

Case report

Robotic-assisted gynecologic surgery associated tympanic membrane perforation: A report of two cases and review of the literature

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ABSTRACT

Robotic gynecologic surgery is associated with the use of steep Trendelenburg positioning. Steep Trendelenburg is necessary to provide optimal exposure to the pelvis but is associated with an increased risk of non-surgical complications such as suboptimal ventilation, facial and laryngeal edema, increased intraocular and intracranial pressure as well as neurologic injury. Several case reports have described otorrhagia after robotic assisted surgery; however, there are limited reports on the risk of tympanic membrane perforation. To our knowledge, there are no published reports on tympanic membrane perforation in gynecologic nor gynecologic oncology surgery. We report two cases of perioperative tympanic membrane rupture and bloody otorrhagia associated with robot-assisted gynecologic surgery. In both cases otolaryngology/Ear Nose and Throat (ENT) was consulted, and the perforations resolved with conservative management.

1. Introduction

Minimally invasive surgery is the current standard of care for endometrial cancer when technically feasible. The use of robot-assisted minimally invasive surgery has continued to increase rapidly since its induction; approximately 42–61% of hysterectomies for uterine cancer are now performed robotically. (Zakhari et al., 2015; Abel et al., 2020) Given the unique positioning requirements of gynecologic surgeries, steep Trendelenburg (25–45 degrees) is required in most cases. Steep Trendelenburg is necessary to provide optimal exposure to the pelvis but is associated increased risk of non-surgical complications such as suboptimal ventilation, facial and laryngeal edema, increased intraocular and intracranial pressure as well as neurologic injuries. (Takmaz et al., 2018) Perioperative otorrhagia and hearing loss associated with Trendelenburg position are rare. To our knowledge, there are no published reports on the risk of tympanic membrane perforation in gynecologic surgery nor gynecologic oncology surgery. We report two cases of perioperative tympanic membrane rupture and bloody otorrhagia associated with robot-assisted gynecologic surgery. In both cases otolaryngology/Ear Nose and Throat (ENT) was consulted, and the perforations resolved with conservative management. Fig. 1..

2. Cases

Case 1: A 85-year-old woman presented for robotic assisted total laparoscopic hysterectomy, bilateral salpingo-oophorectomy, sentinel lymph node mapping and biopsies and cystoscopy for endometrial cancer. Her medical history was significant for osteoporosis, gastric reflux, mitral regurgitation, heart failure with preserved ejection fraction, obstructive sleep apnea and remote history of estrogen receptor positive breast cancer. Body Mass Index (BMI) was 29 kg/m². The table was set at the maximum Trendelenburg of 30 degrees for the duration of the surgery. Blood pressures were somewhat labile ranging from a peak of 155/90 which resolved over 5 min to a trough of 80/40 which also quickly resolved. Otherwise, pressures ranged from 140/80–100/50. The procedure was otherwise uncomplicated and total operative time was 3 h and 15 min. After the patient was awakened from anesthesia, she was noted to have 10 ml of clotted blood in her left ear. She had no ear pain but reported decreased hearing. ENT was consulted. Examination of the pinna demonstrated no evidence of trauma. There was low volume of blood in the external ear canal which was suctioned away to reveal small anterior canal wall trauma as well as tympanic membrane perforation of unknown etiology or chronicity. Patient applied ciprofloxacin and dexamethasone drops to the left ear for 10 days. On ENT follow-up

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2 months after surgery her tympanic membrane was intact without evidence of perforation. She had small amount of dried blood in her ear canal but no active bleeding and her hearing had improved significantly. She continues to follow with gynecologic oncology for endometrial cancer without significant ear complaints.

Case 2: A 85-year-old woman presented for robotic assisted total laparoscopic hysterectomy, bilateral salpingo-oophorectomy, sentinel lymph node mapping and biopsies and cystoscopy for endometrial cancer. Her medical history was significant for bilateral sensorineural hearing loss using hearing aids, hypertension, non-ST elevation myocardial infarction (NSTEMI), chronic systolic heart failure, mitral regurgitation, pulmonary hypertension, left bundle branch block with pacemaker and hypothyroidism. BMI was 25 kg/m². The table was set at the maximum Trendelenburg of 30 degrees for the duration of the surgery. Blood pressures ranged from approximately 130/80–100/75, with 3 elevations to 150/110, each of which lasted less than 5 min. The procedure was uncomplicated. Total operative time was 3 h. At the end of the case, anesthesiology noted that the patient was bleeding from her bilateral ears after positive airway pressure. ENT was consulted. Examination of the left ear revealed tympanic membrane with small perforation. The right tympanic membrane was intact with blood noted in the external ear canal. There was no evidence of trauma. The lesion was suspected to be secondary to longstanding Trendelenburg positioning and positive pressure ventilation during surgery which caused tympanic membrane rupture and bleeding. Recommendation was for ciprofloxacin and dexamethasone drops to both ears for one week. It was deemed safe to continue using hearing aids and the patient did not notice hearing decline. On ENT follow-up 2 weeks after surgery her tympanic membranes were intact. A small amount of dried blood in the ear canal was identified and removed. She has not had ear complaints since.

3. Discussion

Tympanic membrane perforation is a rare surgical complication. Physiologic changes during laparoscopic surgery in the Trendelenburg

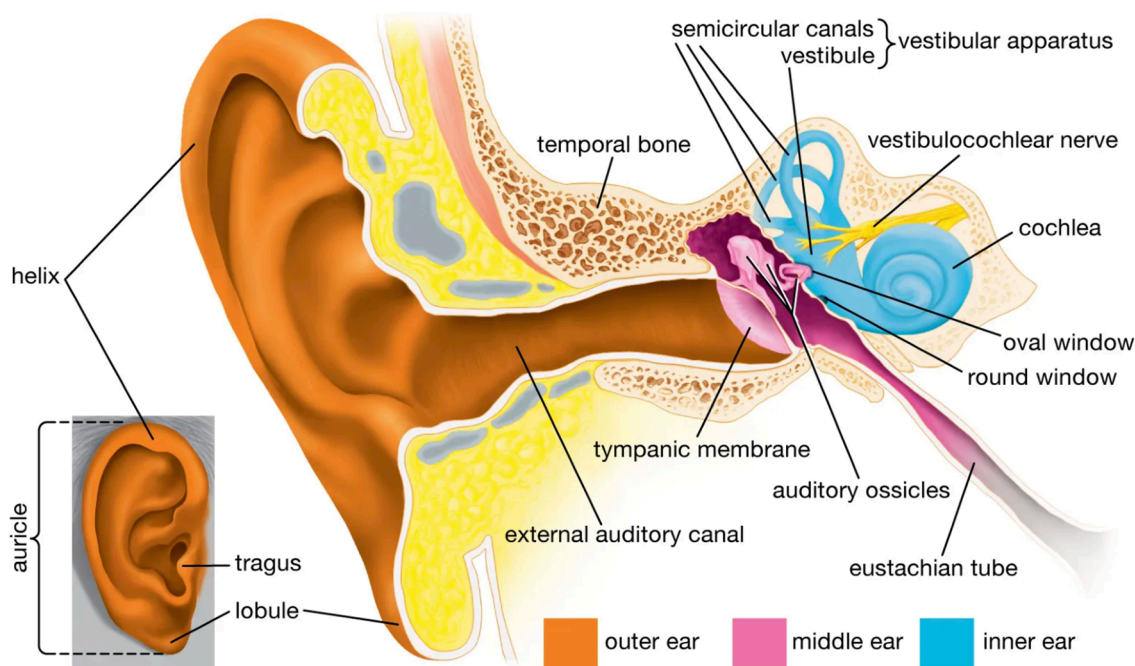
position include increased central venous pressure, increased end tidal CO₂, and increased arterial pressure which may increase blood flow (Aloisi et al., 2017; Chan et al., 2015).

This increase in intracranial pressure causes edema in the face, head, and neck. These phenomena may increase the risk of barotrauma, as seen in these patients. At rest, the Eustachian tube is partially collapsed. The Eustachian tube is opened by contraction of the tensor veli palatine muscle during swallowing, allowing pressure equalization. Inhibition of the swallowing reflex by anesthesia as well as the venous congestion that occurs during Trendelenburg impede this compensatory mechanism, making the tympanic membrane more susceptible to trauma. (Maerz and Gainsburg, 2016).

Steep Trendelenburg is often defined as angles between 25 and 45 degrees (Takmaz et al., 2018). This positioning increases exposure of the operative field in gynecologic surgery, making this complication of particular interest to gynecologists. Especially in robotic surgery for gynecologic cancer, this position is often necessary for adequate visualization for nodal dissection. Robotic gynecologic surgery is known to often require steeper Trendelenburg than traditional laparoscopy, potentially increasing risk for this complication via the mechanism above. (Takmaz et al., 2018).

We only identified one case of tympanic membrane rupture during robotic surgery published in the literature. This involved a 63-year-old man undergoing a robotic-assisted laparoscopic proctectomy with bilateral lymph node dissection. Intraoperative otolaryngology consult was performed with evidence of tympanic membrane rupture. (Maerz and Gainsburg, 2016) Review of the literature identified 9 total cases of perioperative otorrhagia (without tympanic rupture) associated with the Trendelenburg position, 4 of which were robot-assisted (Aloisi et al., 2017; Cohen et al., 2015; Jones and cott, Klawns JM. , 2015; Owens and Rhoades-Lazenby, 2016) and 5 of which were not. (Chan et al., 2015; Aunac and Nsengiyumva, 2001; Addison et al., 2014;2014: bcr2014206118.; España Fuente et al., 2016) Of the robot-assisted procedures, only two were gynecologic. (Aloisi et al., 2017; Owens and Rhoades-Lazenby, 2016).

We also identified two cases of post-operative bloody otorrhea not



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associated with the Trendelenburg position, one in the setting of cardiac surgery with markedly increased CVP (Singh et al., 2012), and the other in the case of prolonged perioperative hypertension (D'souza, 2005), further lending credence to the suggestion that mechanism of injury is related to increased central venous pressure. Of the 6 cases which reported BMI, it ranged from 19–27 kg/m² with an average of 23.5 kg/m². (Aloisi et al., 2017; Cohen et al., 2015; Jones and cott, Klafta JM., 2015; Aunac and Nsengiyumva, 2001; España Fuente et al., 2016) Reported ages ranged from 28 to 80, with an average of 65 years of age. (Aloisi et al., 2017; Chan et al., 2015; Maerz and Gainsburg, 2016; Cohen et al., 2015; Jones and cott, Klafta JM., 2015; Owens and Rhoades-Lazenby, 2016; Aunac and Nsengiyumva, 2001; Addison et al., 2014;2014: bcr2014206118.; España Fuente et al., 2016; Singh et al., 2012; D'souza, 2005) Thus, we suspect age but not BMI to be a pertinent risk factor. Aloisi et al demonstrated a case of spontaneous bilateral otorrhagia associated with robotic surgery, during which they took pains to reduce the degree of Trendelenburg position and lower the insufflation pressure. Their case was complicated by intraoperative hypertension to 193/112, along with advanced patient age. Thus, although the Trendelenburg position and potentially robotic surgery are risk factors, the cause of perioperative otorrhagia and presumably tympanic membrane rupture is likely multifactorial. (Aloisi et al., 2017).

These cases highlight the need for surgeons and anesthesiologists who employ steep Trendelenburg to remain vigilant about this possible complication and continually address the steepness of the angle needed to achieve adequate intraoperative visualization. In both cases we described, otorrhagia was identified after the termination of the case. Draping of the patient may delay diagnosis of this injury as visualization of the bilateral ears is more challenging. We should employ our anesthesia colleagues to assess for this complication. (Cohen et al., 2015) Thankfully, neither patient experienced long term aural deficits after the procedure. We hypothesize that advanced age may have increased these patients' risk for this trauma to occur and thus increased vigilance should be utilized in the elderly patient.

Informed consent

Informed consent was obtained from the patients for publication of this case report. A copy of the consent is available for review by the Editor-in-Chief of this journal upon request.

Declaration of Competing Interests: None of the authors have any competing interests to declare.

CRedit authorship contribution statement

Alison Z Swartz: Writing – original draft. **y Novoa Victoria Arruga Novoa:** Writing – original draft, Resources. **S Hassoun Jenine:** Writing – original draft. **A Crispens Marta:** Writing – review & editing. **S. Prescott Lauren:** Writing – review & editing, Conceptualization, Supervision.

Declaration of Competing Interest

The authors declare that they have no known competing financial

interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.gore.2023.101151>.

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