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HEAD AND NECK

A comparison of electrothermal bipolar vessel sealing system and electrocautery in selective neck dissection

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Abstract The use of LigaSure™ vessel sealing system in head and neck surgery was reported to be reliable and safe, providing sufficient hemostasis and reducing operating time. The aim of this study was to evaluate efficacy of this technique in patients undergoing selective neck dissections. This study was carried out as a prospective controlled study at an otolaryngology department of a tertiary medical center between July 2013 and July 2015. Twenty-five patients older than 18 years who underwent unilateral selective neck dissection for head and neck cancer were included in the study. In the control group (group 2, 10 patients) only monopolar and bipolar diathermy was used; in the Ligasure group (group 1, 15 patients) Ligasure was used for hemostasis and dissection in addition to the conventional techniques. Cervical lymphadenectomy time, operation time, preoperative hemoglobin levels, preoperative hematocrit levels, postoperative hemoglobin levels, postoperative hematocrit levels, total neck drainage and drain removal time were analyzed and compared between the groups. Median operation time in group 1 and 2 were 95 min (IQR = 35) and 142.5 min (IQR = 63), respectively. Median cervical lymphadenectomy time in group 1 and 2 were 55 min (IQR = 23) and 102.5 min (IQR = 49), respectively. Median operation time and cervical operation time were significantly lower in group 1 ($p < 0.05$). In conclusion, LigaSure™ vessel sealing system is a safe, efficacious technique and significantly lowers cervical lymphadenectomy and operation time in selective neck dissections compared to controls. Given the superb hemostatic properties, this technique should be in the surgeon's armamentarium when possible.

Keywords Ligasure · Vessel sealing · Neck dissection · Bipolar diathermy · Electrocautery

Introduction

Neck dissection is a surgical procedure that involves the excision of cervical lymph nodes harboring metastatic lymph nodes. The original defined surgical procedure is radical neck dissection, but nowadays selective neck dissection is the most common implemented type of neck dissection in which the cervical lymph node groups with the highest risk of harboring metastasic nodes are excised with the preservation of nonlymphatic structures [1]. Common hemostasis techniques used during neck dissections include clamp-and-tie, hemostatic clips, monopolar and bipolar cautery. LigaSure™ vessel sealing system uses patient's own collagen and elastin to create a permanent vessel fusion and permanently seals vessels up to 7 mm in diameter [2]. Thus, hemostasis is not dependent on the thrombus formation in the proximal vessel and the effect is limited to the target tissue or vessel with a limited (<2 mm) thermal effect on adjacent tissues [3]. The absence of hemostatic clips and sutures lowers the risk of infection and fibrosis [4]. Neck contains major vessels and numerous smaller vessels. Hemostasis during neck dissection is of paramount importance to avoid complications and blood loss. LigaSure™ vessel sealing system has been shown to reduce operative blood loss and lower the surgical procedure duration significantly in colorectal,

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gynecologic and urologic surgery [5–12]. The use of LigaSure™ vessel sealing system in head and neck surgery has been reported to be reliable and safe, providing sufficient hemostasis and reducing operating time [13]. However, most of the previous reports rely on retrospective data and prospective controlled studies regarding the use of this technique in neck dissection is lacking.

The aim of this study was to evaluate efficacy of this technique in patients undergoing selective neck dissections.

Materials and methods

This study was carried out at an otolaryngology department of a tertiary medical center between July 2013 and July 2015. All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. The study was approved by the Institutional Review Board. Informed consent was obtained from all individual participants included in the study.

The study was designed as a prospective controlled study. All of the data were prospectively collected. These included demographic data, date of the surgery, type of surgery, duration of the surgery, preoperative and postoperative blood counts and postoperative surgical follow-up.

Patient selection

Twenty-five patients older than 18 years who underwent unilateral selective neck dissection for head and neck cancer were included in the study. Exclusion criteria were as follows: history of radiotherapy to the head and neck region, having additional surgery during the selective neck dissection (excision of the primary tumor, bilateral neck dissection or reconstruction) and history of previous surgical intervention in the neck region.

Instrumentation

During the neck dissections Covidien ForceTriad™ energy platform was used (Covidien, Dublin, Ireland). Only monopolar and bipolar diathermy was used in the control group. LigaSure™ vessel sealing system was used for hemostasis and dissection in addition to monopolar and bipolar diathermy in the LigaSure™ group. LigaSure™ small jaw open instrument was used as the vessel sealer and divider. Use of the monopolar and bipolar diathermy was confined to the minute bleedings from the skin incisions and subcutaneous tissue in the Ligasure group which required a finer instrument.

Procedure

All of the patients were operated under endotracheal general anesthesia. All of the neck dissections were performed by three different staff surgeons experienced in the field of head and neck surgery. Only selective neck dissections were performed for the management of occult metastases. Only monopolar and bipolar diathermy was used in the control group. In the Ligasure group LigaSure™ small jaw open instrument was used in ligating tissues, dissection and hemostasis. Operation time (initial cut to closure time) and cervical lymphadenectomy time were noted. Suction drains were placed at the end of the surgery. Drains were removed if the collection was lower than 25 mL/24 h. Patients were followed in the otolaryngology ward postoperatively. A complete blood count was performed the day before the surgery and 1 day after the surgery to avoid the effect of perioperative fluid administration on hematocrit and hemoglobin levels.

Outcome measures

Cervical lymphadenectomy time, operation time, preoperative hemoglobin levels, preoperative hematocrit levels, postoperative hemoglobin levels, postoperative hematocrit levels, complications, total neck drainage and drain removal time were analyzed and compared between the two groups.

Statistical analysis

Statistical analysis was made using computer software (SPSS version 22.0, SPSS Inc. Chicago, IL, USA). Chi square (χ^2) exact tests were used for the comparison of categorical data. Independent and paired sample t-tests were used for the analysis of parametric variables while Wilcoxon and Mann–Whitney *U* tests were used for the analysis of non-parametric variables based on the distribution pattern of the data. The Shapiro–Wilk test was used for determining the distribution pattern of the data. The distribution of the groups was non-parametric. Correlation analysis was performed via Pearson or Spearman correlation analysis based on the distribution pattern of the data. Data were expressed as "median, interquartile range (IQR)". A p value less than 0.05 was considered as statistically significant. Post-hoc power analysis was made with the G*Power 3 software [14].

Results

The mean age of 25 patients (17 males, 8 females) included in the study was 62.72 years (range 22–74). There were 15 patients in the Ligasure group (group 1) and 10 patients in the control group (group 2). The primary diagnosis was laryngeal carcinoma in 22 patients, lip carcinoma in two patients and

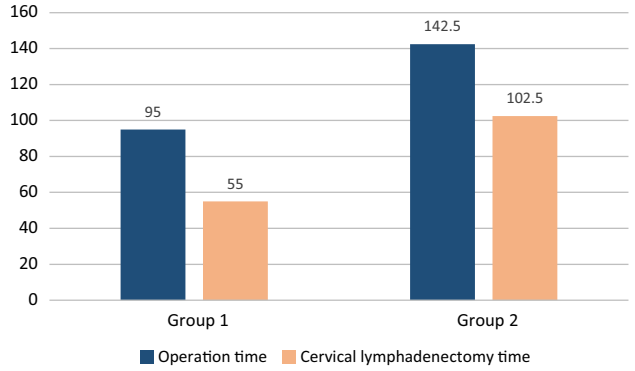

Fig. 1 Operation time and cervical lymphadenectomy time of groups 1 and 2 (data are expressed in minutes)

parotid gland malignancy in 1 patient. None of the patients experienced complications in the early postoperative period.

Median operation time in group 1 and 2 were 95 min (IQR = 35) and 142.5 min (IQR = 63), respectively (Fig. 1). Median cervical lymphadenectomy time in group 1 and 2 was 55 min (IQR = 23) and 102.5 min (IQR = 49), respectively (Fig. 1). Median operation time and cervical lymphadenectomy operation time were significantly lower in group 1 ($p < 0.05$).

Median preoperative hematocrit levels in group 1 and 2 were 39.1 % (IQR = 8) and 39 % (IQR = 4.5), respectively. Median postoperative hematocrit levels in group 1 and 2 were 36.8 % (IQR = 8.1) and 36.6 % (IQR = 2.5), respectively. Median preoperative hemoglobin levels in group 1 and 2 were 12.8 g/dL (IQR = 2.3) and 13.2 g/dL (IQR = 1.8) respectively. Median postoperative hemoglobin levels in group 1 and 2 were 11.9 g/dL (IQR = 2.3) and 12.3 g/dL (IQR = 0.3), respectively. The change in the preoperative and postoperative hematocrit and hemoglobin levels did not differ significantly between groups 1 and 2 ($p > 0.05$).

Median neck drainage in group 1 and 2 were 50 mL (IQR = 45) and 30 mL (IQR = 30), respectively. Median drain removal time in group 1 and 2 were 3 days (IQR = 0) and 3 days (IQR = 0), respectively. Median neck drainage and drain removal time did not significantly differ between the two groups ($p > 0.05$).

Post-hoc analysis revealed a statistical power of 99.3, 90.2, 43.8, 42, 22.4 and 11 % for the analysis of the cervical lymphadenectomy time, operation time, hematocrit levels, hemoglobin levels, neck drainage and drain removal time, respectively.

Discussion

LigaSure vessel sealing system delivers a precise amount of energy by monitoring changes in tissue impedance. By this way appropriate amount of energy is delivered for the desired tissue defect. Energy is transferred to the grasped tissue and the seal is formed with the pressure and the denaturated collagen and elastin. LigaSure™ vessel sealing system has been approved by the US Food and Drug Association for sealing of vessels up to 7 mm in diameter [15, 16]. Vessel seals can withstand three times normal systolic blood pressure [3, 16]. This sealing strength has been confirmed by experimental and clinical studies [3, 15–17]. Vessel sealing strength has been shown equal to hemoclips and ligatures and superior to ultrasonic coagulation and bipolar coagulators [3, 15].

LigaSure vessel sealing system has also been investigated in various fields of head and neck surgery. Prokopakis et al. used LigaSure™ vessel sealing system in total laryngectomy and unilateral radical neck dissection patients and compared their results with historical controls of total laryngectomy and unilateral radical neck dissection patients [18]. They reported excellent hemostatic properties of this technique with a 62.5 % reduction in intraoperative blood loss and they achieved a reduction of 30 min in the mean operation time with no postoperative complications. In our study both operation time and cervical lymphadenectomy time were significantly lower in the Ligasure group compared to the control group. Our data are in line with the previous reports and we think this is one of the major benefits of this technique.

Coiro et al. reported a statistically significant reduction regarding operative times and intraoperative blood losses in a study of 190 thyroidectomies with the LigaSure™ technique compared to the traditional clamp-and-tie technique with no significant differences in postoperative recurrent laryngeal nerve paralysis and hypoparathyroidism [19]. In a prospective study conducted on patients undergoing superficial parotidectomy LigaSure™ vessel sealing system was found as a safe device for parotid gland surgery, providing sufficient hemostasis and reducing operative time with a mean time gain of 52 min [20]. Ligasure vessel sealing system was also studied on patients undergoing tonsillectomy and was found effective and safe, providing sufficient hemostasis [21]. Besides reducing operative time and providing excellent hemostasis, all of the previous reports support LigaSure™ vessel sealing as a safe and reliable technique. There were no complications in the Ligasure group in our study.

In our study we did not calculate the estimated blood loss by measuring the amount in the suction bottle and by weighing the gauzes. We adopted a different approach by comparing preoperative and postoperative blood counts. It is known that one unit of blood loss has an effect of 1 g/dL on hemoglobin and 3 % on hematocrit levels. In both groups there was no statistically significant different change regarding hematocrit and hemoglobin levels [22]. One might question the reliability of our approach but what

should be taken into account is that measuring the blood amount in the suction bottle and weighing the gauzes is also an estimation, and estimations may be affected by other factors and intra-rater and inter-rater differences in measurements [18]. Small sample size is a limitation in our study. Despite the high volume of head and neck oncology cases in our institution the small sample size is related to the low number of isolated selective neck dissections. Most neck dissections are done in conjunction with the management of the primary and/or reconstruction procedures. Bilateral neck dissections most of the time are staged in our institution to avoid complications. Laryngeal and lip cancer patients included in this study were operated for the management of the contralateral neck. The patient with parotid gland cancer required a neck dissection as a separate procedure because her permanent pathology was high-grade mucoepidermoid carcinoma.

In conclusion, LigaSure™ vessel sealing system is a safe, efficacious technique and significantly lowers cervical lymphadenectomy and operation time in selective neck dissections compared to controls. Given the superb hemostatic properties, this technique should be in the surgeon's armamentarium when possible.

Compliance with ethical standards

Conflict of interest None of the authors has declared any conflict of interest (financial or non-financial).

Research involving human participants and/or animals All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent Informed consent was obtained from all individual participants included in the study.

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