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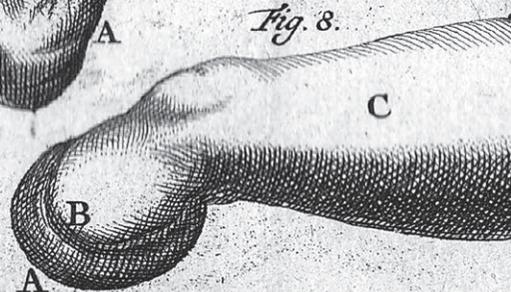
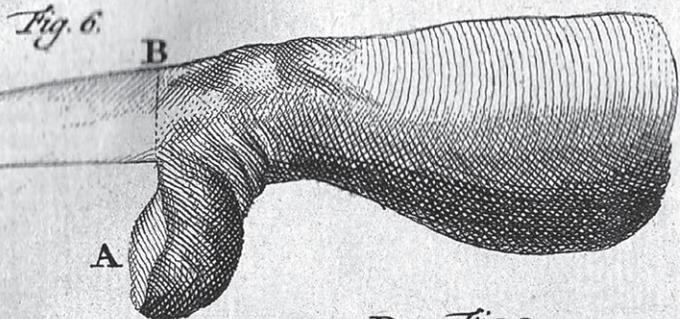
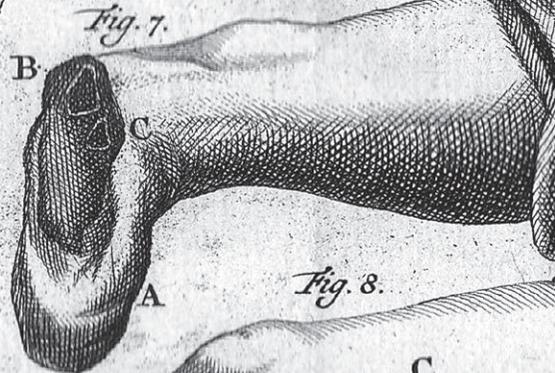
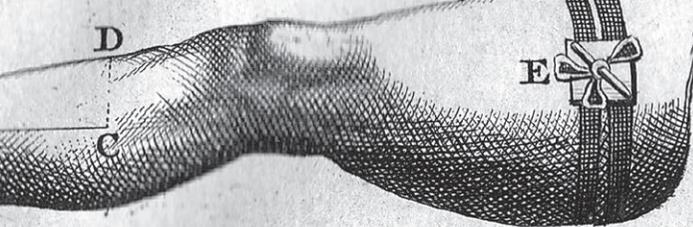
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Comparison of the Baska Mask[®] and Endotracheal Tube on Hemodynamic and Respiratory Parameters in Septoplasty Cases

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Key words: Mean arterial pressure – EtCO₂ – Airway pressure – Endotracheal tube – The Baska Mask[®]

Abstract: Laryngeal mask (LM) types have been used as an airway device for an alternative to the standard endotracheal tube (ETT). One of the novel type of LM, the Baska Mask[®], can be a safe alternative among the airway devices. The purpose of this study is to compare the effects of the new generation supraglottic airway device the Baska Mask[®] and the ETT on hemodynamic parameters (heart rate, mean arterial pressure), airway pressure and end tidal carbon dioxide (EtCO₂) in patients undergoing general anesthesia. After the approval of the ethics committee, 70 patients who underwent septoplasty were included in the study. Written informed consent forms were taken from these patients. Demographic data of the patients were recorded. Hemodynamic data of patients were measured and recorded preoperative, during induction, at the time of intubation 1th, 3th and 5th minute and during extubation. Also, airway pressure and EtCO₂ values of the patients were measured and recorded at the time of intubation, 1th, 3th and 5th minutes. Demographic data were similar in both groups. Mean arterial pressure, heart rate and airway pressure were lower in the group 2 (the Baska Mask[®] group) than in the group 1 (ETT group) and the difference was statistically significant ($p < 0.05$). EtCO₂ values were similar in both groups. No patients had tube leakage. In terms of hemodynamic and respiratory parameters the Baska Mask[®] is more advantageous than the ETT in short-term surgeries.

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Introduction

Many devices are used to provide airway patency during general anesthesia. The laryngeal mask (LM) is one of these devices. It was first used by Dr. Brain in 1983 (Brain, 1983). It is easy to apply and it does not require additional devices such as a laryngoscope. LM can harm teeth, pharyngeal and laryngeal structures less than endotracheal tube. In addition, the sympathetic activation effects (tachycardia, hypertension, myocardial ischemia, etc.) caused by supraglottic tension are less common in the LM use (Shribman et al., 1987; Knight et al., 1988; Takita et al., 2001). The aspiration risk of LM is higher than endotracheal tube, so this is the main disadvantage of the LM (van den Berg et al., 1997).

Many LM types have been produced in recent years. The new generation supraglottic Baska Mask[®] (Logical Health Products PTY Ltd., Morisset, NSW, Australia) is one of them. It doesn't need inflation as it takes the shape of the airway with positive pressure. This structure of the Baska Mask[®] provides the minimum level of leakage and allows it to be used at high airway pressures. The risk of damaging the oropharyngeal structures is less than both endotracheal tube and cuffed LM types (Alexiev et al., 2013; Bindal et al., 2018). The Baska Mask[®] includes an inlet that fits into the upper esophagus and the dorsal surface of the cuff is moulded to direct any oropharyngeal contents away from the glottis and towards the side channels where suction can be inserted to facilitate aspiration of this cavity (Alexiev et al., 2012).

In our study, we compared the effects of the Baska Mask[®] and endotracheal tube on hemodynamic parameters (heart rate, mean arterial pressure), airway pressure and EtCO₂ values.

Material and Methods

A prospective randomized controlled study started with the approval of the ethics committee of Kafkas University Clinical Research Ethics Committee (No. 80576354-050-99/167) and the ethical standards of the Declaration of Helsinki. Seventy consecutive American Society of Anesthesiologists (ASA) classification I and II patients that underwent elective septoplasty were included in the study. Informed consent was obtained from all patients who participated in the study. For the minimum sample size calculated by taking the alpha error of 0.05, the beta error of 0.20 and the ratio of the cases in the control takes 1 was found as 30 patients in both groups. The patients with ASA III-IV-V, body mass index (BMI) > 30 kg/m², chronic medication or alcohol use were excluded. The patients that had the history of intubation difficulty, diabetes mellitus, hypertension, malignant hyperthermia, renal disease were also excluded. The closed envelope method was used for the patient assignment and the patients were divided into two groups as endotracheal tube – ETT (group 1) and the Baska Mask[®] (group 2).

Standard monitoring (pulse oximetry – SpO₂, non-invasive blood pressure, electrocardiography, capnography) was applied to all patients. In both groups,

anesthesia was induced with propofol (Propofol 1%, Fresenius® Kabi Medicine, Istanbul, Turkey) 2 mg/kg, fentanyl (Fentanyl 0.05 mg/ml, Johnson and Johnson Medicine, Istanbul, Turkey) 1–2 µg/kg, rocuronium (Esmeron®, Merck Sharp Dohme, Australia) 0.6 mg/kg. Airway device was placed in all patients at the first attempt. The time of insertion was defined as the time from the handling of the airway device until the mechanical ventilator. EtCO₂ appeared to plateau. All airway equipment was placed by the senior anesthesiologist. Patients were connected to the mechanical ventilator in volume control mode with a tidal volume of 6–8 ml/kg and a respiratory rate of 10–14 breaths/min. Anesthesia was maintained with 1–1.5 MAC sevoflurane (Sevorane®, Liquid 100%, Queenborough, UK) in 3–4 l oxygen/air (40%/60%) mixture. The same ventilator device was used for all patients and device-dependent changes were minimized by calibrating it for each patient. At the end of the operation, inhalation anesthesia was ended. Atropine (Atropine Sulfate, Galen Medical, Istanbul, Turkey) 0.02 mg/kg intravenous (IV) was given to antagonize the muscarinic effects. In group 1, neostigmine (Neostigmine, Adeka Samsun, Turkey) 0.04 mg/kg IV was administered to block muscle relaxants in addition to atropine. After sufficient spontaneous breathing, muscle strength and consciousness level were achieved, the airway device (Baska Mask® or ETT) was removed. Tramadol 100 mg IV (Contramal 100 mg, Abdi Ibrahim, Istanbul, Turkey) was administered as an infusion for postoperative pain.

Demographic data of the patients were recorded. Hemodynamic data of patients were measured and recorded preoperative, during induction, at the time of intubation 1th, 3th and 5th minute and during extubation. Airway pressure and EtCO₂ values of patients were also measured and recorded at the time of intubation 1th, 3th and 5th minutes.

Statistical analysis

Data were analyzed by using IBM SPSS Statistics 23 software (IBM Corp., Armonk, NY). Frequency, mean and standard deviation were used to analyze data. The Kolmogorov Smirnov goodness-of-fit test was used for the normality analysis of the data. The chi-square and *t*-tests were used to compare the means of the 2 groups since the data showed normal distribution. A value of $p < 0.05$ was considered significant.

Results

When the demographic data (age, gender, body mass index) of the patients were examined, the groups were similar. The mean intubation time was 30.82 ± 5.96 s in group 1 and 20.48 ± 6.69 s in group 2. Group 2 was statistically lower. The patient demographics are presented in Table 1. Heart rate and mean arterial pressures of the patients were measured preoperative, during induction of anesthesia, 1th, 3th and 5th minutes after intubation and during extubation. When the heart rate values and mean arterial pressure values were examined; values of patients in group 2 were

Table 1 – Demographics and intubation times of patient groups

	Group 1 (ETT) (n=35)	Group 2 (Baska Mask®) (n=35)
Age (mean ± SD) (year)	27.40 ± 10.02	26.62 ± 10.06
Gender (male) (%)	28 (80%)	28 (80%)
BMI (mean ± SD)	22.62 ± 3.11	23.00 ± 2.57
Placement time (mean ± SD) (s)	30.82 ± 5.96	20.48 ± 6.69

ETT – endotracheal tube; SD – standard deviation; BMI – body mass index

Table 2 – Heart rate and mean arterial pressure values of the patient

	Heart rate (beats/min)			Mean arterial pressure (mm Hg)		
	group 1 (n=35)	group 2 (n=35)	P	group 1 (n=35)	group 2 (n=35)	P
Preoperative	82.11 ± 16.89	77.77 ± 14.13	0.248	98.45 ± 12.17	89.02 ± 21.19	0.026
Induction	94.74 ± 17.45	87.34 ± 21.25	0.116	88.31 ± 12.06	87.68 ± 10.80	0.819
Intubation 1 st min	101.88 ± 15.11	88.02 ± 14.86	0.000	102.91 ± 17.17	95.08 ± 14.44	0.043
Intubation 3 rd min	101.11 ± 15.15	85.94 ± 20.27	0.002	101.60 ± 14.89	92.48 ± 14.13	0.011
Intubation 5 th min	96.68 ± 23.60	88.31 ± 17.65	0.001	99.57 ± 18.42	87.25 ± 13.74	0.002
Extubation	92.62 ± 11.05	80.94 ± 13.95	0.000	102.42 ± 14.81	86.91 ± 13.74	0.000

statistically significantly lower at all times ($p < 0.05$). Values of heart rate and mean arterial pressure are given in Table 2.

Mean airway pressure values and mean EtCO₂ values of the patients were measured at 1th, 3th and 5th minutes after the induction. Airway pressures were statistically significantly lower in group 2 of all time. When EtCO₂ values were examined, there was no statistically significant difference between groups. Mean air pressure and mean EtCO₂ values are given in Table 3.

Mild sore throat occurred in 9 patients in group 1 and in 3 patients in group 2. Also, vomiting was observed in 4 patients in group 1 and 2 patients in group 2. No other complications were seen.

Discussion

Since 1983, the LM has been used as an airway device for an alternative to standard ETT. Its easy placement and less damage to the teeth and oropharyngeal structures

Table 3 – Mean airway pressure and mean EtCO₂ values

	Airway pressures* (mm Hg)			EtCO ₂ ** (mm Hg)		
	group 1 (n=35)	group 2 (n=35)	P	group 1 (n=35)	group 2 (n=35)	P
Intubation 1 st min	12.85 ± 1.92	9.54 ± 2.36	0.015	35.28 ± 3.72	35.42 ± 3.59	0.871
Intubation 3 rd min	12.54 ± 1.77	9.42 ± 2.15	0.014	34.74 ± 6.06	36.71 ± 2.77	0.085
Intubation 5 th min	12.77 ± 1.64	9.97 ± 2.64	0.013	36.37 ± 3.43	36.17 ± 3.23	0.803

*p<0.05; **p>0.05; EtCO₂ – end tidal carbon dioxide

have made it more common to use (Lee et al., 1993; Pennant and White, 1993; Gehrke et al., 2019). LM placement causes less subglottic stress than standard ETT placement. Therefore, complications (tachycardia, arrhythmia, hypertension, myocardial ischemia, etc.) caused by sympathetic activation due to this tension are less common (Knight et al., 1988; Takita et al., 2001). Pratheeba et al. (2016) reported that hemodynamic changes were lower with LMA[®] I-Gel than with LMA[®] classical. Similarly, Bennett et al. (2004) reported that airway can be managed with LM without inducing hypertension or tachycardia in patients with coronary disease. In addition, Revi et al. (2015) reported that there was no statistically significant difference in hemodynamic status between LMA[®] I-Gel, LMA[®] Pro-Seal and LMA[®] classical. Joo and Rose (1999) compared fiberoptic devices and laryngoscope during LM insertion and they reported that fiberoptic guided intubation had less effect on hemodynamic parameters. Kihara et al. (2000) reported that there was no difference between blind LM insertion and laryngoscopy. Kavitha et al. (2011) reported that there was no significant difference between intubating LM and laryngoscopy in terms of hemodynamic changes.

The Baska Mask[®] is a new generation type of LM which is produced along with technological developments. There is no separate cuff as it adapts to the larynx due to its silicone structure. Thus, larynx damage is less common due to the absence of the cuff. Another feature of the Baska Mask[®] is that it has a drainage inlet for esophageal aspiration. This reduces the risk of aspiration. Bindal and his colleagues (2018) did not find any hemodynamic difference compared to other LMs in their study. In our study, the Baska Mask[®] group was more stable than ETT group during the operation, with smaller changes in blood pressure and heart rate. However, there have not been enough clinical studies on Baska Mask[®], yet.

One of the important problems in the use of the LM is air leakage due to the application of positive pressure. Some of the causes of air leakage are the improper size of the LM, insufficient inflation of the LM cuff and LM displacement. This leakage

of air may risk the patient's life by causing the inadequate ventilation. The leakage becomes more important, especially in the patients who have high airway pressure, such as chronic obstructive pulmonary disease and asthma. The air tightness of the new generation airway device, the Baska Mask[®], is better than the other LMs due to its silicon structure and adaptation to the larynx without swelling (Ramachandran and Kumar, 2014). It's reported that other LMs provide better sealing than conventional LMs in 2018 (Bindal et al., 2018). In our study, no leakage was detected in the Baska Mask[®].

EtCO₂ monitoring is an important indicator of correct placement of airways (Knapp et al., 1999). In addition, the change of EtCO₂ values can be used as a parameter for early diagnosis of complications such as air leakage, upper airway obstruction and bronchospasm, which lead to the insufficient ventilation (Hart et al., 1997; Burton et al., 2006). The studies reported that EtCO₂ values of the new generation LMs are similar to the other airway devices' EtCO₂ values (Lee et al., 2009; Ozdamar et al., 2010; Sabuncu et al., 2018). However, it should not be forgotten that EtCO₂ may increase in patients with increased gastric pressure (laparoscopic surgery) and in patients operated in the Trendelenburg position (Hsing et al., 1995; Maltby et al., 2000). In our study, we used EtCO₂ to detect upper airway complications earlier. There was no statistical difference between the groups and EtCO₂ levels were clinically acceptable.

In general, anesthesia applications, high airway pressure, increased sympathetic activation, use of N₂O can cause an increase in pressure of the middle ear. Due to this increase, it may cause complications such as vomiting, hearing loss, otalgia, hemotympanum and middle ear inflammation (Nader et al., 2004; Carmichael and Boyev, 2016). In many studies, including our previous study, the use of Baska Mask[®] causes less change in the middle ear pressure compared to standard intubation (Degerli et al., 2013; Torun et al., 2019). Therefore, the occurrence of possible complications will decrease. However, studies in this area are insufficient.

LM is such an airway device that is placed easily. In literature reviews, the placement time of LM is 8–28 seconds while ETT insertion is 17–20 seconds (Van Zundert and Brimacombe, 2008; Verghese and Ramaswamy, 2008; Carron et al., 2012). The differences between the definition of the insertion time of airway devices has some different factors such as the experience of the healthcare staff, the number of trials, the history of difficult intubation and the size inconsistencies of the devices. The common point is that the LM insertion time is shorter than the ETT, in the literature. In our study, the insertion time was 20.48 ± 6.69 seconds for Baska Mask[®] and 30.82 ± 5.96 seconds for ETT. The reason of the difference between the literature and our findings is the initial time of the procedure that mentioned in the material and method section. In studies among LM types; Baska Mask[®] had a longer insertion time than classical LM variants (Sharma et al., 2017; Bindal et al., 2018). Silicone structure and shape of other LM prolong the insertion time compared to classical LM types.

There are only case reports about the use of various laryngeal masks in different head and neck positions and other operation positions such as prone position (Ceylan, 2008; Saini and Bansal, 2013). Prospective clinical studies are needed on LM types in different operation positions. The Baska Mask[®] may be a good alternative for different operation positions due to its silicone structure that adapts to the larynx anatomy and its high sealing pressure.

There are some limitations of our study. The standard data about the Baska Mask[®] is controversial because of the insufficient data about the Baska Mask[®] in the literature. Also, the level of neuromuscular block for extubation was evaluated clinically, since the train-of-four (TOF) device was not available in our hospital.

Conclusion

The Baska Mask[®] can be safely used as an alternative to other intubation devices since it has lower complication rate, better sealing at high pressure and a part for gastric aspiration. However; further studies are needed for the Baska Mask[®] and other types of LM devices.

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Effect of Microscopic Third Ventriculostomy (Lamina Terminalis Fenestration) on Shunt-needed Hydrocephalus in Patients with Aneurysmal Subarachnoid Hemorrhage

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Abstract: There are reports that in patients with aSAH (aneurysmal subarachnoid hemorrhage), LTF (lamina terminalis fenestration) reduces the rate of shunt-needed hydrocephalus via facilitation of CSF (cerebrospinal fluid) dynamic, diminished leptomeningeal inflammation, and decreased subarachnoid fibrosis. Regarding the conflicting results, this study was conducted to evaluate the effects of LTF on decreased shunt-needed hydrocephalus in patients with aSAH. A cross-sectional retrospective study was carried out to survey all patients with confirmed aSAH operated from March 2011 to September 2016 in an academic vascular center (Rasool Akram Hospital in Tehran, Iran). Of a total of 151 patients, 72 patients were male and 79 were female. The mean age of the participants was 51 years. A transiently CSF diversion (EVD – external ventricular drainage) was performed (the acute hydrocephalus rate) on 21 patients (13.9%). In 36 patients (23.8%), aneurysm occlusion with LTF and in 115 patients (76.2%) only aneurysm occlusion surgery was performed. In hydrocephalus follow-up after surgery, 13 (12%) patients needed shunt insertion (the rate of shunt-needed hydrocephalus). The statistical analysis demonstrated no significant relation between LTF and shunt-needed hydrocephalus. Confirmation of the hypothesis that LTF may decrease the rate of shunt-needed hydrocephalus can significantly decrease morbidity, mortality, and

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treatment costs of shunting (that is a simple, but a potentially dangerous procedure). So, it is advised to plan and perform an RCT (randomized controlled trial) that can remove the confounding factors, match the groups, and illustrate the exact effect of LTF on shunt-needed hydrocephalus.

Introduction

Subarachnoid hemorrhage (SAH) is defined as the presence of blood within the cerebral cisterns and comprises about five percent of all cerebrovascular strokes. The most common cause of spontaneous SAH is the rupture of the intracranial aneurysms, aneurysmal SAH (aSAH) (Winn, 2016). The prevalence of this stroke is about 7–9 per 100,000 person-year (Woernle et al., 2013; Winn, 2016). The prevalence increases with higher age, and it is more frequent in women than men in the sixth decade of life. Despite the persisted prevalence, the mortality rate has decreased, and the estimated case fatality rate is 23–67%, with a 5% decrease per year (Winn, 2016).

One of the most important complications following aSAH in patients survived from the acute phase of the disease is hydrocephalus, with a rate of 6–67%. Increased age, being a female, high Hunt and Hess (H&H) scale on admission, thick SAH on initial brain computed tomography (CT) scan, intraventricular hemorrhage (IVH), hydrocephalus in initial brain CT scan, posterior circulation aneurysm, the presence of clinical vasospasm, and endovascular treatment are factors related to the shunt-dependent hydrocephalus (Nam et al., 2010; Woernle et al., 2013; Bae et al., 2014).

According to the studies, most important mechanisms that result in hydrocephalus include disturbance in cerebrospinal fluid (CSF) dynamic, obstructive mechanisms due to the presence of blood, disruption in the absorptive mechanisms at the level of arachnoid granulations, and hemorrhage induced inflammation (Komotar et al., 2002; Demirgil et al., 2003; Dehdashti et al., 2004; Adams et al., 2016).

It has been demonstrated that 6 to 45% of patients with acute hydrocephalus require shunt insertion, ultimately (Tapaninaho et al., 1993; Zaidi et al., 2015). Although shunt insertion is a benign procedure, it can be accompanied by serious complications such as shunt failure, shunt infection, and repetitive admission (Tapaninaho et al., 1993; Zaidi et al., 2015). The rate of shunt failure and other complications have been reported up to 40% for the first year and up to 85% for the following 10 years (Komotar et al., 2002).

In recent years, reports show that lamina terminalis fenestration (LTF) decreases the rate of shunt-needed hydrocephalus via the facilitation of CSF dynamic, diminished leptomeningeal inflammation, and decreased subarachnoid fibrosis (Komotar et al., 2002). Regarding the conflicting results of the effect of LTF on shunt-needed hydrocephalus, this study was conducted to evaluate the effects of LTF on decreased shunt-needed hydrocephalus in patients with aSAH in an academic center.

Material and Methods

A cross-sectional retrospective study was performed to survey all patients with confirmed aSAH operated from March 2011 to September 2016 in an academic vascular center (Rasool Akram Hospital in Tehran, Iran). The intended data were collected via the admission hospital files and hospital imaging archives.

All patients with a diagnosis of SAH were included in the study, and the patients with SAH without confirmed aSAH, the patients with confirmed aSAH who did not undergo operation for any reason, and the patients with deficient data were excluded from the study.

Four-vessel brain digital subtraction angiography (DSA) was performed for all patients, and an aneurysm as a reason for SAH was confirmed.

According to the routine management of patients with SAH in our center, brain angiography and surgery were performed very soon. Angiography in the same day or the day after admission and surgery in the same day or the day after performing the angiography generally depend on the clinical and medical condition of the patients.

Considering treatment, all the patients underwent craniotomy and microsurgical clipping of the aneurysm. But, LTF (third ventriculostomy) was performed for some patients but not all.

LTF or third ventriculostomy was performed after the aneurysm clipping via the microscopic opening of the anterior wall of the third ventricle located posterior to the optic chiasma.

To define the clinical status of the patients, clinical scales including the Glasgow Coma Scale (GCS), World Federation of Neurosurgical Societies (WFNS), and H&H scales were used, and for grading SAH on CT scan, Fisher grade was used.

The sample size included all patients with aSAH in the aforementioned period. After collecting the data and required variables, the data were analysed using SPSS software by a statistic specialist.

Using the statistical formula including chi-square, fissure, independent *t*-test, and logistic regression, the data analysed. The significant value for this study was 0.05.

Ethical considerations

Regarding the retrospective nature of this study, we had no intervention or effect on the patients and patients' outcomes. Moreover, the institutional ethics committee of the Iran University of Medical Sciences approved the study. The informed consent was obtained from all participants.

Results

Considering the inclusion criteria, a total of 320 patients enrolled. After applying the exclusion criteria, 151 patients who underwent aneurysmal occlusion surgery (surgical clipping) were surveyed (Figure 1).

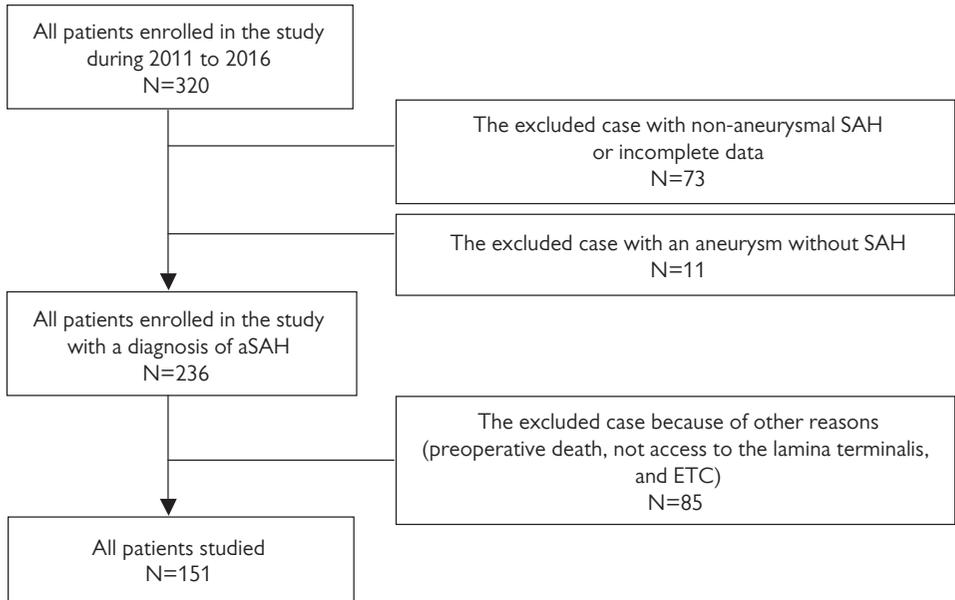


Figure 1 – The consort flow chart of the patients.

The mean interval between admission and surgery was 3.9 days within a range of 1 to 18 days. Of a total of 151 patients, 72 patients (47.7%) were males and 79 (52.3%) were females. The mean age was 51. In 21 patients (13.9%), a transiently CSF diversion (EVD – external ventricular drainage) was performed due to acute

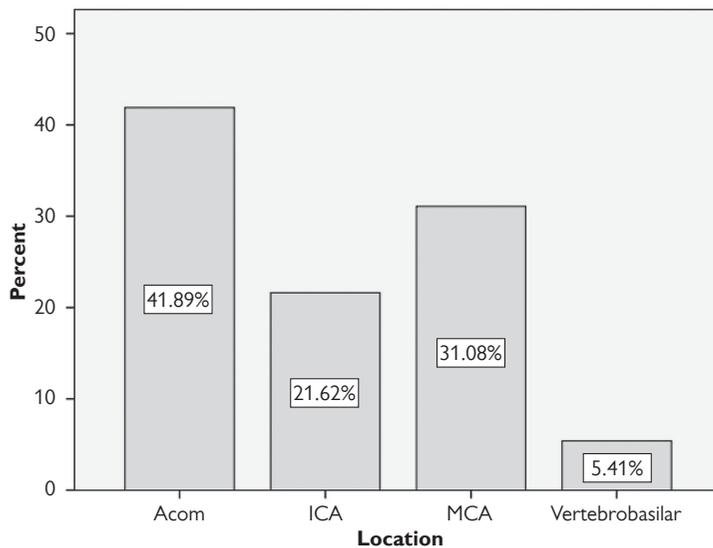


Figure 2 – The location of an aneurysm.

Table 1 – Comparison of some features of two groups: LTF and not LTF

Parameters		LTF (n=36)	No LTF (n=115)	P-value
Age, mean ± SD		54.42 ± 11.04	49.97 ± 13.10	>0.05
Sex	male	17	55	>0.05
	female	19	59	
GCS, mean ± SD		12.69	13.58	>0.05
Hunt and Hess grade	1	4	18	>0.05
	2	11	42	
	3	12	40	
	4	6	14	
	5	3	1	
WFNS grade	1	13	54	<0.05
	2	12	34	
	3	3	8	
	4	4	18	
	5	4	1	
Fisher grade	1	1	6	>0.05
	2	9	32	
	3	14	38	
	4	12	39	
IVH	yes	10	19	>0.05
	no	26	95	
Hydrocephalus on admission (EVD insertion)	yes	7	14	>0.05
	no	29	101	

LTF – lamina terminalis fenestration; SD – standard deviation; GCS – Glasgow Coma Scale; WFNS – World Federation of Neurosurgical Societies; IVH – intraventricular hemorrhage; EVD – external ventricular drainage

hydrocephalus (the rate of acute hydrocephalus). Anterior communicating artery (ACOM) was the most common location of the aneurysm (Figure 2). In 36 patients (23.8%), aneurysm occlusion surgery with LTF (LTF group) and in 115 patients (76.2%) only aneurysm occlusion surgery (not LTF group) were performed. Totally, 105 patients (69.5%) were discharged and 46 patients (30.5%) died. In follow-up for hydrocephalus after surgery, 43 patients died, and 13 (12%) patients needed shunt insertion (the rate of shunt-needed hydrocephalus).

Table 1 shows the most important baseline features of the patients in two groups. Comparing the two groups revealed no significant difference.

Comparing the effect LTF on shunting demonstrated that although the rate of shunt-needed hydrocephalus differed between the two groups of LTF and not LTF, this difference was not statistically significant. Moreover, the analysis showed no positive effects of LTF on other variables (Table 2).

Table 2 – Statistical relation between LTF and some study variables

Variable	LTF		Total	P-value	
	yes	no			
Shunting	yes	15.4%	11.0%	12.0%	>0.05
	no	84.6%	89.0%	88.0%	
Outcome	discharge	67.0%	70.0%	69.5%	>0.05
	death	33.0%	30.0%	30.5%	
Hospitalization (days)		27.06	23.38		>0.05

LTF – lamina terminalis fenestration

Discussion

Hydrocephalus is one of the most important complications in patients who survive following the acute phase of aSAH. Some factors are related to the shunt-needed hydrocephalus including increased age, being a female, high H&H grade on admission, thick SAH on brain CT scan, IVH, hydrocephalus on first brain CT scan, posterior circulation aneurysm, clinical vasospasm, and endovascular treatment (Nam et al., 2010; Woernle et al., 2013; Bae et al., 2014).

The hydrocephalus after SAH occurred in up to 67% of the patients. It is divided into three subgroups according to the time of occurrence: acute (up to day 3), subacute (day 4 to 13), and chronic (more than 14 days) (Dorai et al., 2003; de Oliveira et al., 2007; Yang et al., 2013). In the acute phase, some of these patients require the emergency external ventricular drainage to decrease the ICP (intracranial pressure). Nevertheless, this acute condition can be spontaneously resolved, or in some patients, the CSF dynamic interfering mechanisms result in continued raised ICP that require permanent CSF diversion intervention (Adams et al., 2016).

CSF dynamic disruption is one of the most important reasons for persistent hydrocephalus. Some studies reported that disruption in CSF dynamic, obstructive mechanism due to the presence of blood, disruption in the absorptive mechanisms at the arachnoid granules levels, and hemorrhage induced inflammation are the most important mechanisms that result in hydrocephalus (Adams et al., 2016). SAH results in permanent hydrocephalus in about 20% of patients due to leptomeningeal fibrosis and arachnoid granules fibrosis and resultantly decreased CSF absorption (Komotar et al., 2002).

It is noted that 6 to 45% of acute hydrocephalus require shunting. Although the shunt insertion accounts for a benign process, it can be associated with procedure-related complications such as shunt failure, infection, repetitive admission, and etc. (Tapaninaho et al., 1993; Zaidi et al., 2015). Therefore, the risk of shunt failure is up to 40% in the first year, and up to 85% in the following 10 years (Komotar et al., 2002).

Table 3 – Summary of some studies on the effects of LTF on shunt-needed hydrocephalus

Study	Year	Study nature	Sample size	Rate of SNH	Result	Recommendation
Sindou (1994)	1994	Retro-spective	197	Not surveyed	Positive role on outcome in patients with poor clinical condition (graded IV or V H&H).	LTF and MoLF favourable affect the outcome by facilitating CSF circulation in the basal cisterns.
Komotar et al. (2002)	2002	Retro-spective	582	LTF: 2.3% No LTF: 12.6%	LTF decrease incidence of SNH more than 80%.	If incorporated into the current practice, potentially improve the patients' morbidity by preventing long-term complication.
Andaluz and Zuccarello (2004)	2004	Prospective	106	LTF: 4.25% No LTF: 13.9%	LTF significantly decreases the incidence of post-SAH hydrocephalus and is associated with a reduction in the incidence of brain retraction injury during surgery.	It is safe and easily performed manoeuvre and is recommended during the surgical treatment of aneurysms of the anterior circulation, during which the lamina terminalis can be exposed. Further randomized controlled studies are warranted.
Kim et al. (2006)	2006	Retro-spective	71	LTF: 29.6% No LTF: 58.8%	No significant correlation between LTF and the rate of SNH ($p>0.05$).	Although the LTF can be a safe and easy procedure during ACoA aneurysm operations, the prophylactic effect for preventing the development of chronic hydrocephalus is not prominent and potential complications, including the injury of neighbouring vascular structure and brain parenchyma can occur. Therefore, the neurosurgeons must give careful consideration to LTF during surgery for the ruptured ACoA aneurysms.
Komotar et al. (2008)	2008	Retro-spective	369	LTF: 25% No LTF: 20%	LTF does not reduce the incidence of SNH or cerebral vasospasm.	To further clarify this issue, a multicenter, prospective, randomized trial is needed.

Study	Year	Study nature	Sample size	Rate of SNH	Result	Recommendation
Komotar et al. (2009)	2009	Systematic review	1973	LTF: 10% No LTF: 14%	No significant association LTF and the incidence of SNH.	Although the overall literature supports this technique, a number of studies question its benefit, rendering the efficacy of LTF in reducing shunt-dependent hydrocephalus unclear. A well-designed, multicenter, randomized controlled trial is needed to resolve this controversy.
Hatefi et al. (2015)	2015	Randomized double-blind clinical trial	50	LTF: 16% No LTF: 12%	Despite LTF can be a safe method, there were not observed significant differences between LTF and incidence of vasospasm and SNH.	This finding emphasizes the need for systematic evaluation of the effect of fenestration in this patient's population with neurosurgeon, multicentre and with greater sample size.
Winkler et al. (2018)	2017	Retro-spective	663	LTF and MoLF: 3.2% No LTF and MoLF: 17.9%	Tandem fenestration of the LT and MoL during open aneurysm clipping and/or bypass is associated with reduced the rates of shunt dependency following aSAH.	These results suggest that this technique may be efficacious and should be applied to ruptured aneurysm of both the anterior and posterior circulations when the LT and MoL are surgically accessible. Future prospective randomized multicenter trials are warranted to confirm these promising preliminary results.
Our study	2018	Retro-spective	151	LTF: 15.4% No LTF: 11%	No effect on SNH.	Future prospective randomized multicenter studies are needed to specify the effect of LTF on shunt-dependent hydrocephalus.

LT – lamina terminalis; LTF – lamina terminalis fenestration; SNH – shunt-needed hydrocephalus; MoL – membrane of Lilliequist; MoLF – membrane of Lilliequist fenestration; SAH – subarachnoid hemorrhage; aSAH – aneurysmal subarachnoid hemorrhage; CSF – cerebrospinal fluid; ACoA – anterior communicating artery

Sugawara et al. (2016) reported that 33.8% of their patients required shunting for shunt-needed hydrocephalus (10.7% hydrocephalus with high pressure and 23% hydrocephalus with normal pressure).

Adams et al. (2016) surveyed 1,553 patients who survived 14 days after SAH. The rate of permanent CSF diversion was 17.7%. The mean follow-up was 8 years. Patients who required shunting had higher age, higher H&H, and fisher grade on admission, needed more EVD insertion and endovascular treatment, and meningitis and IVH occurred more in these patients. The mean time to shunt insertion was 33 days. The patients who underwent shunting within the first month were younger, female, and hydrocephalus on the first brain CT scan compared to the patients who underwent shunt after 30 days. Multivariate analysis demonstrated that the age at admission, size of an aneurysm, hydrocephalus on the first brain CT scan, and meningitis were the independent risk factors for shunt insertion (Adams et al., 2016).

Komotar et al. published their paper in 2008. The rates of shunt insertion, shunt conversion, and clinical vasospasm were, respectively, 25, 50, and 23% in patients who underwent LTF and 20, 27, and 27% in patients without LTF. They concluded that LTF probably did not have any effect on decreasing the rate of shunt insertion and vasospasm (Komotar et al., 2008).

Andaluz and Zuccarello (2004) demonstrated that LTF results in a decrease in the rate of shunting and vasospasm and improves patients after aSAH.

Hatefi et al. (2015) demonstrated that the demographic features, H&H and fissure grades, the rate of shunt insertion, and clinical vasospasm are the same in groups with LTF and without LTF.

The rate of acute hydrocephalus needed for surgical intervention for diminishing ICP was 13.9%. A wide range has been reported for this rate, from 15% in the study of Komotar et al. (2008) to 63.6% in the study of Czorlich et al. (2015). Comparing the results and other studies demonstrated the lower rate of acute hydrocephalus in the present study. Although a part of this difference can be explained with a different and relative definition of hydrocephalus and difference in planning for surgical treatment in various centers, planning a suitable clinical trial for surveying the definite rate of acute hydrocephalus, exhibiting differences, and illustrating the reasons for its low rate in the patients are required.

The rate of chronic hydrocephalus in our study was 12%. This rate was within a wide range from 8.4% in the study of Andaluz and Zuccarello (2004) to 37% in the study of Yoshioka et al. (2000), too. Comparing these results and other studies demonstrated the lower rate of chronic hydrocephalus in the present study similar to acute hydrocephalus.

The present study revealed no positive effects of LTF on decreasing the rate of shunt-needed hydrocephalus. Probably, the low rate of acute hydrocephalus has an effect on the results. The review of the literature demonstrated paradoxical results; some reported positive effects and some reported no effects.

Although a prospective study (Andaluz and Zuccarello, 2004) demonstrated that the LTF significantly decreases the incidence of post-SAH hydrocephalus, another study (Komotar et al., 2009) reported no positive effect in a systematic review after analysis of 1,973 patients. The only randomized double-blind clinical trial performed demonstrated no positive effect. Table 3 compares the most important studies performed in this setting.

Conclusion

In summary, the rate of acute hydrocephalus and chronic hydrocephalus was 13.9 and 12%, respectively. LTF demonstrated no effect on decreasing the rate of chronic hydrocephalus.

Confirming the hypothesis that LTF decreases shunt-needed hydrocephalus significantly reduces morbidity, mortality, and treatment costs of shunting (a simple but potentially dangerous procedure). It is advised to plan and perform a randomized double-blind clinical trial with larger sample size to remove the confounding factors and homogenize the groups to illustrate the exact effect of LTF on shunt-needed hydrocephalus.

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Laparoscopic Pectopexy: An Effective Procedure for Pelvic Organ Prolapse with an Evident Improvement on Quality of Life

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Abstract: It has been stated that the effectiveness of pectopexy method for the treatment of pelvic organ prolapse (POP) is similar to sacrocolpopexy. We aimed to search the effects of pectopexy method to the quality of life, sexual function and urinary incontinence. Thirty-one patients who were operated for POP with the technique of laparoscopic pectouteropexy/pectocolpopexy between January 2016 and November 2017 were included the study. Exclusion criteria were pelvic inflammatory disease, suspect of malignancy, pregnancy, prior POP or continence surgery. Quality of life inventories were (P-QOL, PISQ-12, UDI-6, IIQ-7) recorded preoperatively and at the postoperative third month. Results were compared statistically. The percentage of patients with menopause was 67.7% (n=21) and with reproductive term was 32.3% (n=10). Mean prolapse related quality of life inventory (P-QOL) score was 83.45 ± 8.7 (64–98) preoperatively and 8.61 ± 6.4 (0–23) postoperatively ($p < 0.05$). The preoperative and postoperative score of quality of life inventories for urinary symptoms were 20 (15–21) and 2 (0–9) for IIQ-7 and 13 (3–18) and 4 (0–11) for UDI-6, respectively ($p < 0.05$). The mean PISQ-12 sexual quality of life inventory score was 29.61 ± 4.8 (14–38) preoperatively and 7.1 ± 3.2 (1–13) postoperatively. According to our results laparoscopic pectopexy offers a feasible, safe and comfortable alternative for apical prolapse surgery.

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Introduction

Pelvic organ prolapse (POP) is a health problem that affects millions of women worldwide and manifests in 50% of women over 50 years of age (Subak et al., 2001). Although POP is not a life threatening disease, it impairs the quality of life (QOL) significantly and negatively affects the psychosocial status of the patient due to discomfort and urinary and/or intestinal dysfunctions (Ghersel et al., 2019). Therefore, the treatment of this disease is important to precede the isolation from the social life especially in middle and advanced ages.

Sacropexy is considered as the gold standard technique and it is the most effective approach for apical prolapse surgery which keeps the physiological axis of the vagina preserved (Nygaard et al., 2009; Maher et al., 2010; Bataller et al., 2019). Unlike open abdominal sacrocolpopexy, laparoscopic and robotic-assisted approaches don't require a large abdominal incision and minimize bowel manipulation so they provide less postoperative pain and shorter recovery time. Laparoscopic sacrocolpopexy (LSP), which shortens hospital stay compared to open surgery, is an effective method but has some disadvantages in the postoperative period such as defecation disorders and pelvic pain (Akladios et al., 2010). The mesh placed between the sacrum and the vagina creates pelvic discomfort in many patients. Also potential damage to hypogastric nerve can cause dyschezia. The anatomic location of the sigmoid colon may also make it difficult to place the mesh between the vagina and the sacrum. There may be restriction in the movement of the colon after the operation and defecation or pain problems may be seen (Kale et al., 2017). A new technique for POP surgery was defined by Banerjee and Noe in 2011 to prevent the complications of LSP mentioned above.

We aimed to investigate the effects of this effective and safe technique on quality of life, on psychosexual functions and incontinence. The method becomes widespread in recent years and reduces morbidity rates in patients.

Material and Methods

Thirty-one patients who underwent laparoscopic pectoutero/colpopexy operation in gynecology clinic of Health Science University, Kocaeli Derince Education and Research Hospital with the diagnosis of POP were included to the study. The patients who presented with vaginal fullness, vaginal pressure, sagging sensation, were examined in lithotomy position. Patients with POP-Q stage greater than 2 were included to the study. Transvaginal ultrasonography and pap smear test were routinely applied to all patients. Endometrial sampling was performed in patients with suspected malignancy. The exclusion criteria were previous history of pelvic inflammatory disease, malignancy suspicion, pregnancy, prior POP or continence surgery and patients who did not want to be operated with this technique.

In the preoperative evaluation of the patients; data related to the age, body mass index, parity status, history of surgery, gynecological examination were recorded. The validated prolapse quality of life (P-QOL), pelvic organ prolapse/

urinary incontinence sexual questionnaire (PISQ-12), urinary distress inventory (UDI-6), incontinence impact questionnaire (IIQ-7) forms that were used in our study were filled preoperatively. P-QOL questionnaire is a simple, reliable and easy-to-understand questionnaire that can assess symptom severity, the impact of these symptoms on quality of life, and treatment outcomes for women with pelvic organ prolapse. UDI-6 is a questionnaire form consisting of six questions and specific to lower urinary tract symptoms. It combines information on irritant, stress, and obstructive/uncomfortable symptoms. IIQ-7 is a quality of life assessment tool specific to urinary incontinence. It consists of seven questions and allows an assessment of physical activity, social life and emotional health. The two query forms are intended to be used in combination. A short form of the (PISQ-12) was used for the assessment of sexual quality of life. The patients were called for control at the first postoperative week and at the third month. Preoperative reproductive quality of life questionnaires were filled in by patients at the postoperative third month and the data were recorded. The preoperative and postoperative quality of life data were compared statistically.

Surgical technique

There was no need for a special diet or bowel cleansing for the preoperative preparation of the patients. All patients were dressed with embolic compression stockings. Preoperatively 1.5 g Cefazolin was administered intravenously to the all patients for surgical prophylaxis.

A 30-degree laparoscopic lens was guided into the abdomen with a 10-mm laparoscopic port from a 1 cm incision site on the lower edge of the umbilicus. Abdomen was inflated with carbon dioxide at 12 mm Hg pressure. Two 5-mm ports were placed to 2–4 cm inferomedial area of spina iliaca anterior superior bilaterally. One 15-mm port was placed on the left upper quadrant of abdomen. The round ligament part of 4 cm² size which contains the lateral part of the iliopectineal ligament was used as the anatomical cue point. The peritoneum adjacent to the round ligament was superficially incised. The soft tissue in the pelvic wall was bluntly dissected until the iliopectineal ligament was seen, and the dissection was extended to the obturator nerve region. The same procedure was applied to the contralateral side.

After the iliopectineal ligament was prepared, the peritoneal incision on the 2 sides was bluntly expanded along an imaginary line connecting the vaginal apex and pectineal line. Polypropylene monofilament mesh (3×15 cm) and 2-0 non-absorbable suture 10-mm sent from the port to the surgical area. The proximal end portions of mesh were fixed to the bilateral iliopectineal ligament with 2 sutures and the suture needle was taken out. Cervical bulge or vaginal apex were fixed to the middle of the mesh in the tension to prevent sagging. If the length of the mesh was long, the length of the mesh was shortened before the second iliopectineal ligament was fixed. Laparoscopic tacker was used instead of suture while the mesh was fixed to the

tissues in some patients (Jelovsek et al., 2007). The peritoneum was closed using 2-0 absorbable sutures. After the carbon dioxide was evacuated, the ports were removed.

Statistical analysis

Statistical analysis was performed with IBM SPSS 20.0 (IBM Corp., Armonk, NY, USA) package program. Normal distribution was assessed by Kolmogorov-Smirnov test. Numerical variables with normal distribution were presented as mean \pm standard deviation, numerical variables not showing normal distribution were given as median (25th–75th percentile), and categorical variables as frequency (percentages). The difference between the groups was determined by the student's *t*-test for the numerical variables with normal distribution, and the Mann-Whitney U test for the non-normal variables. The *t*-test in the dependent samples was examined by Wilcoxon *t*-test when the normal distribution assumption was not provided. For the test of two-way hypotheses, the level of significance $p < 0.05$ was accepted as sufficient.

Ethics committee

Ethics committee approval was obtained from Kocaeli University Faculty of Medicine and the patients were informed about the clinical and laboratory data to be used for scientific purposes and the confidentiality of the data and the consent forms were signed (registration number KUGOKAEK 2017/132).

Results

When the demographic data of the patients were examined, the mean age of the 31 female patients was 52.19 ± 11.78 (34–72) years and the mean body mass index was 28.82 ± 3.2 (18.4–33.2) (Table 1). Of the 31 patients who underwent laparoscopic pectopexy; 8 of them were operated due to vaginal vault prolapse, 7 of them were treated for grade 3–4 uterine prolapsus and cystocele, one with cystocele only and 15 for only grade 3–4 uterine prolapsus. Laparoscopic pectouteropexy was performed in 10 patients and laparoscopic pectocolpopexy was performed in 21 patients.

Table 1 – Demographic data of patients

Demographic data	
Patient number (n)	31
Reproductive	10 (32.3%)
Menopause	21 (67.7%)
Age (mean \pm SD [min–max])	52.19 ± 11.78 [34–72]
Number of birth (mean \pm SD [min–max])	2.90 ± 1.68 [1–9]
BMI (mean \pm SD [min–max])	28.82 ± 3.20 [18.4–33.2]

SD – standard deviation; BMI – body mass index

Table 2 – Quality of life results of patients

Quality of life questionnaire	Preoperative score (mean ± SD) (min–max)	Postoperative score (mean ± SD) (min–max)	P
P-QOL	83.45 ± 8.71 (64–98)	8.61 ± 6.43 (0–23)	0.001
UDI-6	12.52 ± 3.11 (3–18)	4.13 ± 2.36 (0–11)	0.001
IIQ-7	19.48 ± 1.56 (15–21)	2.94 ± 2.08 (0–9)	0.001
PISQ-12	29.61 ± 4.80 (14–38)	7.10 ± 3.28 (1–13)	0.001

SD – standard deviation

When the operative data was analysed, the mean operation time was 33.8 ± 14.6 minutes. There were no perioperative and postoperative complications. Three months postoperatively, one patient had recurrence. The quality of life data of this patient was better than that in the preoperative period, no additional operation was therefore considered.

The P-QOL score, which is the quality of life scale of prolapse, was 83.45 ± 8.7 (64–98) in preoperative patients and 8.61 ± 6.4 (0–23) in postoperative patients. There was a statistically significant difference between the quality of life scores of the patients before and after the surgery ($p < 0.05$) (Table 2).

UDI-6 quality of life questionnaire used for assessing urinary symptoms, incontinence and pelvic discomfort. The median value of preoperative UDI-6 score was 13 (3–18) and postoperative score was 4 (0–11). The difference was statistically significant ($p < 0.05$). Preoperative and postoperative median IIQ-7 scores were 20 (15–21) and 2 (0–9) respectively and the difference was statistically significant ($p < 0.05$).

Laparoscopic pectopexy was performed in all patients. The mesh fixation was made by using suture in 12 patients (38.7%) and with tacker in 19 patients (61.3%). No significant difference in postoperative quality of life was found between these groups.

Sexual function score evaluated with PISQ-12 was found as 29.61 ± 4.8 (14–38) in the preoperative patients, and 7.1 ± 3.2 (1–13) in postoperative patients. Postoperative sexual quality of life improved significantly compared to preoperative period and the improvement was statistically significant.

Discussion

According to the results of this study we consider that laparoscopic pectopexy is an alternative technique to LSP for the functional and anatomic success of POP treatment.

Apical prolapse repair was performed laparoscopically for more than 20 years (Whitehead et al., 2007; North et al., 2009), however it depends on the experience of the surgeon. Possible problems may arise during laparoscopic sacrocolpopexy.

Sigmoid colon and sacral promontorium should be identified and care should be taken to avoid damaging the right ureter, presacral veins, hypogastric nerve and sigmoid colon in the sacral area.

Another issue is the reason of the difficult surgical field at the ventral side of the sacrum; many surgeons have modified the technique and have fixed the mesh to the top of the promontory. However, this change of mesh localisation results in a positional change in the vaginal axis (Whitehead et al., 2007; Noe et al., 2015).

The iliopectineal ligament is an extension of the lacunar ligament that runs on the pectineal line of the pubic bone (Faure et al., 2001). As shown by Cosson et al. (2003), the iliopectineal ligament is a stronger structure than the arcus tendinous of the sacrospinous ligament and pelvic fascia. The structure is strong, and holds suture well. It is also possible to find sufficient material for a suture in the lateral part of the iliopectineal ligament, facilitating reconstruction of the pelvic floor (Noe et al., 2015). This segment of the ligament is situated at the second sacral vertebra (S2) level which is the optimal level for the physiological axis of the vagina. S2 level is the anchor point for the physiological axis of the vagina (Noe et al., 2015).

Laparoscopic pectopexy is a new type of endoscopic prolapse surgery using the lateral parts of the iliopectineal ligament for bilateral mesh fixation for the descended structures (Noe et al., 2013). Noe et al. (2013) compared laparoscopic sacrocolpopexy with pectopexy and they found less operation time and bleeding in pectopexy group. On the other hand, there was no difference between the two groups for the mean onset of bowel movements. In another study, Noe et al. (2015) published their comparative results that standard LSP versus laparoscopic pectopexy. According to these results there was a statistically significant difference between the incidence of *de novo* defecation problems following laparoscopic pectopexy (0%) and sacrocolpopexy (19.5%). In our study we did not observe any defecation problems in the patients. This may be explained by the fact that pectopexy neither reduces the space of the pelvis (outlet obstruction) nor carries the risks of trauma to the hypogastric nerves.

In classical technique of sacrocolpopexy, due to the narrowness of the minor pelvis, the presence of unexpected vessel variations or the fineness of the anterior longitudinal ligament and the difficulties in mesh fixation may increase the intraoperative complications such as adjacent organ injury or bleeding (Nygaard et al., 2009; Maher et al., 2010; Noe et al., 2013). In our study, 31 patients who underwent laparoscopic pectopexy had no intraoperative complications.

The majority of studies that have been published in previous years and evaluated POP treatment usually focus on the anatomical success of the treatment, while other important parts such as vaginal adjustment, bowel problems, QOL or socioeconomic consequences are ignored. The most important benefit of the patient in individual surgery is the regression of symptoms and increased quality of life (Barber et al., 2009). Maher and colleagues (2004) found improvement in disease-specific and overall quality of life after POP surgery in patients with sacrospinous

ligament fixation and abdominal sacrocolpopexy. CARE study reported significant improvement in disease-specific quality of life at 3 months and 2 years following sacrocolpopexy (Brubaker et al., 2003, 2008). In our study, postoperative P-QOL showed a significant improvement compared to the preoperative period.

Improvement of sexual function as well as disease-related quality of life after sacrocolpopexy has also been demonstrated in some studies (Grimminck et al., 2016; Ko et al., 2017). Tahaoglu et al. (2018) reported significant improvement in quality of life and sexual function after laparoscopic pectopexy. In our study, PISQ-12 sexual quality of life score was significantly improved after laparoscopic pectopexy in the postoperative period.

Urinary complaints are associated with pelvic organ prolapse and with impaired quality of life. Regression of urinary complaints after surgical intervention will contribute to the quality of life of patients. In a multicentre study involving 207 patients operated for apical prolapse, Altman et al. (2018) reported a statistically significant improvement in patients' UDI-6 score after prolapse surgery. In another study by Coolen et al. (2017) comparing laparoscopic and open sacrocolpopexy, disease-specific quality of life measures, which were evaluated by UDI-6 score, demonstrated the efficacy of sacrocolpopexy as in previous studies, while the results of open and laparoscopic group were similar. In our study, the quality of life was significantly improved in patients who were evaluated with UDI-6 and IIQ-7 quality of life criteria.

Since pectopexy technique provides bilateral mesh fixation to the iliopectineal ligament, the pressure is distributed evenly over both sides. However, in the technique of sacrocolpopexy, this pressure is at one point. Noe et al. (2013) suggested that rectosel development or bowel obstruction, which are disadvantages of the anterior fixation method, could be reduced by more physiological lateral fixation. They also reported that the use of monofilament mesh did not cause any erosion in the study in which they defined pectopexy technique. Also, we observed in this study, that the patients who underwent laparoscopic pectopexy had neither rectosel development, nor bowel obstruction and mesh erosion.

Conclusion

According to our results, laparoscopic pectopexy offers a feasible, safe, and comfortable alternative for apical prolapse surgery. Pectopexy may increase a surgeon's technical perspective for apical prolapse surgery.

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Acute Appendicitis in a Diabetic Child with *Salmonella* Infection

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Abstract: Acute appendicitis is the most frequent and challenging condition requiring emergent intrabdominal surgery in children. The diagnosis of appendicitis becomes more difficult and challenging in children, especially with other medical problems. Computed tomography is the primary tool for diagnosing or excluding appendicitis in cases with atypical presentation. *Salmonella* infections may present as acute abdominal problems in children. We present a clinical combination that has never been previously reported, of a diabetic girl with non-typhoid *Salmonella* infection, diagnosed with acute appendicitis. We wonder about the causal correlation of these diseases, versus their simple coexistence.

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Introduction

Acute appendicitis is one of the most common causes of abdominal pain and is the most frequent condition requiring emergent intrabdominal surgery in children. Yet, despite its common occurrence, it still remains a continuing clinical and diagnostic challenge, especially in the pediatric population, due to potential atypical clinical presentation in this age group, and also a wide range of differential diagnoses (Singh et al., 2014), including gastroenteritis. The early diagnosis is vital for the successful outcome because the delay in diagnosis (> 36–48 hours) can lead to gangrene or perforation and associated complications with increased morbidity prolonged hospitalization and even mortality in young children (Singh et al., 2014), especially those with coexisting diseases. Advanced radiologic imaging has an ever-increasing role in the prompt and accurate diagnosis of acute appendicitis in the pediatric population with the use of computed tomography (CT) proposed from some authors as the primary tool for diagnosing or excluding appendicitis in children (Callahan et al., 2002), improving also the rupture rates.

We present a diabetic girl with non-typhoid *Salmonella* infection and acute appendicitis, a clinical combination that has never been previously reported.

Case report

A 6-year-old girl presented to the emergency department with a 24-hour history of central abdominal pain, eight episodes of loose stool, two episodes of vomiting and fever up to 38.2 °C. Two-days prior, her pediatrician prescribed amoxicillin plus clavulanic acid for suspected acute otitis media. The girl had a medical history of diabetes mellitus type I treated with short-acting and long-acting insulin, asthma and afebrile seizures treated with valproic acid. On physical examination, the patient's tonsils were mildly swollen, red with whitish spots and an otoscopic examination revealed turbidity of the left tympanic membrane. Her abdomen was tender in all four quadrants especially in the right lower one (RLQ) and bowel sounds were present. Blood tests were performed and they revealed a white cell count (WCC) of 5,200 K/ μ l (types of WBCs: neut.: 70.30%, lymph.: 12.70%, mono: 16.80%) and C-reactive protein (CRP) of 193.52 mg/l (normal range: 0–5 mg/l). Stool samples were requested and a blood culture was taken along with a blood gas analysis. Intravenous fluids and antibiotics (ampicillin) were administered to her. Approximately 12 hours later, her abdominal pain was getting worse and she had another four episodes of loose stool. Blood tests were repeated and they showed an increase of C-reactive protein (CRP) up to 243.09 mg/l with a white cell count (WCC) of 6,800 K/ μ l (types of WBCs: neut.: 50%, lymph.: 10%, mono: 5%). An abdominal ultrasound was performed that showed the presence of free intraperitoneal fluid surrounding the loops of the bowel, slightly echovoid in scattered areas, and swelling of the colon along with increased echogenicity of the surrounding fat. Due to these findings, her antibiotic therapy was altered to metronidazole and cefotaxime and surgical assessment was requested. After a

recommendation for further imaging, a computed tomography of the abdomen and pelvis was performed that revealed acute appendicitis, so an open appendectomy was scheduled. At surgery, an inflammation-oedema of all the body and the tip of the appendix was found and an excessive amount of free straw coloured reactive intraperitoneal fluid. It was an inflamed without necrosis appendicitis, according to clinical-imaging-operative-clinical AAST grade system. The girl became afebrile and painless immediately after the surgery. In the meantime, the results from her stool cultures showed that she had non-typhoid *Salmonella* resistant to the usually recommended regimens (ampicillin, amoxicillin plus clavulanic acid, cefaclor or trimethoprim-sulfamethoxazole). She was discharged three days later, showing remarkable clinical improvement, with instructions for *per os* antibiotic treatment with ampicillin plus sulbactame according to the chemotherapy sensitivity test. Ten days after surgery, she had a new positive for *Salmonella* stool culture. So, *per os* ciprofloxacin was recommended and stopped with a new negative stool culture 7 days later.

Discussion

Salmonella infections may present as acute abdominal problems in children, can be particularly challenging and lead to surgical emergency (Arda et al., 2001; Kumar et al., 2015). The spectrum of abdominal manifestations from *Salmonella* (*typhi* and *paratyphi*) infections includes intestinal perforations, acute cholecystitis, salpingitis, and rarely appendicitis (Kumar et al., 2015; Stewart-Parker et al., 2016). Non-typhoid *Salmonella* species cause gastroenteritis and are also rarely associated with appendicitis (Stewart-Parker et al., 2016). In most cases *Salmonella* pathogens cause an appendicitis-mimicking syndrome through infectious ileocolitis and/or mesenteric lymphadenitis called as pseudoappendicitis which can lead to a needless operation (Kumar et al., 2015; Stewart-Parker et al., 2016). There are however a few reported cases of acutely inflamed or perforated appendicitis as a result of *Salmonella* infection (Stewart-Parker et al., 2016). *Salmonella* appendicitis may require different antibiotic treatment to that used in appendicitis, so preoperative stool cultures and bacterial analysis of peritoneal fluid may facilitate prompt and appropriate management (Stewart-Parker et al., 2016). Even if there is not a precise diagnosis in *Salmonella* related acute abdomen even with abdominal ultrasound sonography and/or computerized tomography, the surgical approach is the right choice, considering the high morbidity associated with delayed treatment of appendicitis (Arda et al., 2001; Manganaro et al., 2006), despite a relative risk of a needless operation. A positive preoperative culture for *Salmonella* should not contraindicate appendectomy (Stewart-Parker et al., 2016).

Furthermore, the diagnosis of appendicitis becomes more difficult and challenging in children with other medical problems, including diabetes mellitus and the associated relative immunodeficiency (Stewart et al., 2014). Common and rare

infectious diseases, including those of the gastrointestinal track, are more frequent and serious in the diabetic population (Tsai et al., 2008; Casqueiro et al., 2012). Patient who are medication-dependent diabetics are more likely to develop infection from some *Salmonella* species (Telzak et al., 1991). Diabetics present a more complicated, atypical or clouding clinical picture of acute appendicitis having a higher risk for delayed diagnosis, perforation and postoperative complications (Stewart et al., 2014; Bach et al., 2016). Abdominal pain in diabetic patients necessitating a higher index of suspicion (Bach et al., 2016), early surgical consultation (Tsai et al., 2008), and more aggressive decision for operation.

An appendiceal culture is not a routine performed test in surgically treated patients with acute appendicitis, especially without evidence of a purulent exudate in the lumen. Non-typhoid *Salmonella* caused appendicitis may indeed be under-reported as peritoneal fluid is not universally sent for examination at the time of surgery, and laboratories often do not fully identify coliforms isolated from peritoneal fluids, assuming that these are gut flora (Stewart-Parker et al., 2016).

Conclusion

In summary, *Salmonella* infections are a rare cause of appendicitis. Children with atypical presentations should be observed closely. Stool samples should be sent to all patients with loose stool and suspected appendicitis, and early surgical consultation is recommended especially in immunocompromised patients. Should a positive stool culture for *Salmonella* in a patient with identical CT/clinical and operative findings of appendicitis, be considered a strong evidence of *Salmonella* infection involvement as the real cause of appendicitis against their simple co-existence?

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Challenging Treatment of a Female Patient with Extensive Fournier's Gangrene – Case Report

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Abstract: Fournier's gangrene (FG) is a necrotizing fasciitis of the genital, perianal and perineal regions, caused by multiple anaerobic/aerobic infection. It is a rare but very serious condition with multiple long-term complications and high mortality rate. Early diagnosis and multidisciplinary approach in treatment of complicated cases of FG are crucial to the successful outcome. We report a case of an extensive FG in a 59-years-old female patient with multiple risk factors such as obesity, type 2 diabetes and hypertension. She was hospitalized as an emergency case with diabetic ketoacidosis, sepsis and extensive necrotic lesions located perineal, perianal, genital and spread to inguinal, hypogastric, gluteal and sacrococcygeal region. Fournier's gangrene was diagnosed, and after prompt resuscitation, intravenous fluids, broad-spectrum antibiotics, insulin infusion, emergency aggressive surgical debridement was performed. Several aerobic and anaerobic bacteria were isolated from wound culture and hemoculture. Patient has second debridement after four

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days. After second debridement was applied metabolic control, broad-spectrum antibiotics coverage, dressing the wound and negative pressure wound therapy (NPWT). Patient was discharged home five weeks after a second debridement in good condition. One month later she underwent reconstructive surgical treatment. Besides extensive FG and multiple comorbidity she was successfully managed with good outcome. Fournier's gangrene remains a life-threatening and fulminant disease which need urgent diagnosis and aggressive medical and surgical treatment, to achieve a reduction in long term complications and mortality rate.

Introduction

Fournier's gangrene, was first described by French venereologist Jean Alfred Fournier in 1883, as a fulminant type of gangrene in male patients with lesions in their genitals (Fournier, 1883). Fournier's gangrene is a life-threatening condition defined as necrotizing fasciitis of the genital, perianal and perineal regions which can rapidly extent to the lower extremities, abdominal wall or retroperitoneal space (Eke, 2000; Korkut et al., 2003). Fournier's gangrene a rare condition with male predominance and high mortality rate (~73%) (Romero et al., 2016). The most common risk factors for development of Fournier's gangrene are: diabetes mellitus, alcoholism, malnutrition, smoking, malignancies, immunosuppressive therapy, obesity, liver or kidney failure (Sorensen and Krieger, 2016). Early diagnosis and adequate initial treatment including resuscitation, broad-spectrum antibiotics and aggressive surgical debridement are crucial to successful outcome.

Case report

A 59-years-old female patient with obesity and medical history of arterial hypertension and type 2 diabetes was hospitalized as an emergency case with diabetic ketoacidosis and sepsis. Anamnestic data showed an initial perianal skin lesion, fourteen days prior to hospitalization. The patient was treated with a local surgical incision in secondary-level hospital, and after the intervention, she was discharged at home with advice for further treatment with antibiotics. After one week, despite antibiotic treatment, the patient condition was getting worse day-to-day, so she underwent medical check-up in the same hospital, but due to the serious progression of a local lesion and bad medical condition, she was immediately referred to tertiary-level hospital. On physical examination patient presented an extensive gangrenous lesion located perianal, perineal, which spread through hypogastric region, gluteal and sacrococcygeal region. Physical examination showed blood pressure of 80/40 mm Hg, a heart rate of 100 beats per minute and a body temperature of 39.1 °C. Blood tests indicated a systematic inflammation response – white blood cell – $19.5 \times 10^9/l$ and C-reactive protein level of 422.8 mg/dl. Random blood glucose level was 45.9 mmol/l, so uncontrolled diabetes was diagnosed. In addition, laboratory tests showed high concentration of creatinine – 220 $\mu\text{mol/l}$ and blood urea – 22.8 mmol/l, signs of anemia – hemoglobin concentration –

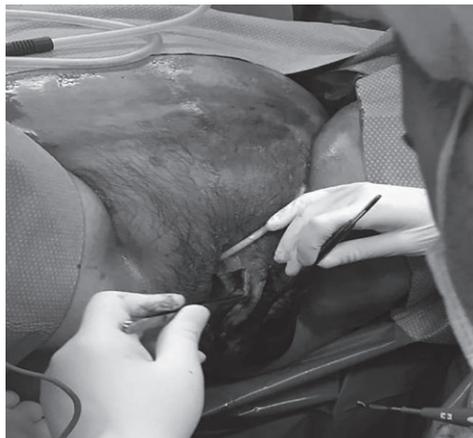


Figure 1 – Fournier's gangrene (necrotic lesions).



Figure 2 – Necrectomia. Debridement. Lavage. No II.

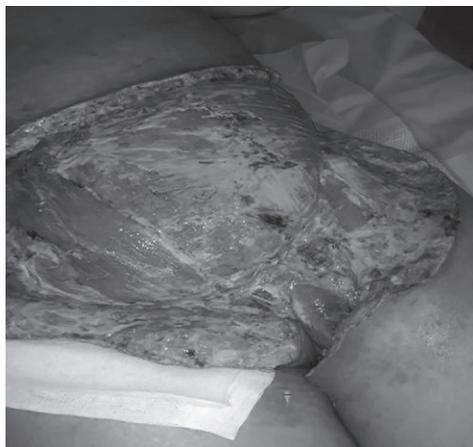


Figure 3 – 4th postoperative day.



Figure 4 – Postsurgical wound after second debridement.

100 g/l, red blood cells – 3.6×10^{12} /l, hematocrit – 0.31%. Based on the history, physical examination, laboratory analysis a diagnosis of sepsis and Fournier's gangrene was considered (Dg. Sepsis. Fasciitis necroticans regio perinealis, regio perianalis, labium majorum lat. sin, regio inguinalis billateralis, regio hypogastrici et umbilici, reg. lumbalis lat. sin, reg. femoris medialis lat. sin. et reg. sacralis.) (Figure 1).

After initial resuscitation with intravenous fluids, broad-spectrum antibiotics (Imipenem/Cilastin 3 g/day, Vancomycin 2 g/day) and (IV) insulin infusion, the patient underwent emergency surgery under general anesthesia. An aggressive debridement of all necrotic areas down to viable tissue was made (Necrectomia. Debridement. Lavage. No II) (Figures 2 and 3).



Figure 5 – Negative pressure wound therapy (NPWT).



Figure 6 – Dressing the wound with Aquacell Ag.



Figure 7 – Dressing the wound on gluteal and sacrococcygeal region with Granuflex and Hydro Clean.



Figure 8 – Post reconstruction.

After first debridement the open wound was dressed with Aquacell Ag. Postoperative, on 4th day, necrosis appeared again and second debridement was indicated (Figure 4).

After second debridement the wound was dressed with Hydro Clean, Granuflex and Aquacell Ag and negative pressure wound therapy was indicated. Postsurgical treatments of wound are shown on Figures 5–7.

Febrile status continued after second debridement, so wound cultures were collected and were identified: *Pseudomonas aeruginosa*, *Proteus mirabilis*, *Enterococcus* and *Citrobacter freundii*. After wound culture results, antibiotics were changed according to antibiogram: amp. Gentamycin 240 mg/day and amp. Piperacillin/Tazobactam 18 g/day. The febrile status continued and blood was collected for

hemoculture where was identified *Acinetobacter*, that was the reason for new antibiotic approach, first with Colistin 3000,000 IE/day (10 days) and then amp. Meropenem IV 2 g/day and amp. Clindamycin 1,800 mg/day in next five days. During hospitalization besides antibiotics was administered anticoagulant and supportive therapy, glycemetic control and parenteral nutrition.

Patient was discharged home five weeks after a second debridement in good condition with granulation of wound, with advice to continue with wound toilet at home, antibiotic therapy tab. Cital 1 g/day, next 7 days and anticoagulant therapy amp. Clexane 40 mg.

After few weeks the patient returned at the University Clinic of Plastic and Reconstructive Surgery in Skopje for reconstructive surgery (Figure 8).

Discussion

Fournier's gangrene is a type of necrotizing fasciitis of the genital, perianal, and perineal regions. It is a serious surgical problem with high mortality rate (Hota, 2012). This condition is more common in men, but a literature data shows a high incidence of 31.6% in women (Czymek et al., 2010). About 60% of patients with Fournier's gangrene have diabetes (Puvanendran et al., 2009). Pathophysiologically, Fournier's gangrene starts with microthrombosis of the small subcutaneous vessels which derives to skin gangrene, subsequent rapid spread of bacteria along the muscular fascia and relatively poor blood supply. The major clinical manifestation of Fournier's gangrene is: systemic inflammatory response syndrome, sepsis and extensive skin changes as a result of necrosis such as red/purple patches, erythema and swelling. Urgent diagnosis and treatment are crucial in the prognosis (Eke, 2000; Korkut et al., 2003). Diagnosis of Fournier's gangrene commonly is based on a clinical manifestation. Management of Fournier's gangrene basically depends on multidisciplinary approach. Initial resuscitation with fluid therapy and stabilization of cardiopulmonary function in patients with septic shock is very important at the time of presentation. In case of diabetic ketoacidosis is necessary immediately to start with intravenous insulin therapy. Aggressive surgical debridement of necrotized tissue in combination with broad-spectrum antibiotics is the main pathway in treatment of Fournier's gangrene. The removal of all the necrotized tissue is important to stop the spreading of the infection and subsequently elimination of systemic effects of toxins and bacteria (Czymek et al., 2009). Local wound care after surgical debridement is very important. Dressings the wound with Aqacell Ag, Granuflex, Hydro Clean and negative pressure wound therapy have been advocated. Negative pressure wound therapy have shown enhanced granulation tissue and reduction in wound surface area as a result of stimulation of fibroblasts activity, capillary dilatation, increasing circulation around the wound (Al Fadhli et al., 2009). With adequate surgical debridement, local wound care and antibiotic therapy, healthy granulation tissue appears. In case of significant tissue loss, especially in genitalia and perineum which leads to high morbidity, reconstructive procedure may be considered (Zaba et al., 2009).

Conclusion

We can conclude that Fournier's gangrene still remains a diagnostic and therapeutic challenge, due to the fact that it is a rare medical condition with high mortality rate. Fournier's gangrene requires an urgent diagnosis and aggressive medical and surgical treatment, to achieve a reduction in long-term complications and mortality. We recommended adequate initial surgical therapy and multidisciplinary approach in treatment, for good patient outcome, especially in cases with multiple comorbidities.

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Obstructive Jaundice Secondary to Pancreatic Head Metastasis of Malignant Amelanotic Melanoma as the First Clinical Manifestation

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Key words: Obstructive jaundice – Malignant melanoma – Pancreatic metastasis – BRAF genes

Abstract: Malignant melanoma is commonly known for its high probability of metastasizing to distant organs. Metastases to gastrointestinal tract are well documented, but resulting jaundice is only scarcely seen. We present a case of histologically verified metastasis of amelanotic melanoma to the head of pancreas infiltrating the common bile duct and consequently causing obstructive jaundice which constituted its first clinical manifestation. Multidisciplinary approach is essential in patients with malignant melanoma since early detection of the melanoma or its metastases may improve patients' clinical outcome, especially owing to the use of targeted biological treatment without any delay.

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Introduction

Malignant melanoma is the most aggressive type of skin cancer that accounts for 4–5% of all cancers diagnosed in the USA every year and even 10.5% in Australia. Amelanotic melanoma is a histologic variant of malignant melanoma with rather discrete macroscopic appearance. The lack of melanin and therefore lack of pigmentation accounts for a low rate of early recognition by patients as well as physicians. Melanoma metastases to gastrointestinal tract are generally less common and only a few cases of metastases to the biliary tract and its surroundings have been reported. Obstructive jaundice was the first manifesting symptom in this particular patient.

Case report

A 72-years-old male patient was referred to our department by his primary care physician for jaundice that he first noticed that day. The only other complaint the patient mentioned was the presence of painless palpable subcutaneous lumps on his neck that appeared approximately two weeks before his presentation. His past medical history was significant only for an ischemic stroke 3 years prior to this admission.

The patient presented with a total bilirubin of 307.3 $\mu\text{mol/l}$ (reference range 1.71 to 20.5 $\mu\text{mol/l}$), alkaline phosphatase (ALP) of 3.24 $\mu\text{kat/l}$, gama glutaryl transferase (GGT) of 5.26 $\mu\text{kat/l}$. A chest X-ray on admission disclosed moderate bilateral fluidothorax. Ultrasonography showed dilatation of intrahepatic bile ducts and common bile duct, and a hydroptic gallbladder (123 mm in longitudinal axis). A duodenoscopy demonstrated a normal looking papilla of Vater in D2 and a

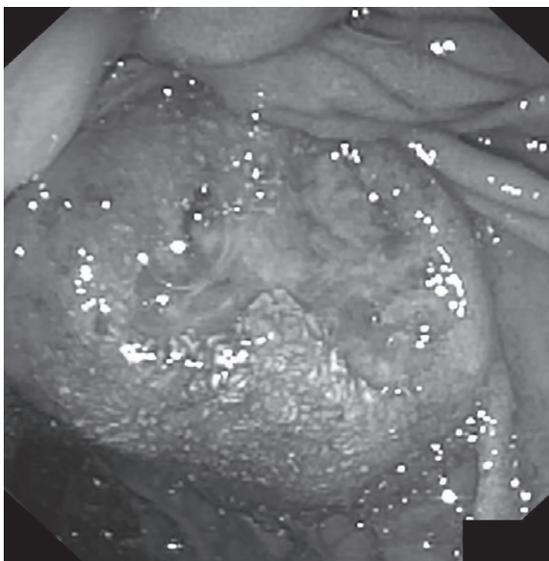


Figure 1 – Images from the duodenoscopy show the infiltration of the duodenal wall.

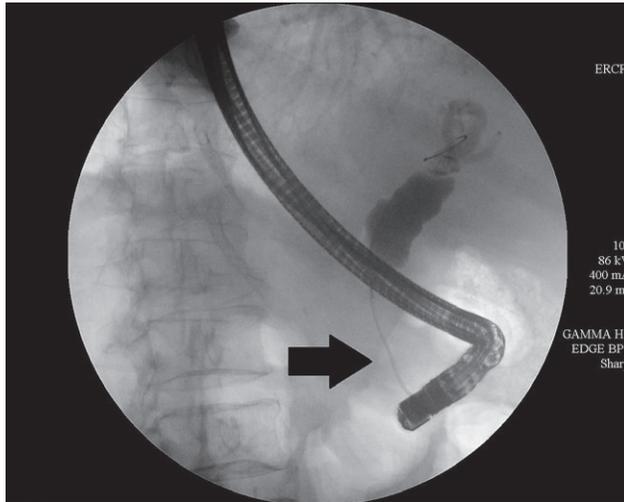


Figure 2 – An endoscopic retrograde cholangiopancreatography demonstrates a stenosis (arrow) in the common bile duct.

malignant looking polypoid mass approximately 7 cm below the papilla (Figure 1). Multiple forceps biopsies were taken solely from this mass and the papilla of Vater. No biopsies were taken from the actual lesion causing the obstruction due to high risk of bleeding. During endoscopic retrograde cholangiopancreatography (ERCP) the bile tree was cannulated, and a suprapapillary stenosis of the common bile duct in its pancreatic part was identified and stented with a 7 cm long 10 Fr plastic stent, type Amsterdam (Figure 2). The procedure was complicated by post-procedural bleeding from the papillotomy which had to be treated by intravenous fluids, vasoactive support and multiple blood transfusions in the Intensive Care Unit (ICU).

Staging CT (computed tomography) scan confirmed previous findings and showed the following: multiple metastatic lesions on the pericardium, pleura, subcutaneously in the chest wall, in the abdomen and pelvis. Other large lesions were found retroperitoneally, intraperitoneally and also in the D3 segment of the duodenum. Head of the pancreas was enlarged and had a diameter anteroposteriorly of 33 mm with a prominence towards the duodenum.

Final histopathology findings confirmed intestinal tissue with an infiltration by amelanotic malignant melanoma metastatic cells. The immunohistochemical stains for melanoma specific markers S-100 protein, SOX10, and Melan A were all positive and therefore confirmed the diagnosis of malignant melanoma (Figure 3). The bioptic tissue was also analysed for mutations in BRAF genes which could guide further targeted treatment. The mutation c. 1799T>A, p. (Val600Glu) was found in the DNA from our patient's tumour. A suspicious looking structure, a maculopapular lesion with a fibrotic pedunculated nodule in its centre with brown pigmentation of its surroundings, was identified near the left mammary gland. Therefore, it was

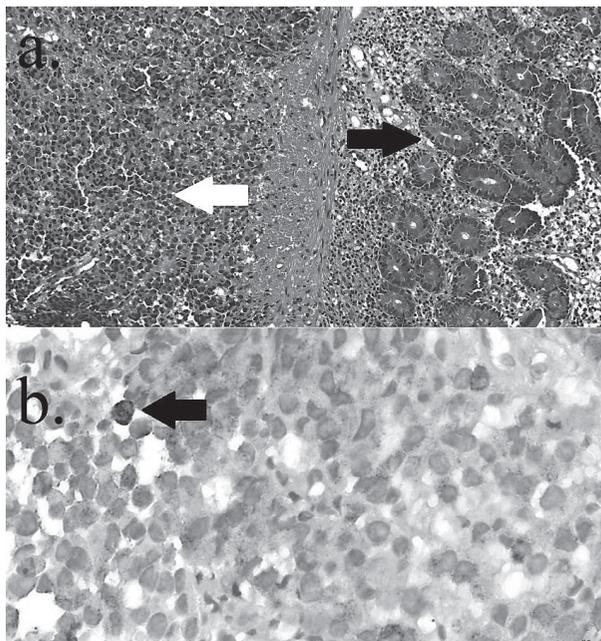


Figure 3 – Histology slides confirming the diagnosis of malignant melanoma. a) Small bowel mucosa (black arrow) with submucosal infiltration by solid epithelioid tumour with cytonuclear atypia (white arrow) (28.6×, hematoxylin and eosin and periodic acid Schiff). b) Cytoplasmic positivity of the tumour cells (arrow) for Melan-A protein (123.6× immunohistochemistry).

biopsied and subsequently examined under the microscope to identify the primary lesion. A primary tumour with histologically proven melanoma was not identified in any studied tissue samples.

The patient was informed of the unfavourable prognosis of his disease and a follow-up appointment was scheduled for after the results of BRAF mutations were expected to be available to potentially start a biologic treatment. Unfortunately, the patient died just few days later even before our scheduled appointment. Despite thorough investigation we were not able to uncover patient's place or cause of death.

Discussion

Whenever a diagnosis of melanoma is established, the most critical question is whether the cancer is localized or metastatic to regional lymph nodes or distant organs. Most deaths from melanoma are attributable to metastases that are resistant to conventional therapies (Fidler, 1990). Our patient presented with painless jaundice which was later specified as conjugated hyperbilirubinemia caused by obstruction of the biliary tract. Differential diagnosis of biliary obstruction includes among other potential causes: intrinsic and extrinsic and primary and secondary tumours of biliary ducts or adjacent organs, primary sclerosing cholangitis (PSC), cholangiopathy, acute and chronic pancreatitis, and strictures resulting from previous invasive procedures. There are 4 major types of malignant melanoma: superficial spreading melanoma,

nodular melanoma, lentigo maligna melanoma, and acral lentiginous melanoma. All of these types may be found in different histologic variants. One of them is the amelanotic melanoma, which is the tumour presented in this case study. Although the amelanotic melanoma is less common than the clinically pigmented melanoma, accounting for 2 to 10 percent of cases, it poses serious diagnostic challenges for patients and clinicians alike (Gualandri et al., 2009; Wee et al., 2018). This was clearly the case with our patient, who presented to the hospital with stage IV metastatic malignant melanoma. Our case is the first one to describe biliary obstruction caused by malignant melanoma metastasis to the head of pancreas. Very few other secondary tumours to the head of pancreas, such as for example multiple myeloma or diffuse large B cell lymphoma causing obstructive jaundice, have previously been described (Zheng et al., 2017; Umemura et al., 2018). Cases of malignant melanoma metastasis to the ampulla of Vater causing jaundice are the most similar to our case. These patients mostly present with signs of right upper quadrant pain with jaundice or painless jaundice with or without pruritus, as seen in our patient with the only symptom of painless jaundice. Other symptoms described in these cases include nausea, vomiting, loss of appetite and weight loss, which were not present in our patient. Majority of these patients share a poor prognosis due to disseminated stage of the disease (Parquier et al., 1991; Thompson et al., 1993; Sans et al., 1996; Van Bokhoven et al., 2006; Colovic et al., 2007; Marks et al., 2010). Malignant melanoma with gastrointestinal metastases represents a late manifestation of the disease with a generally poor prognosis (Capizzi and Donohue, 1994; Marks et al., 2010). These metastases are most commonly asymptomatic and are only discovered during an autopsy (Capizzi and Donohue, 1994; Marks et al., 2010). Finding the ideal therapy for these lesions remains difficult given the very low incidence of melanoma metastatic to the biliary tree or its surroundings (Capizzi and Donohue, 1994). Biliary stents seem to offer at least a temporary symptomatic relief with a rapid improvement of cholestasis and its clinical manifestations (Capizzi and Donohue, 1994). Surgical resection via pancreatico-duodenectomy may be an option for isolated metastatic lesions in select symptomatic patients with a good performance status, although the risk of metastatic disease leading to death still exists in these patients (Meyers et al., 1998). Our patient would have been a candidate for therapies targeting immune checkpoint molecule programmed death 1 (PD-1) or its ligand (PD-L1), cytotoxic T lymphocyte associated antigen 4 and also the mitogen-activated protein (MAP) kinase pathway with BRAF and MEK inhibitors since BRAF gene mutation was confirmed. In recent years, many potential treatment options improving median overall survival as well as quality of life were established and many more are being studied. These medicines, such as Vemurafenib, Dabrafenib, Trametinib, Nivolumab, Ipilimumab or Atezolizumab, would have been suitable treatment options in the case of our patient (Hauschild et al., 2012; Larkin et al., 2014, 2015; Swaika et al., 2014; Long et al., 2015; Robert et al., 2015; Chapman et al., 2017; Sullivan et al., 2019).

Conclusion

Multidisciplinary approach is crucial in diagnosing and establishing appropriate treatment in complex patients, as it was in our case. Malignant melanoma may present with various symptoms and therefore mimic broad spectrum of diseases. Amelanotic melanoma possesses a serious threat, not only by its lack of pigmentation and potentially delayed diagnosis, but also by its high potential to form distant metastases early in the course of the disease. A good compliance with recommended medical plan is also an important factor prolonging median overall survival.

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