

Multiple asystoles in a patient undergoing total knee arthroplasty - a case report

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Case report

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Abstract

Background Unexpected cardiac arrest in patients during surgery is associated with high mortality. Reasons are often multifactorial and not exactly clear. Case presentation Therefore, this case report describes a patient, who developed reversible asystoles during knee surgery under general anesthesia. All diagnostic cardiac examinations were unremarkable. After surgery the patient showed no further symptoms. Conclusion To prevent cardiac arrest due to non-cardiac reasons, patients with high risk for asystole caused by vasovagal reflex or pain need to be identified. Preoperative conditions like hypovolemia need to be improved and additional monitoring should be used. Further investigations to find the influence of non-cardiac disease and long-term medication are necessary.

Background

Cardiac arrest in patients undergoing surgery is often dramatic. Over 50% mortality rates are documented. The overall incidence of perioperative cardiac arrests is estimated between 4.3 to 34.6 per 10,000 procedures which rises to 54.4 per 10,000 in the elderly population. [1] In total knee arthroplasty (TKA), Berstock et al. (2018) reported a 90-day mortality of 0.39% (700,981 TKAs from 1991 to 2014) [2].

The reason for cardiac arrest are frequently multifactorial, depending on preoperative conditions of the patient, cardiac risks and anesthesia management, human factors as well as the surgical procedure [1]. Specific risk factors for cardiac events in TKA are prior cardiac events, chronic hypertension, diabetes mellitus, increasing age and male sex. Some factors were shown to be protective such as overweight (BMI between 26 to 30 kg/m²). [2,3]

A reason for cardiac arrest could be an overexcitation of the parasympathetic nerve system. Pain, for example, could lead to bradycardia and followed by asystole like in cases of vasovagal syncope or the Bezold-Jarisch reflex [4].

The following case report describes reversible asystoles during a knee arthroplasty under general anesthesia.

Case Presentation

We present a 71-year-old self-employed, non-smoking German female patient scheduled to undergo a right TKA. Relevant past medical history included type 2 diabetes mellitus treated with insulin (HbA1c 43 mmol/mol), BMI 35.5 kg/m² (176cm/110kg), arterial hypertension (usual value 140/60 mmHg right arm) and restless leg syndrome. Important self-medications were metformin, valsartan, hydrochlorothiazide, nebivolol, aspirin, lercanidipine hydrochloride, levodopa and benserazide hydrochloride. The patient's history included a TKA on the right side in 2000, a traumatic dislocation in 2011 and a revision arthroplasty in 2012 caused by instability. These operations were performed under general anesthesia without complications.

In February 2018 the patient presented to our orthopedic outpatient department because of increasing pain in the right knee joint. Examinations showed implant loosening and a Staphylococcus epidermidis infection. Therefore, the patient was scheduled for two stage revision with implant removal and antibiotic loaded spacer implantation. Until the day of operation the patient got no antibiotic therapy. For pain management she got a prescription for celecoxib and metamizole PO as well as subcutaneous antithrombotic prophylaxis with enoxaparin sodium and the recommendation to cool, protect and store up the leg.

In the premedication visit the patient was classified as ASA III (according to the American Society of Anaesthesiologists) with a metabolic equivalent of ≥ 4 . An electrocardiogram and current lab values (erythrocytes 7.0 mmol/l; Hb 7.0 mmol/l; Hk 0.32 l/l; CRP 5.7 mg/l; all others without abnormalities) were already done. The patient showed no signs of cardiopulmonary decompensation like dyspnea, edema or auscultatory abnormalities at this time. For the day of surgery 5mg oxazepam PO and usual medication except metformin, valsartan and hydrochlorothiazide was prescribed. The patient has been informed that she can eat until 6 hours before surgery and drink clear liquids until 2 hours before surgery. The procedure was performed under general anesthesia with endotracheal intubation. The initial vital parameters were a blood pressure (BP) of 160/80 mmHg and a heart rate (HR) of 65 bpm. The induction of anesthesia was performed under standard monitoring (non-invasive BP, HR and pulse oximetry) in the following order: propofol (180mg) intravenous (IV), sufentanil (20 μ g) IV and rocuronium (50mg) IV. Sevoflurane (target value of minimal alveolar concentration of 0,8-0,9) and sufentanil (10 μ g as single IV bolus at point of incision) were used to maintain anesthesia. Furthermore, 1g tranexamic acid IV and balanced electrolyte solution (jonosteril 2l for the hole surgery) was given. After induction BP was 95/55 mmHg, measurement was done every three minutes and documented every five minutes. The patient received norepinephrine (20ml/h »3 μ g/min over IV perfusion) for 20 minutes, directly after induction of anesthesia until surgically incision (28 minutes after induction), which was stopped at a mean arterial pressure of 65 mmHg. Thereafter, the patient was stable without catecholamines.

Surgeon saw intraoperative pronounced synovitis and intramedullary femoral and tibial periprosthetic infection membranes. They took a smear and the patient received cefuroxime 1,5g IV. During the tibial component spontaneously resolving episodes of asystole were observed on 3-lead-ECG. They were seen two times over maximum of two seconds and depended on the surgical manipulation. Before any intervention they ended spontaneously with complete removal and no hemodynamic changes were seen. Forty-five minutes after incision when the surgeon began the intramedullary reaming, there was a seven-second asystole again. This vanished after stopping the reaming. However, now asystole was associated with a fast fall in BP (42/18 mmHg), oxygen saturation (68%) and end-tidal CO₂ (21 mmHg). The patient received 0.5 mg of atropine IV to prevent reproducible asystole for the rest of the procedure. Epinephrine was prepared but not injected because of the complete recovery of hemodynamic parameters after end of manipulation. Other reasons for asystole were checked without any indication of a reversible cause.

Around these events the patient had no signs of pain like hypertension or tachycardia. From the event of asystole until the end of the surgery, depth of anesthesia was monitored by the bispectral index (BIS), with no evidence of low anesthesia (BIS score of 42) after the last event. According to our standard

operation procedure BIS was not indicated for this surgery but we wanted to exclude pain as a reason for another asystole (because of low anesthesia) until the end of operation.

Extubating was done without any problems. The patient got metamizole (1g) at the end of surgery to prevent postoperative pain. In the recovery room the patient got a 12-channel-EKG, laboratory tests to exclude ischemia, blood gas analysis and a transthoracic echocardiography without any abnormalities. Noninvasive cardiovascular investigations like repeated 12-channel-EKG, 24-hour Holter monitoring and ultrasound of extracranial vessels were done. These investigations revealed a couple of supraventricular ectopic but were otherwise unremarkable. The cardiologist assumed that the patient had a vagal reaction when bone manipulations were done by surgeon and advised atropine IV for following operations.

Six weeks later the patient underwent scheduled spacer removal and TKA. The patient got atropine IV after induction of anesthesia, to reach a higher HR and received invasive BP measurement and BIS-monitoring. As the surgeon manipulated the medullary cavity, the patient developed a self-limiting episode of bradycardia (40 bpm) lasting only three seconds. No other events were recorded during surgery or hospital stay.

Discussion

The patient had intraoperative asystoles through manipulation in the medullary cavity without an apparent primary cardiac cause.

First the pre-existing conditions of our patient are known as risk factors for cardiac adverse events. With respect to studies about mortality in TKA, hypertension requiring medication is one of the predictors for cardiac complications in TKAs (OR 4.74; 95% CI 1.04 to 21.59; $p = 0.0440$) [5] as well as type 2 diabetes mellitus treated with insulin (OR 1.95; 95% CI 1.13 to 3.35; $p = 0.016$) [6].

In addition, the literature describes that periodic leg movements in patients with restless legs syndrome (RLS) during sleep produces episodes of tachycardia followed by bradycardia. This has been reported less frequently in the elderly, with women having a higher prevalence of bradycardia during these episodes [7, 8]. At the time of medullary manipulation and asystole there was no measurement of relaxation or BIS monitoring. We can only guess the patient was in the same state as sleep. Cholley-Roulleau et al. (2017) [8] found no association between RLS and cardiovascular diseases, however this is not conclusively clarified in the general neurological literature.

Besides from the pre-existing conditions of the patient another cause for the asystoles could be relative imbalance between para- and sympathetic nervous systems, resulting in a decreasing HR, venous pooling and loss of vascular tone which would be consistent with the findings of our cardiologists. This proposed pathway agrees with the pathophysiology of the Bezold-Jarisch reflex. A vasovagal syncope as a cause for an asystole is also conceivable. Pain stimuli and decreased venous return, transmitted by the glossopharyngeal and vagal nerves, perhaps led to an activation of the medullary vasomotor center. Increased vagal activity stimulates the parasympathetic system accompanied by depression of the

sympathetic activity, followed by bradycardia, vasodilation and decreased release of catecholamines.[4] Farther, the surgical positioning (spine position and intermitted lifted up right leg) and procedure accompanied by the pre-existing severe obesity leads to an increased intrabdominal pressure in the patient resulting in compression of the inferior vena cava with reduced venous return and lower right arterial pressure. The patient also was not wearing compression stocking on the left non-operated leg which could strengthened the venous pooling. Regarding reduced venous return and possible higher risk for vasovagal reactions it should also be considered the haemoglobin levels. The patient had a haemoglobin level of 11.27 g/dl at the beginning of surgery. The haemoglobin level fell to 9.5 g/dl during surgery. Under catecholamine therapy mean arterial pressure of the patient was more than 60 mmHg with normal HR as well, even if systolic BP of the patient was lower than in her everyday life. According to the criteria of patient blood management (PBM) [9,10] there was no indication for a blood transfusion. The patient received 2-liter of balanced electrolyte solution as volume replacement. The blood loss (approximately 800 ml) could cause lower venous return, resulting in an enhanced vasovagal reaction. Irrespective of the recommendations of the PBM, it is conceivable that the patient would had needed higher blood levels of haemoglobin which was not noticeable because of the effects of the usual medication (e.g. no tachycardia due to beta blocker therapy, no changes in BP after stabilization with catecholamine treatment). Regarding the infection of the prothesis and the re-operation a higher blood loss should be considered and in preparation for the surgery anemia should have been treated in this case. There are current guidelines of PBM specially for patients undergoing knee and hip arthroplasty [11, 12]. In case of our patient the ferritin level should be determined and if necessary iron and/or erythropoietin had to be replaced [11, 12]. Spahn (2010) [13] described significant increased mortality in patients with pre- and postoperative anemia undergoing total hip or knee arthroplasty. Possibly, this patient group needs blood transfusion earlier to improve postoperative outcome.

With respect to the anemia and reasons for imbalance between para- and sympathetic nervous systems the usual medication should be considered as well. Therefore, long-term ACE inhibitor and a diuretic agent were not administered the day of surgery because of the increased risk for intraoperative hypotension through hypovolemia and due to pre-existing anemia. This would lower compensatory mechanisms via renin angiotensin system followed by failed vasoconstriction and enhanced Bezold-Jarisch reflex [14]. It is possible that similar effects can be observed in RLS. Dopamine, a natural catecholamine, shows reduced effects in our patient because of the mentioned lower dopaminergic striatal receptor binding and reduced compensatory pathways.

Before re-implantation of the prosthesis we injected atropine (1mg) IV at the beginning of anesthesia which reduces the reaction of the vagal nerve. Additionally, the patient underwent intraarterial BP measuring (highest value 145/60mmHg and lowest value 100/50mmHg), BIS monitoring (between 37 to 60) and repeated blood gas analyzes. Haemoglobin was 7.0mmol/l the day before surgery and changed during operation to 5.5mmol/l followed by postoperative blood transfusion). The patient was stable besides the short term of bradycardia. In comparison to the first operation there were no differences, besides from a higher dosage of sufentanil (35µg for induction + 10µg). This higher dosage based on the

values of BIS monitoring (from 42 to 60) and BP as signs of pain (increased from 100/50mmHg over 120/65 to 140/70mmHg while ending catecholamine treatment) as signs of pain.

Conclusions

The cause of asystole in our patient seemed to be multifactorial. Pre-existing conditions like hypovolemia and anemia need special attention and should be treated before surgery. To exclude pain or to reduce the risk for pain, additional peripheral regional anesthesia in patients with chronic pains, change of prosthesis or repeated interventions are recommended. Patients with risks for Bezold-Jarisch reflex or other vasovagal reactions (anemia, hypovolemia, operation with high pain, vena cava compression due the patient positioning, cardiac interventions, lower preload) must be evaluated before surgery and prophylactic measurement like BIS can be undertaken.

Declarations

Consent:

Written consent for publication was obtained from the patient.

Abbreviations

BIS: Bispectral index; BP: Blood pressure; HR: Heart rate; PBM: Patient blood management; RLS: Restless legs syndrome; TKA: Total knee arthroplasty.

Competing interests

The authors declare no competing interests.

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Authors' contributions

AMB helped manage the patient, conduct the background research and write the manuscript. LF helped write the manuscript. DW helped care for the patient and helped write the manuscript. All authors read and approved the final manuscript.

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Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Ethics approval and consent to participate

Not applicable.

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