Emergencies and Extreme Situations

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In this chapter, some extreme situations that can be encountered in everyday clinical practice will be briefly addressed and presented. These include, of course, emergencies, such as those that can occur in the form of a KM intolerance or a seizure.

12.1 Extreme Situations

In everyday professional life, one often encounters extreme situations. For some, this starts with the oncological patient having a tracheostoma or discovering only one leg when "uncovering" a patient lying in bed, and for others with small babies suffering from cancer or patients covered in blood being admitted after a traffic accident. The extreme situations are individual to each examiner and can be psychologically stressful. However, it is very important to distance oneself mentally as much as possible in order to be able to do the best possible for the patient quickly and effectively. Here we go into a few examples:

12.1.1 Polytrauma

The definition of a polytrauma is a multiple, life-threatening injury caused by an accident. Here, very good interdisciplinary cooperation and organization is essential for the patient. The procedures and protocols differ depending on the hospital. It is always important to have a clear organization. In any emergency, it must be clear who is "in charge" in order to treat quickly and effectively. And in the case of an emergency on the street or at the airport, this can also be you as a PJ'ler or radiologist, who then has to give clear instructions to bystanders and passers-by so that the patient is well cared for as quickly as possible. In the hospital, the initial measures are well organized in the shock room, then the patients are usually examined in the CT. Bony injuries, organ and vascular injuries can be detected and assessed very quickly so that further measures can be initiated immediately.

12.1.2 Anaphylactoid Reaction

You are a few years in the profession and have performed at least 5000 CT examinations with contrast agent. A few patients have complained of a few spots at most after the examination. Then comes the next CT. An outpatient in whom you have performed a CT angiography of the pelvic-leg vessels. You look at the images while the patient sits in the waiting room. The MTRA notices that the patient is relatively pale. She calls her. The patient is already cold sweaty and shows red pustules and dyspnea. They recognize that there is an allergic reaction and call the anesthetist from the intensive care unit. He now quickly injects the medication against the anaphylactoid reaction.

Fortunately, the rapid intervention helped. The next day you can already see the patient again in front of the hospital.

12.1.3 CT-Guided Puncture

Mr. Müller has a pulmonary nodule. This is to be punctured in the CT. You routinely run through your program. The needle is placed and a sample obtained. However, the patient was relatively restless, so that the access route was difficult. You note: A pleural effusion has formed. Probably an intercostal artery is injured. You ask the MTRA to connect KM and run an angio in the aortic program over the area. CT shows the findings—there is bleeding from the intercostal artery and the patient gets a haemothorax (Fig 12.1). You call the surgeon. Fortunately, the patient is stable until the surgeon takes him to the OR.

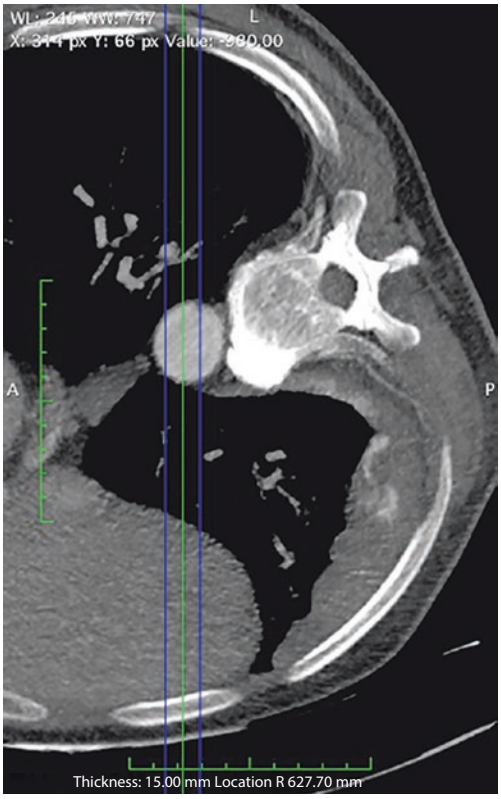

Fig. 12.1 CT angiographic evidence of arterial bleeding from the intercostal artery into the pleural space

12.1.4 Seizure During Stent Angioplasty

(See also section on seizures).

A patient has a high-grade restenosis of the carotid artery. As almost every day in angiography, a stent angioplasty is to be performed in this patient. Everything is going as usual. The wire has successfully passed the stenosis, and the initial dilatation went smoothly. Blood pressure is rather high throughout the procedure, up to blood pressure values of about 180 mmHg systolic. But the patient says that's always the case. Then the stent is released, angiographically the stenosis is completely eliminated. At that point, the patient starts seizing. You ask for Rivotril to treat the seizure and instruct to let CT know. The fears are confirmed. The patient presents with a large ICB (intracerebral hemorrhage). The neurosurgical colleagues are called in, but surgical therapy does not seem advisable. In the next few hours the patient is in intensive care. His condition does not improve, however, and he dies a few days after the operation.

12.2 Contrast Agent Incident and Emergency Medication

12.2.1 Side Effects

Adverse reactions caused by KM may be dose-dependent or dose-independent (Table 12.1).

Among other things, vasodilatation may occur, which causes a drop in blood pressure (hypotension). Histamines released from mast cells are responsible for an immediate allergic reaction and in turn lead to vasodilation of the small peripheral vessels. This is the cause of a possible circulatory shock.

Table 12.1 Adverse direct side effects/reactions to KM

	Dose-dependent response	Dose-independent response
Response type	Direct (local) effect on organs and tissues as well as organ systems	Systemic response
Pathological process	Chemotoxic	Anaphylactic
Symptoms	Sensation of warmth/cold, reddening of the skin, headache	Nausea, vomiting, urticaria, itching

Furthermore, an involvement of the coagulation system and the CNS is discussed.

Many patients assume that a KM reaction is accompanied by an iodine allergy—but an iodine allergy would not be compatible with life, since we need iodine as an indispensable component of our human metabolism.

An adverse KM reaction is not based on an iodine allergy, but is due to an intolerance of the KM complex.

Locally, especially with iodine-containing contrast media, pain, damage to the vessel walls, vasodilatation (→ drop in blood pressure) may occur.

Low osmolar CMs are generally better tolerated than high osmolar ones, non-ionic ones better than ionic ones.

Contrast Induced Nephropathy (CIN)

Contrast-induced nephropathy is defined as a deterioration of renal function (symptomatic by pathological creatinine values 3–10 days after the application of KM) after the administration of iodine-containing, intravasally applied contrast media. It occurs in 7–10% of patients, with patients with pre-existing renal insufficiency or diabetes mellitus with renal insufficiency being particularly at risk. In this group of patients, contrast media should not be administered if possible. However, if it cannot be avoided for compelling diagnostic reasons, the following aspects should be taken into account:

- Before the examination, the patient should be sufficiently hydrated, i.e. supplied with fluid (i.v. hydration with isotonic NaCl solution is optimal).
- Nephrotoxic substances should be avoided as concomitant therapies or discontinued if necessary.
- During the investigation:
  - Use of a low osmolar and viscous KM
  - Use as little KM as possible!
  - Repeated KM administration should be avoided at all costs!

Hyperthyroidism and Thyrotoxic Crisis

If iodine-containing contrast medium is used (e.g. in the course of an angiography), the iodine plasma level is increased due to cleavage of the iodine nucleotide. A normal healthy thyroid gland can adapt to the increased iodine load. However, if autonomous production or an immune disease of the thyroid gland is already present, hyperthyroidism and even a thyrotoxic crisis may occur.

The frequency with which hyperthyroidism occurs depends on several factors:

- Severity of iodine deficiency prior to iodine exposure,
- Extent of exposure to iodine,
- Frequency of functionally autonomous cells in the thyroid gland,
- Age of patients.

Symptoms of Hyperthyroidism Include

- Weight loss (despite sufficient food intake)
- Accelerated pulse
- Sweating
- Hypertension
- Nervousness, restlessness
- Sleep disorders
- Possible goiter

Symptoms of Thyrotoxic Crisis Include

- Stage 1 (lethality less than 10%): Extreme sinus tachycardia (>150/min) or tachyarrhythmia with existing atrial fibrillation, heart failure; high fever; gastrointestinal and neurological symptoms, exsiccosis, dehydration
- Stage 2: Clouding of consciousness
- Stage 3 (lethality: over 30%): Unconsciousness

In patients at risk, perchlorate (irenate) is used prophylactically before and 1–2 weeks after the examination with a thyrostatic. Perchlorate decreases iodine uptake into the thyroid gland.

Prophylaxis with Perchlorate

Example of Prophylactic Treatment of Iodine-Induced Hyperthyroidism

- 2–4 h before KM administration 25 drops of Irenate (perchlorate)
- 3 × 15 drops of Irenat/day for one week
- Check TSH basal, T4, T4 after three and six weeks

Example of Treatment in Manifest Hyperthyroidism and Vital Indication

- 2–4 h before KM administration 25 drops of Irenate (perchlorate)
- 3 × 15 drops of Irenat/day for two weeks
- 20 mg/day Favistan (thiamazole) for two weeks

Nephrogenic Systemic Fibrosis (NSF)

This form of fibrosis can occur (very rarely) in patients who already have stage 4 or 5 renal failure and are undergoing testing with gadolinum. Why it occurs is not yet fully understood. It may become symptomatic in the period from 2 days to 18 months after exposure to gadolinum-containing BM. There are prophylactic measures that can be taken to reduce the risk of NSF. These include:

- If KM administration is diagnostically essential in high-risk patients, then cyclic gadolinum KM or KM with a low risk classification should be used (Table 12.2).
- The lowest possible dose should be aimed for and repeated administration should be avoided at all costs.

Table 12.2 Risk classification of gadolinum contrast agents in relation to the development of NSF. (According to EMEA)

Risk class	Contrast agent
High risk	Optimark, Omniscan, Magnevist, Gado-MRT-Ratiopharm
Medium risk	Vasovist, Primovist, Multihance
Low risk	Gadovist, ProHance, Dotarem

Circulatory Arrest

Symptoms

- Lack of (carotid) pulse
- Respiratory arrest, gasping possibly after 15–40 s
- Cerebral seizures possible after 15–45 s
- Pupil dilation and loss of light reaction after 30–60 s

Resuscitation

- Cardiac massage: Find a hard surface, if not already available → pressure point in the middle of the chest (lower half of the sternum) → compression depth approx. 4–5 cm → 100 compressions
- Ventilation: after the first 30 compressions (frequency 100–120/min) → first ventilation cycle of approx. 1 s with ventilation twice
- Continue as above in the ratio **30 (cardiac compressions):2 (ventilations)**
- **Special features:**
  - in pregnant women from the 20th week of pregnancy, lift the pelvis to the right and move the uterus to the left during positioning before chest compressions
  - for children, five ventilations initially; if only one caregiver is present, 30 (cardiac compressions):2 (ventilations); for the 2-helper method, 15 (cardiac compressions):2 (ventilations)

Emergency Medication

- Suprarenin® (adrenalin 1:1000): dilute 1 mL (1 mg) with 9 mL physiological saline solution
- Glucocorticoids (e.g. dexamethasone 40–100 mg, prednisolone 200–500 mg)

- H_1 and H_2 antagonists
- Atropine 0.5 mg
- Midazolam 5 mg
- i.v. narcotics
- Crystalloid solutions
- Colloidal volume substitutes

Seizures

A seizure does not have to occur as a side effect, but it can occur at any time due to an existing underlying disease (epilepsy, brain tumors, metastases, scarring in the brain, etc.), e.g. also in the MRI or CT during the examination procedure.

There are various forms of seizures, of which the grand mal seizure and status epilepticus are the most relevant in emergency medicine.

Grand Mal Seizure

This type of seizure is divided into different phases:

- Preconvulsive phase with general symptoms such as headache, fatigue, hallucinations
- Convulsive phase (tonic stage) with fall, loss of consciousness, apnoea, tongue bite, extensor tonus
- Convulsive phase (clonic stage) with rhythmic contractions of the musculature, enuresis, tongue biting, cyanosis
- Postconvulsive/postictal phase followed by a brief comatose state, twilight, confusion.

This is the most common type of seizure you will encounter. The most important treatment measure here is to prevent injury to the patient, e.g. by falling off the examination table. A biting wedge or similar is no longer used today. In the case of a short-lasting seizure, acute drug therapy is not usually necessary. It is important that you get support from the doctor in charge.

Status Epilepticus

If a tonic-clonic seizure lasts longer than five minutes or if an entire series of seizures occurs without the patient regaining consciousness in the meantime, this is referred to as status epilepticus. The danger here is an undersupply of oxygen (hypoxia) and dangerous cardiovascular stress.

Acute Therapy for Status Epilepticus

- Oxygen supply, blood pressure control, if possible ECG and blood sugar control
- Benzodiazepines i.v., e.g. 2–4 mg lorazepam (alternatively diazepam 10–20 mg or clonazepam 1–2 mg)
- If there is no effect after five minutes, the administration is repeated
- Phenytoin and valproate are reserve drugs that are only given if the status epilepticus cannot be terminated even by administration of benzodiazepines.

Practice Questions

1. A patient suddenly becomes cold sweaty and develops dyspnea after a CT scan with KM. What is your first thought?
2. What can extreme sinus tachycardia, high fever; gastrointestinal and neurological symptoms indicate?
3. What can be done prophylactically to prevent hyperthyroidism from iodine-containing KM?
4. What are the resuscitative measures in case of circulatory arrest?
5. How is status epilepticus defined and what is dangerous about it?

Solutions ▶ Chap. 27