CASE REPORT

Cognitive aids: 'a must' for procedures performed by multidisciplinary sedation teams outside the operation room?

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Accepted 18 September 2017

SUMMARY

The human brain might not perform optimally during stressful situations. Cognitive aids can help in such situations to carry out all necessary treatment steps in a correct order. We present the case of a severe anaphylactic reaction during a percutaneous radiological intervention to drain an echinococcosis cyst on the radiology suite outside the operation room (OR), in which cognitive aids were successfully used to optimise patient care by a multidisciplinary team. Cognitive aids do not replace experience and skills of the individual caregivers, but can be invaluable tools for multidisciplinary teams dealing with crisis situations outside the OR.

We all know the human brain might not perform optimally during such situations. Therefore, essential steps in the treatment of unexpected periprocedural situations and emergencies especially in surroundings outside the OR may be missed. In these situations, cognitive aids can help health-care providers to take all treatment steps in correct order, to use the same terminology in multidisciplinary teams and thereby to improve the quality of patient treatment in critical situations outside the OR.

We present the case of a severe anaphylactic reaction during a radiological intervention to drain an echinococcosis cyst, in which cognitive aids were successfully used to optimise patient care.

BACKGROUND

The number of procedures outside the OR using moderate or deep sedation is continually growing. This means that sedation providers have to deal with the standard risks of deep sedation (eg, haemodynamic or respiratory depression) and with an unaccustomed environment. The entire team—sedation providers as well as physicians and technicians performing the interventional procedure—should be aware of these possible risks of deep sedation. Communication within the entire multidisciplinary team, including preprocedural briefing of possible complications and the respective actions to be taken if those occur, plays a central role for safety, as do frequent checks and feedback within the team.

Each sedation provider must have followed a structured training enabling him to anticipate on this modified field of work. Every sedation provider needs to be capable to screen patients adequately on comorbidities before a procedure, use adequate monitoring for recognising—possible unexpected—cardiorespiratory side effects during a procedure, and have the skills and equipment to treat emergencies immediately to ensure patient safety.

Beside expected risks, there are also unexpected—although not always uncommon—life-threatening situations caused by the procedure itself (eg, allergic reactions or bleeding complications). Although every anaesthesia provider is thoroughly trained and regularly retrained in handling these circumstances including cardiopulmonary resuscitation, these situations rarely occur during routine procedures; thus, one might feel unfamiliar in a given emergency situation during a routine case.

CASE PRESENTATION

A 35-year-old man, American Society of Anesthesiologists (ASA) physical status II (85 kg, 180 cm), without known allergies was scheduled for percutaneous transhepatic drainage under deep sedation of a multivesicular hydatid cyst located in the right liver lobe in close contact to the bifurcation of the vena porta.

On admission, the patient was normotensive (blood pressure (BP) 112/62 mm Hg), in sinus rhythm (heart rate (HR) 75 beats per minute (bpm)) and with a peripheral oxygen saturation (SpO₂) of 100%.

In the radiology suite, after having performed a team sign-in procedure including repeating the patient's medical history and allergic profile, an 18-gauge intravenous was inserted and lidocaine 50 mg and clemastine 2 mg were given intravenously. By nasal cannula, 2 L/min of oxygen was administered. HR, SpO₂, ECG, non-invasive blood pressure (NIBP) and exhaled carbon dioxide were constantly monitored. After time-out with the radiologist, the sedation specialist—a sedation-trained anaesthesia nurse—injected 250 µg alfentanil and started propofol infusion aiming for a Modified Observer's Assessment of Alertness/Sedation score of 2, meaning that the patient responded only after mild shaking. After achieving this sedation level, the radiologist started the procedure. Immediately after injecting contrast material into the cyst, spill from the cyst occurred towards the right vena portae. Simultaneously, the patient developed a sinus tachycardia (HR 106 bpm) and hypotension (BP 41/16 mm Hg) and stopped breathing.

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To cite: Eberl S, Koers L, Van Haperen M, et al. *BMJ Case Rep* Published Online First: [please include Day Month Year]. doi:10.1136/bcr-2017-221645

Anaphylaxis

START	1. Appoint team leader
	2. Start timer
	3. Call an "anaphylactic crisis"
	4. Get help: pager 59663, press emergency alarm
	5. Get: terlipressine, salbutamol 1mg/ml → central OR pharmacy
	6. Intubate , give high flow O₂ at 100%
	7. Pulse? No: start BLS: algorithm 1 or 2
DIRECT ACTIONS	1. Remove trigger
	2. Position patient in Trendelenburg
	3. Give IV fluids: crystalloids if colloids are suspected agent
	4. Give adrenaline: 500 mcg IM or 10-20 mcg IV
	5. Titrate adrenaline every 1-2 minutes in increasing dose to desired effect
	6. Give:
	- clemastine 2 mg IV
	- ranitidine 50 mg IV
DDX	- dexamethasone 8 mg IV
	7. Consider:
	- adrenaline infusion 0,05-0,1 mcg/kg/min IV
	- terlipressine 1-2mg IV
	- salbutamol nebulise (algorithm 6)
	- salbutamol 5-10 mcg/kg IV
	8. Formulate DDx and rule out
	1. Pneumothorax: algorithm 8
SECONDARY ACTIONS	2. Aspiration
	3. Pulmonary embolism: algorithm 9
	4. Bleeding: algorithm 11
	5. Myocardial infarction: algorithm 14
	6. Overdose of anaesthetics: algorithm 16
	1. Insert arterial line
SECONDARY ACTIONS	2. Obtain 2nd IV access
	3. Keep patient intubated and sedated when reaction severe
	4. Consider ICU admission
	5. Take baseline bloods for tryptase levels 90 minutes and 24 hours after the event (yellow capped tube)
	6. Refer for allergy testing

Figure 1 Cognitive aid: anaphylaxis. BLS, basic life support; DDX, differential diagnosis; ICU, intensive care unit.

The sedation specialist directly called for help and started mask ventilation. At arrival of the anaesthesiologist, sinus tachycardia had increased to an HR of 140 bpm, while NIBP and SpO₂ were unrecordable. No pulsations of the carotid artery or femoral artery were measurable. A cardiac arrest scenario secondary to an anaphylactic reaction was declared and cardiopulmonary resuscitation was started. For treatment of the anaphylactic shock, 1 mg epinephrine was administered intravenously. The patient was intubated without difficulty and ventilated with an FiO₂ of 1.0. Additionally 1 mg epinephrine and 2 mg phenylephrine intravenously were given during cardiopulmonary resuscitation (CPR). Shortly thereafter the patient regained return of spontaneous

circulation with low systemic pressure (52/32 mm Hg). Continuous infusions of 0.1 µg/kg/min epinephrine and 0.08 µg/kg/min norepinephrine were started, and a medical student was asked to read aloud the cognitive aids concerning anaphylactic reaction ([figure 1](#)) to ensure that all required actions have been taken. It turned out that two treatment interventions had been missed. First, no additional intravenous fluids had been given. Four bags of NaCl 0.9% had been placed next to the patient but not been connected with his intravenous line. After realising this omission, the patient received 1 L of NaCl 0.9% and 1 L of colloids within 10 min. Starting from here, BP further stabilised (98/67 mm Hg).

The second omission was the failure to consider corticosteroids. The attending anaesthetist had assumed that application of corticosteroids was a standard procedure before percutaneous hydatid cyst drainage. However, this was not the case. Thereupon the patient received 50 mg prednisolone intravenously.

Ten minutes later the patient was transferred to the intensive care unit in a haemodynamically stable condition.

OUTCOME AND FOLLOW-UP

The trachea was successfully extubated the following day, and the patient was discharged home 2 days later.

DISCUSSION

Percutaneous treatment of a hydatid cyst is usually performed under deep sedation outside the OR with a team consisting of a sedation specialist, a radiologist and a radiology technician. Sedation specialists in the Academic Medical Center (AMC) are trained in simulation scenarios (full-scale simulator, team training of anaesthesia nurses, residents and board-certified anaesthesiologists) to anticipate and treat expected emergency events, such as airway obstruction or haemodynamic depression. They are also trained to react adequately in unexpected situations, for example, an anaphylactic reaction. Part of this training includes use of a hospital-specific cognitive aid. Furthermore, all complications are documented in a specific sedation database and are periodically discussed with the entire sedation team, including improvement strategies.

The present case shows that physicians and nurses might oversee essential treatment steps even if they had followed regular training and retraining of CPR and other emergency situations.

Anaphylactic reactions during this special procedure of hydatid cyst puncture are rare (1.7%), but carry a mortality rate of 0.03%.¹ Therefore, it is important that all members of this multidisciplinary team speak the same 'language' and use the same approach.

The literature shows that multidisciplinary teams dealing with emergency situations frequently omit critical treatment steps.² Cognitive aids—properly designed and used immediately—can help in reducing the number of omitted steps and improve communication within the team during a crisis situation.²⁻⁵ Although in the presented case the medical team managed this emergency in a professional manner, two important treatment steps would have been missed—or at least significantly delayed—without the cognitive aids.

Cognitive aids should provide a framework with all the cardinal treatment steps of a crisis to off-load some of the team's cognitive duties. This will allow the team to increase its bandwidth to more effectively deal with more complicated issues, for example, underlying causes of the crisis.

In our hospital, the Academic Medical Centre in Amsterdam, we have implemented a special training for sedation providers.

During this training, residents, certified anaesthesiologists, anaesthesia nurses and other mid-level healthcare providers acquire the knowledge and build up skills to perform sedation in a safe manner. In this curriculum, cognitive aids have been implemented since 2013 and are routinely used during emergency situations.^{6,7} All groups are obligated to follow once a year a regular re-education in working with clinical algorithms particularly in emergencies to guarantee that they are 'fit to fly'. However, this training will never guarantee that no treatment steps are missed.

In the presented case we cannot be certain that the outcome of the patient would have been worse without the use of a cognitive

aid. However, the additional treatments were identified immediately by using the cognitive aid.

The human brain is fallible, especially under stress and in situations with a high cognitive load.⁸ Cognitive aids can never replace the expertise or skills of medical personnel; however, they can reduce human error and thereby improve quality of care. Systematic and timely use of cognitive aids helps to avoid the omission of any steps when working through an emergency protocol.

Contributors SE is responsible for drafting the manuscript. SE, LK, MVH and BP are responsible for revising the manuscript. All authors have read and approved the manuscript.

Competing interests None declared.

Patient consent Obtained.

Provenance and peer review Not commissioned; externally peer reviewed.

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Learning points

- ▶ Preprocedural, intraoperative and postoperative standards are requested for sedation procedures, including training of emergency situations.
- ▶ Few complications occur during sedation, but any complication might be serious and must be treated adequately.
- ▶ Anaphylactic reactions during radiological interventions are rare but life-threatening complications.
- ▶ Regular re-education of physicians, nurses and technicians in handling expected and unexpected emergencies is mandatory, but does not guarantee that no essential treatment steps are missed.
- ▶ Cognitive aids used by multidisciplinary teams can help to assure that all steps are performed within a treatment algorithm.

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