it is desirable to confirm its conclusions using more recent reviews.

The review of 2010 did not add anything new. To support the efficacy of dexamethasone, it referred to three systematic reviews that were published earlier.

The DARE review was published in 2008, and included studies from the last ten years.

The authors included 13 studies with 1628 patients undergoing five different types of surgery. In each subgroup, the incidence of vomiting in patients receiving dexamethasone preoperatively was significantly lower than in patients who receiving the placebo. Although the review was well conducted, no meta-analysis was performed, and a few methodological issues may have introduced some bias into it.

All reviews, although not recent, confirm the efficacy of dexamethasone to reduce the risk of postoperative nausea and vomiting. The Cochrane review is the only one who presents a pooled estimate of effect, suggesting that the preoperative administration of dexamethasone reduces the risk of nausea and vomiting by 43% and 49%, respectively.

**STEP 4: APPLYING THE INSIGHTS INTO PRACTICE**

Next, the practitioner needs to judge whether the information is applicable to his or her own patient and to his or her setting. With respect to the patient, it is important to know his or her preferences. With respect to the setting, the practitioner needs to judge whether he or she has the experience and the materials to perform the intervention and whether the setting is appropriate for the intervention.

**Continuation of our example:**

The anesthesiologist informs the patient that she is at a high risk of developing postoperative nausea and vomiting (PONV) because she is a female, has a history of PONV and is scheduled to undergo abdominal surgery (9). The patient must also be informed that the preoperative administration of dexamethasone is expected to reduce the risk of nausea and vomiting by 43% and 49%, respectively, but that, even with this prophylactic treatment, nausea and vomiting may still occur.

**STEP 5: EVALUATE THE RESULTS**

The last step evaluates the process and its results. Did the use of the new information lead to the expected results? In the future, should this intervention be used for all patients or only for a subgroup of them? Is there a way to improve this process, for example with respect to formulating the question, searching, assessing and applying the evidence or evaluation of the results? See also below for a summary of questions to evaluate this cycle.

This step completes the continuous quality improvement cycle. Patient care and clinical practice can improve each time the circle is completed.

The questions that can be used to evaluate individual evidence-based practice are the following (source: SACKETT et al. (6))

<table>
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<tr>
<th>Formulating the question:</th>
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<tr>
<td>- Did I structure the question well?</td>
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<tr>
<th>Searching for evidence:</th>
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<tbody>
<tr>
<td>- Did I search for scientific evidence?</td>
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<tr>
<td>- Was my search strategy efficient (appropriate search terms in the best sources)?</td>
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<tr>
<td>- Did I find an answer to my question?</td>
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<tr>
<th>Assessment of scientific evidence:</th>
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<tr>
<td>- Am I capable of distinguishing high-quality studies from poor studies?</td>
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<tr>
<td>- Did I critically appraise the evidence?</td>
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<tr>
<th>Application of evidence:</th>
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<tr>
<td>- Did I implement the results of evidence in my practice?</td>
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<tr>
<td>- Were the obtained results the same as the expected results?</td>
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**Continuation of our example:**

The patient chooses to accept dexamethasone administration before her surgery and she did not suffer from postoperative nausea and vomiting just as expected.

The process of asking the question, searching and appraising the evidence, as well as applying its results to our patient was rather straightforward. High quality evidence was available about the efficacy of dexamethasone compared to placebo. However, the question could have been even more focused, in order to be able to better inform our patient. We could have looked at the high-risk...
patient population for postoperative nausea and vomiting in our PICO approach, because it has been shown that the prophylactic antiemetic treatment efficacy may depend on the level that risk. However, data on side effects were sparse. In addition, the relative benefit of dexamethasone compared to other drugs is not well studied. These issues may be included in future EBM cycles on this question.

IMPLEMENTATION IN PRACTICE

Several practitioners have problems integrating results of scientific studies into their daily practice.

A recent study in the Netherlands evaluated perceived barriers for practicing EBM among anesthesiologists (10). It also evaluated whether the barriers differed between different career stage and work setting. This qualitative study was performed among four registrars (anesthesiologists in training), four consultant anesthesiologists (at least 10 years of experience) and four senior anesthesiologists (consultants with additional leadership tasks) from two departments of anesthesiology, in an academic and a general hospital, in The Netherlands.

In both departments, senior doctors were more willing and able to apply EBM compared to registrars and consultants. Seniors reported that combining clinical work with leadership had facilitated the need to critically reflect on their own and their colleagues’ clinical performance, which is an important aspect of practicing EBM. Registrars and consultants demonstrated less sense of urgency to practice EBM. Both groups of doctors were rather unwilling to change oneself, had limited capabilities to practice EBM and were weighing experience more than evidence. Registrars struggled with all the new knowledge and skills they had to learn. Because registrars are dependent on their boss, they felt the pressure to adapt their practice according to the boss’ ideas. Registrars of general hospitals noticed little consensus among clinical routines of consultants, although consultants were unaware of this.

DISCUSSION

Evidence-based medicine (EBM) within anesthesiology is emerging, but not common knowledge. Hopefully, practitioners recognize the value of this movement for the field. Several means could be used to facilitate the implementation of EBM in the daily practice of the anesthesiologist. First, more systematic reviews in the field of anesthesiology could be produced. Systematic reviews give an overview of the best available evidence for certain clinical questions. They give a readily available answer without the practitioner having to search for individual studies. The database of the Cochrane Anesthesiology Group currently includes 74 high quality systematic reviews. In addition, it includes 76 protocols, meaning that these reviews are underway. However, for such a broad field as anesthesiology, there are still a lot of unanswered research questions.

A second mean is to teach students reflective reasoning, a skill needed to practice EBM. Students should learn to be critical about their own clinical practice. The study concerning the barriers of EBM illustrated that these skills are developed in senior doctors, who combine clinical work with leadership tasks, but that younger practitioners, even those with up to ten years of experience, lacked such critical attitude.

A third mean is to address the lack of uniformity in the evaluations and treatments of patients. It implies that practitioners should unite and discuss the need for interventions in subsets of patients. This could lead to the development of local or national guidelines, based on evidence. A critical, reflective view is required to participate constructively in such discussions. Practitioners need to ask themselves why they use a certain intervention for a particular patient, is this based on experience of others (senior doctors), on their own experience, or on results of studies that support the use of this intervention?

EBM is a commitment of practitioners but it has important advantages. Resources can be allocated more efficiently when treatments, procedures or tests are used with proven value. Besides this, EBM offers practitioners the possibility to life-long learning in daily practice. By evaluating clinical practice critically, and evaluating whether a patient was treated according to the most recent scientific insights. If it was not the case, EBM allows proposing other options for the following patients. All this effort serves one main purpose, the increase in quality of anesthesia practice.

Acknowledgements

We thank dr. Hans Van Brabandt for critically reading our manuscript.
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2. Evidence-based medicine working group. Evidence-based medicine, A new approach to teaching the practice of medicine, JAMA, 268, 2420-2425, 1992.