Cardiac arrest in orthopedic surgery – a case report

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Case Report

Keywords: Cardiac arrest, bradycardia, asystole, total knee arthroplasty

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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 asystole 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.

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Background

Cardiac arrest in patients undergoing surgery is often dramatically. Mortality rates are documented with over 50%. The overall incidence of perioperative cardiac arrests is estimated to be 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].

Often causes for cardiac arrest are 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/m^2). [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 a reversible asystole during a knee arthroplasty under general anesthesia.

Case Presentation

The patient was a 71-year-old self-employed, non-smoking German female. Relevant past medical history included type 2 diabetes mellitus treated with insulin, BMI 35.5 kg/m^2, arterial hypertension 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.

In the premedication visit the patient was classified as ASA III (according to the American Society of Anesthesiologists). The patient showed no signs of cardiopulmonary decompensation at this time. For the day of surgery 5mg oxacepam and long-term medication except metformin, valsartan and hydrochlorothiazide was prescribed.

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 with propofol (180mg), sufentanil (20µg) and rocuronium (50mg). Sevoflurane and sufentanil (10µg over bolus) were used to maintain anesthesia. Furthermore, 1g tranexamic acid was given. After induction BP was 95/55 mmHg. The patient received norepinephrine (20ml/h »3µg/min) for 20 minutes which was stopped at a mean arterial pressure of 65 mmHg. Thereafter, the patient was stable without catecholamines.During the tibial component removal reproducible asystole's were observed. They depended on the surgical manipulation and ended spontaneously with complete removal. First 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, oxygen saturation and end-tidal CO_2. The patient received 0.5 mg of atropine to prevent reproducible asystole for the rest of the procedure. Around these events the patient had no signs of pain like hypertension or tahcycardia. 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.

Extubation was done without any problems. 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, long-term EKG and ultrasound of extracranial vessels were done. These investigations revealed a couple of supraventricular ectopics but were otherwise unremarkable. The Cardiologist assumed that the patient had a vagal reaction when bone manipulations were done by surgeon and advised atropine for following operations.

Six weeks later the patient underwent scheduled spacer removal and TKA. The patient got atropine 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 an intraoperative asystole through manipulation in the medullary cavity without an apparent primary cardiac cause. With respect to studies about mortality in TKA, our patient has some risk factors for adverse cardiac events. 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]. 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) [7] found no association between RLS and cardiovascular diseases, however this is not conclusively clarified in the general neurological literature.

Other causes for the asystole in our patient could be an overexcitation of the parasympathetic system, 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 the asystole is also conceivable. Pain stimuli and decreased venous return, transmitted by the glossopharyngeal and vagal nerves, resulting in an activation of the medullary vasomotor centre. Increased vagal activity stimulates the parasympathetic system accompanied by depression of the sympathetic activity. Followed by bradycardia, vasodilation and decreased release of catecholamines.[4]

The patient had a haemoglobin level of 11.27 g/dl at the beginning of surgery. The hemoglobin 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) [8] 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) causes lower venous return and could enhanced the vasovagal reaction. Irrespective of the recommendations of the PBM, it is conceivable that the patient would had needed higher blood levels which was not noticeable because of the effects of the long-term medication (e.g. no tachycardia due to beta blocker therapy, normal BP with ended 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 [9]. In case of our patient the ferritin level should been determined and if necessary iron and/or erythropoietin had to be replaced

[9]. Spahn (2010) [10] 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.

Long-term ACE inhibitor and a diuretic agent were not administered the day of surgery because of the increased risk for hypotension through hypovolemia and anemia. This would lower compensatory mechanisms via renin angiotensin system followed by failed vasoconstriction and enhanced Bezold-Jarisch reflex [11]. 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.

Another reason for the asystole could be the surgical positioning and procedure accompanied by the pre-existing mild obesity which 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.

Before re-implantation of the prosthesis we injected atropine (1mg) at the beginning of anesthesia which reduces the reaction of the vagal nerve. Additionally, the patient underwent intraarterial BP measuring, BIS monitoring and repeated blood gas analyzes. The patient was stable besides the short term of bradycardia. In comparison to the first operation there was no differences, besides from a higher dosage of sufentanil (35µg for induction + 10µg according to BIS monitoring and 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 scanned before surgery and prophylactic measurement like BIS can be done.

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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