HEAD AND NECK

Predictive factors for postoperative wound complications after neck dissection

I fattori prognostici per le complicanze della ferita chirurgica dopo svuotamento linfatico del collo

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SUMMARY

The objective of this retrospective study was to evaluate risk factors for wound complications after neck dissection. One hundred and nineteen patients were treated with neck dissection for squamous-cell carcinoma of the upper aerodigestive tract at the National Cancer Institute in Rome between 2006 and 2009. Postoperative wound complications were divided into major or minor and were related to different variables to identify risk factors. Postoperative wound complications were found in 20.2% of patients with an individual patient probability for different risk factors ranging from 2% to 34.1%. Preoperative chemoradiation therapy (CRT) and the type of neck dissection were associated with a higher risk of major complications (p ≤ 0.05). Previous CRT and radical neck dissection/modified radical neck dissection are risk factors for major wound complications in patients with head and neck squamous cell carcinoma undergoing neck dissection. Patients requiring neck dissection after CRT should be informed about the increased risk of the procedure, and selective neck dissection, if oncologically appropriate, should be considered to reduce complications.

KEY WORDS: Neck Dissection • Complications • Head and neck • Chemoradiation therapy

RIASSUNTO

L'obiettivo di questo studio retrospettivo è stato quello di valutare i fattori di rischio per le complicanze della ferita chirurgica dopo svuotamento linfonodale del collo. Dal 2006 al 2009, 119 pazienti con carcinoma squamoso delle prime vie aero-digestive sono stati sottoposti a svuotamento del collo presso l'Istituto Nazionale Tumori di Roma. Le complicanze della ferita chirurgica sono state classificate in maggiori e minori al fine di identificare i fattori di rischio delle stesse. Il 20.2% dei pazienti ha presentato complicanze della ferita chirurgica nel postoperatorio con una probabilità individuale che variava dal 2% al 34.1% a seconda dei fattori di rischio. La chemio-radioterapia preoperatoria e il tipo di svuotamento del collo (radicale o radicale modificato) sono associati ad un rischio aumentato (p ≤ 0.05) di complicanze maggiori della ferita chirurgica in pazienti trattati per carcinoma squamoso delle prime vie aero-digestive.

PAROLE CHIAVE: *Svuotamento linfonodale del collo • Complicanze • Testa e collo • Chemioradioterapia*

Introduction

Neck dissection (ND) may give rise to complications during or after surgery. Systemic and intraoperative complications such as death, major vessel rupture or nerve injury may worry the surgeon and cause anxiety for the patient. Postoperative wound complications, even if less concerning, may result in expensive and time-consuming management. In the last century, effort has been made to try and reduce complications by modifying the aggressive surgical procedure involved; however, the risk factors for postoperative wound complications still remain to be clarified. The advent of preoperative chemoradiation therapy (CRT) has added another possible cause of wound complications [1]. The objective of the present study was to evaluate the risk factors for complications after neck dissection.

Materials and methods

From January 2006 to December 2009, 331 patients (120 women and 211 men) with squamous cell carcinoma of the upper aerodigestive tract underwent neck dissection at the Department of Otolaryngology Head and Neck Surgery, National Cancer Institute in Rome. The aim of the present study was to assess risk factors for wound complications. The criteria for inclusion in the study were: (1) neck dissection simultaneous with a surgical procedure (e.g., transoral resection) performed in a separate surgical field, (2) neck dissection as a single surgical procedure,

such as in the case of unknown primary or planned neck dissection (PND) after CRT, (3) unilateral neck dissection and (4) neck dissection not performed at the same time as the primary treatment. This selection was chosen in order to avoid the risk of complications related to an adjunctive procedure.

Neck dissection has been classified into "radical" neck dissection (RND), "modified radical" neck dissection (MRND), or "selective" neck dissection (SND) procedures. In the present series, RND removed all lymph nodes from level I to V together with the sternocleidomastoid muscle, the internal jugular vein, and the spinal accessory nerve, while the MRND removed the lymph nodes of the same levels but preserved the latter three structures. The SND procedure may include removal of lymph node levels I to III or IV or levels II to IV according to the primary tumour. Moreover, MRND and RND were performed via a tri-flapped incision, while a bi-flapped incision was adopted for the SND.

One hundred and nineteen of 331 patients who met the inclusion criteria were analyzed retrospectively to identify risk factors and probability of wound complications. All patients who received CRT underwent neck dissection between 12 and 14 weeks after the end of the treatment and were assessed by MRI to identify unresectable tumours. The variables assessed included gender, age, smoking habit, alcohol abuse, anticoagulant therapy, diabetes, preoperative blood values (haemoglobin, hematocrit level, white cells, platelets and albumin), previous CRT, preoperative clinical lymph node status (cN), surgical time, type of neck dissection, concomitant surgical procedure, pathological nodes (pN) and nodal extracapsular spread. In the cases submitted to surgery after CRT, cN staging was assessed at the end of the CRT.

Observed wound complications were classified into major complications requiring surgical revision (massive haematoma, extended wound dehiscence, wide skin flap necrosis, and high flow chyle leak) and minor complications requiring only local dressing and therapy and no further surgical procedure (slight haematoma, wound dehiscence, limited skin flap necrosis, seroma and facial swelling).

Massive haematoma was considered as bleeding causing loss of the cervico-mandibular angle and swelling of the supraclavicular fossa or dyspnea. Slight haematoma was defined as bleeding without loss of the cervico-mandibular angle and swelling of the supraclavicular fossa or dyspnea.

The criterion used to differentiate between extended or regular wound dehiscence was the presence of a "dehiscent area" ≥ 2 cm^2. Skin flap necrosis was defined as wide when it affected an area of 2 cm^2 or more. The flow chyle leak was defined as high if leakage of 500 mL/day occurred.

Descriptive statistics were used to summarize pertinent study information. A comparison of the proportions between groups was performed using a two-sided chi-square test or a two-sided Fisher's exact test when there were fewer than 5 expected events. Surgical time was tested to identify a possible cut-off value by receiver operating characteristic (ROC) analysis. Logistic regression analysis was used to assess the impact of different variables on the development of wound complications in neck dissection. The cut-off p value for inclusion or exclusion in the model was set at 0.10 and 0.15, respectively. Results are reported as odds ratio (OR) with a 95% confidence interval (CI). A logistic equation including the coefficients of the regression analysis was then constructed to calculate an estimation of the individual patient probability (IPP) of wound complications, as follows:

probability of wound complications $= (\text{Exp}^{\Sigma(X \times B) + \text{intercept(a)}})/1 + (\text{Exp}^{\Sigma(X \times B) + \text{intercept(a)}})$, where $X \times B$ is the coefficient B for each single confounding factor. The SPSS (version 18.0) and Medcalc (version 10) statistical programs were used for all analyses.

Results

The clinical charts of 119 patients were reviewed, 79 were male (66.4%) and 40 female (33.6%) with a mean age of 62 years (range: 29-87). The demographic and clinical characteristics are presented in Table I. Forty-one patients (34.5%) of 119 received concurrent fractionated radiation therapy and chemotherapy consisting of 2.0 Gy/day (70 Gy for primary and gross nodal disease; 50 Gy for clinically uninvolved cervical nodal stations) and cisplatin at 100 mg/mq every 3 weeks per 3 cycles. All these patients had a complete response of the primary tumour considering only the pre-CRT neck status (N > 3 cm) and underwent neck dissection between 12 and 14 weeks after the conclusion of nonsurgical management of disease. The other 78/119 (65.5%) patients had no prior treatment and no systemic complications were observed. Out of 119 patients, 95 (79.8%) did not develop any complications, while 24 (20.2%) experienced some type of wound complication; this was major in 14 cases (11.7%) and minor in 10 cases (8.3%) (Table II). The major complications that required surgical revision were wound dehiscence (7 cases, 5.9%), massive haematoma (5 cases, 4.2%), wound dehiscence with haematoma (1 case, 0.8%) and chyle leak (1 case, 0.8%). Three patients who had previously received CRT and who developed wide cervical skin flap necrosis required transposition of a pectoralis pedicled flap between 30 and 40 days post surgery. No major vessel rupture was observed. In all cases, the source of haematoma was attributed to the bleeding of multiple small-size vessels.

The 10 patients with minor complications were successfully managed over 2 months with medical therapy (anti-

Table I. Demographics and clinical characteristics of patients.

	N	%
Gender		
Male	79	66.4
Female	40	33.6
Age		
≤ 45 yrs	8	6.7
> 45 yrs	111	93.3
Smoker		
Yes	82	68.9
No	37	31.1
Alcohol abuse		
Yes	13	10.9
No	106	89.1
Anticoagulant therapy		
Yes	28	23.5
No	91	76.5
Diabetes		
Yes	8	6.7
No	111	93.3
Preoperative blood values		
Haemoglobin		
≤ 14.10 g/dl	64	53.8
> 14.10 g/dl	55	46.2
Haematocrit		
≤ 40.85 %	60	50.4
> 40.85 %	59	49.6
White cells		
≤ 6.6 x 10^3/μL	62	52.1
> 6.6 x 10^3/μL	57	47.9
Platelets		
≤ 229 x 10^3/μL	60	50.4
> 229 x 10^3/μL	59	49.6
Albumin		
≤ 4.33 g/dl	61	51.3
> 4.33 g/dl	58	48.7
Preoperative ChRT to the neck		
Yes	41	34.5
No	78	65.5
cN		
N0	47	39.5
N+	72	60.5
Time of ND		
< 100 minutes	62	52.1
> 100 minutes	57	47.9
Type of ND		
Radical ND	18	15.1
Modified radical ND	45	37.8
Selective ND	56	47.1
Concomitant surgical procedures		
Yes	69	58.0
No	50	42.0
pN		
N0	64	53.8
N+	55	46.2
Nodal extracapsular spread		
Yes	26	21.8
No	93	78.2
Total	**119**	**100**

cN: preoperative clinical lymph node status; ND: neck dissection; ChRT: ChemoRadiation therapy; pN0: pathological status.

Table II. Complications after neck dissection.

	N	%
No complications	95	79.8
Major complications		
All	14	11.7
Wound dehiscence	7	
Massive hematoma	5	
Wound dehiscence + haematoma	1	
Chyle leak	1	
Minor complications		
All	10	8.3
Slight haematoma	8	
Seroma	2	
Total	**119**	**100**

biotics) and compressive dressings. The minor complications were slight haematoma (8 cases, 6.7%) and seroma (2, 1.6%).

The results of statistical analyses are reported in Tables III and IV. A two-sided chi-square test and two-sided Fisher's exact test showed an association between preoperative CRT and the type of neck dissection for wound complications, while the other variables were not statistically significant (Table III).

The rate of major and minor complications in the group of patients submitted to concurrent CRT was 24.4% and 0%, respectively, versus 5.1% and 12.8% in the patients who did not undergo CRT (p = 0.001). In those submitted to RND or MRND, the proportions were 17.5% and 4.8%, respectively, versus 5.4% and 12.5% in those who underwent selective neck dissection (SND) (p = 0.05). Major complications in cN+ patients (16.7%) were higher than in cN0 patients (4.3%), while minor complications showed the opposite trend (4.3% versus 12.8%), and the statistical association between groups was not significant (p = 0.06) even if a trend was noted. Anticoagulant therapy (p = 0.19), diabetes (p = 0.21), concomitant surgical procedure (p = 0.06), pN status (p = 0.52) and nodal extra-capsular spread (p = 0.45) were not associated with complications.

The variables associated with complications were analyzed by multivariate analysis in order to assess the OR for wound complications. Multivariate analysis showed that CRT (OR = 6.03, CI = 1.72–21.17, p = 0.005,) and type of neck dissection (OR = 3.79, CI = 0.96–15.01, p = 0.057) were risk factors for major wound complications (Table IV). The risk factors for minor wound complications after neck dissection were not assessed due to the low number of events. The IPP for wound complications was 2% in patients submitted to SND without CRT, while it was 7.9% in patients who underwent RND/MRND, 12% in patients treated with CRT, and 34.1% in the patients who underwent both preoperative CRT and RND/MRND (Table V).

Table III. Association between wound complications and variables evaluated.

	None		Major		Minor		p
	N	%	N	%	N	%	
Gender							0.21
Male	60	75.9	10	12.7	9	11.4	
Female	35	87	4	10	1	25	
Age							0.34
≤ 45 yrs	8	100	0	0	0	0	
> 45 yrs	87	78.4	14	12.6	10	9.0	
Smoker							0.70
Yes	64	78	11	13.4	7	8.5	
No	31	83.8	3	8.1	3	8.1	
Alcohol abuse							0.41
Yes	9	69.2	3	23.1	1	7.7	
No	86	81.1	11	10.4	9	8.5	
Preoperative blood values							
Haemoglobin							0.32
≤ 14.10 g/dl	54	84.4	5	7.8	5	7.8	
> 14.10 g/dl	41	74.5	9	16.4	5	9.1	
Haematocrit							0.36
≤ 40.85 %	51	85	5	8.3	4	6.7	
> 40.85 %	44	74.6	9	15.3	6	10.2	
White cells							0.04
≤ 6.6 x 10^3/μL	50	80.6	10	16.1	2	3.2	
> 6.6 x 10^3/μL	45	78.9	4	7.0	8	14.0	
Platelets							0.24
≤ 229 x 10^3/μL	45	75	10	16.7	5	8.3	
> 229 x 10^3/μL	50	84.7	4	6.8	5	8.5	
Albumin							0.25
≤ 4.33 g/dl	49	80.3	9	14.8	3	4.9	
> 4.33 g/dl	46	79.3	5	8.6	7	12.1	
Concurrent ChRT to the neck							0.001
Yes	31	75.6	10	24.4	0	0.0	
No	64	82.1	4	5.1	10	12.8	
cN							0.06
N0	39	83.0	2	4.3	6	12.8	
N+	56	77.8	12	16.7	4	5.6	
Diabetes							0.21
Yes	5	62.5	1	12.5	2	25.0	
No	90	81.1	13	11.7	8	7.2	
Anticoagulant therapy							0.19
Yes	20	71.4	6	21.4	2	7.1	
No	75	82.4	8	8.8	8	8.8	
Type of ND							0.05
RND or MRND	49	77.8	11	17.5	3	4.8	
Selective ND	46	82.1	3	5.4	7	12.5	
Concomitant surgical procedures							0.06
Yes	54	78.3	6	8.7	9	13.0	
No	41	82.0	8	16.0	1	2.0	
pN							0.52
N0	49	76.6	8	12.5	7	10.9	
N+	46	83.6	6	10.9	3	5.5	
Nodal extracapsular spread							0.45
Yes	23	88.5	2	7.7	1	3.8	
No	72	77.4	12	12.9	9	9.7	

cN: preoperative clinical lymph node status; ND: neck dissection; MRND: modified radical neck dissection; RND: radical neck dissection; ChRT: ChemoRadiation therapy; pN0: pathological status.

Table IV. Multivariate analysis: predictors of major wound complications after neck dissection.

	Odds ratio	Confidence Interval	P value
Preoperative ChRT			
Yes vs No	6.030	1.717-21.171	0.005
Type of ND			
MRND or RND vs SND	3.793	0.959-15.010	0.057

ND: neck dissection; SND: selective neck dissection; MRND: modified radical neck dissection; RND: radical neck dissection; ChRT: ChemoRadiation therapy.

Table V. Individual patient probability (IPP) for major wound complications according to the type of neck dissection andChRT.

	No ChRT	ChRT
SND	2%	7.9%
RND/MRND	12%	34.1%

SND: selective neck dissection; MRND: modified radical neck dissection; RND: radical neck dissection; ChRT: ChemoRadiation therapy.

Discussion

Approximately 20% of patients in the present series experienced postoperative wound complications. Most of the variables considered, such as anticoagulant therapy, diabetes, concomitant surgical procedure, cN and pN status and nodal extracapsular spread, were not associated with wound complications. In the case of cN+ status, the p value was close to significance (0.06). This is probably related to the more extensive neck dissection performed in the group with clinical pathological nodal disease. In particular, 85.5% of the cN+ patients versus 14.5% of the cN- patients underwent an RND/MRND.

Multivariate analysis [2-8] showed that previous concurrent CRT for head and neck tumours (OR = 6) and type of neck dissection (OR = 3.7) were associated with a high risk of wound complications. At present, only a few studies have reported the rate of local postoperative complications after neck dissection [3-7]. Published data on the association between RT or CRT and wound complications are discordant, with the reported incidence of wound complications after CRT varying from 3% to 61% [2 9-11]. Some authors have reported that they have not found any significant differences in terms of complications between groups of patients who were or were not submitted to preoperative RT or CRT [12-14]. Others assumed that CRT should be considered a risk factor for wound complications. Davidson [8] observed the following wound complications: full-thickness necrosis, facial swelling, chyle fistula, seroma, marginal nerve injury, haematoma and suture abscess in 9 of 41 (22%) patients treated with planned neck dissection (PND). In the case series reported by Reza-Nouraei [9], PND caused 8 out of 49 (20%) significant complications, resulting in swallowing and breathing deterioration, wound infection with bleeding, and shoulder morbidity requiring an Eden-Lange procedure. Maran et al. [10] reported data on a series of 394 neck dissections mostly associated with surgical resection of the primary tumour. The authors noted a higher risk of wound breakdown in previously irradiated patients (25%) versus the untreated group (5%).

The present study confirmed that CRT is a risk factor for major wound complications. The higher complication rate usually observed in previously chemo-irradiated patients was due to the tissue response to radiation. Currently, normal tissue reaction to radiotherapy is regarded as a dynamic and progressive process with individual differences due to genetic variations leading to problems with wound-healing [15-16]. Radiotherapy activates a different wound-healing process from that of normal wound healing, causing an excessive deposition of extracellular matrix and collagen that is characteristic of radiation fibrosis. Furthermore, radiation also induces vascular damage, and the above-mentioned remodelled tissue can lead to tissue hypoxia, perpetuating a fibrogenic response [16]. This tissue alteration determines a delayed and altered wound-healing process after surgery compared to that of normal tissue. Patients due to undergo a PND after RT or CRT should be informed about the increased risk of the procedure.
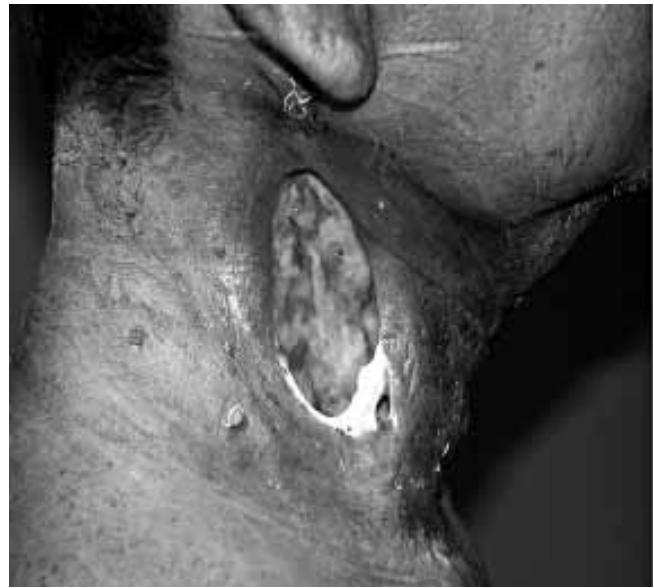
Fig. 1. Wound dehiscence after a bi-flapped incision.

Fig. 2. Wound dehiscence after a tri-flapped incision.

The type of neck dissection was associated with major wound complications. The OR for major wound complications was 3.7-fold higher in the case of MRND or RND than in the case of SND, and this could be correlated to the wider surgical field resulting from the more extensive procedures. In addition, MRND and RND were performed via a tri-flapped incision, while a bi-flapped incision was adopted for SND. It can be assumed that the use of 3 flaps results in reduced vascularization at the periphery of the skin followed by ischaemia, which may explain the higher incidence of skin-flap necrosis or dehiscence. In any case, all the RND/MRND procedures in the present study were associated with a 3-flap incision, and further studies are needed to assess if these complications can be avoided by the use of a 2-flap incision for the same type of neck dissection. The nomenclature adopted in this study for ND is accepted worldwide, even if it may deserve revision as reported by many authors [17].

However, the present result differs from others published in the literature. Davidson et al. noted that the type of ND did not alter the rate of complications [8]. Similarly, wound or systemic complications did not correlate with preoperative haemoglobin level, haematocrit, white blood cell or platelet count [8]. Our study could not confirm any association between preoperative blood values and the occurrence of complications.

All complications were successfully treated after medication and/or surgical revision. Wound dehiscence was the most frequent major complication and 3 out of 8 cases required a pedicled flap for repair. Tissue transfer can be considered for repair in case of wound dehiscence after neck dissection. We preferred to use a pedicled flap in those cases who previously had CRT in order to have the tissue as best oxygenated as possible. The major pectoralis pedicled flap was the first choice due to the lower distance to the recipient site and the satisfactory aesthetic results. Thus, we suggest that wound complications are curable but with considerable cost in terms of both time and resources. After the present study, we consider as routine the use of a pedicled flap at the time of RND after CRT therapy in order to reduce the complication rate.

Minor wound complications associated with neck dissection were not evaluated with a two-sided chi-square test, two-sided Fisher's exact test or multivariate analysis due to the low number of cases. Nonetheless, some conclusions can be drawn from the descriptive statistics: minor complications were present in patients with all the analyzed variables, and in particular, 10 cases (12.8%) without concurrent CRT showed minor wound complications compared to 0 cases in the group with concurrent CRT. This data should be interpreted taking into consideration that major complications occurred in 24.4% of patients with concurrent CRT, but only in 5.1% of cases without CRT. Similarly, minor complications were higher in pa-

tients who underwent SND (12.5%) than in those treated with RND or MRND (4.8%), while major complications were 5.4% versus 17.5%, respectively.

Conclusions

Preoperative CRT, and RND or MRND with a 3-flap incision, are risk factors for major wound complications in patients undergoing neck dissection. It can be assumed that IPP for major complications is 2% for patients undergoing SND without CRT. IPP for wound complications for patients treated with RND/MRND without CRT was 7.9% and for wound complications for patients treated by SND with CRT was 12%. Furthermore, the probability of wound complications for patients treated with RND/MRND and CRT was not additive but synergistic (34.1%). Patients who are candidates for neck dissection after CRT therapy and/or who require neck dissection that is more extensive than SND should be informed about the increased risks of the procedure. The rate of major complications might be reduced by using a bi-flapped incision in place of a tri-flapped incision.

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