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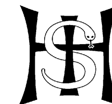

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Infection control practices and infectious complications in dermatological surgery

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Summary The aim of this study was to assess infection control practices and their impact upon infectious complications in skin surgery conducted by private dermatologists. A prospective study was carried out by 73 volunteers belonging to the Surgical Group of the Société Française de Dermatologie over a period of three months. Data were collected for surgical procedures performed during this period, including the excision of all benign or malignant tumours, but excluding sebaceous cysts and pyodermas. A total of 3491 dermatological surgical procedures were included in the survey. Post-operative infections occurred in 67 patients (1.9%), with superficial suppuration accounting for 92.5% of surgical site infections. The incidence was higher in the excision group with a reconstructive procedure (4.3%) than in excisions alone (1.6%). Infection control precautions varied according to the site of procedure; multivariate analysis showed that haemorrhagic complications were an independent factor for infection in both types of surgical procedure. The male gender, immunosuppressive therapy and not wearing sterile gloves were independent factors for infections occurring following excisions with reconstruction. Not all of the procedures needed the use of a hospital theatre. It is clear that for excisions with a reconstructive procedure or for certain anatomical sites, such as the nose, there should be more emphasis upon infection control precautions. Further studies are needed to establish optimal guidelines for this kind of surgery.
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Introduction

Dermatologists have expanded their practice to include surgical procedures in response to the development of cutaneous tumours related to ageing. Surgery performed by dermatologists on an outpatient basis under local anaesthesia is less costly than other more complex options and has become the treatment of choice for certain cutaneous malignancies.[1,2] It is unclear what resources are currently available for this and there is little information about the complications which could follow this kind of surgery. We conducted a prospective study in order to investigate this. Part of this study, dealing with the incidence of complications associated with dermatological surgery, has been published previously.[3] The main objective of the current paper, was to assess infection control practices and any association with infectious complications in skin surgery, conducted by dermatologists in private as well as hospital settings.

Methods

A prospective study was carried out among 73 volunteers from 130 dermatologists belonging to the Surgical Group of the Société Française de Dermatologie from 1 December 2002 to 28 February 2003. Data were collected for all consecutive surgical procedures performed during this period, including excisions of benign or malignant tumours but excluding sebaceous cysts (because most of them are already infected). Each dermatologist confirmed in writing that he/she would include all consecutive procedures carried out during the study period. Surgery accounted for $<25\%$ of the overall procedures for 64% of these dermatologists, $<50\%$ for 20%, and $>50\%$ of the overall procedures for 14%. For each surgical procedure, the survey collected information about the patient, the surgical procedure itself, the infection control measures and any post-operative infections. Patient characteristics associated with an increased risk of surgical complications were also collected, e.g. gender, age, diabetes mellitus, immunosuppressive therapy, administration of anti-aggregating or anticoagulant treatment, and antibiotic treatment prior to surgery or as surgical prophylaxis. The surgical procedures were classified into two groups: simple excisions with suture (with an overall scar of <2 cm or with an overall scar >2 cm) and excisions with a reconstructive procedure (including full skin graft and skin flap). The anatomical site of the procedure was categorized according to three sites (head and neck, trunk, limbs). The duration of each procedure was also recorded.

Surgical site infection was classified as superficial suppuration, abscess or systemic infection. The patients were followed up to the suture removal visit. A haemorrhagic complication was defined as uncontrolled bleeding during or immediately after surgery or subsequent haematoma.

The site (private office or hospital setting) and type of room where the procedure was performed (an examination room, a specially designated room for surgical procedure or hospital operating theatre) were recorded. The infection control precautions under which the procedure was performed were noted: management of surgical instruments (dry-heat sterilization, moist heat autoclave, chemical disinfection or use of disposable instruments); use of sterile gloves, drapes, gown or mask; antiseptic agents used for the preparation of the surgical site and any prophylactic antibiotic treatment.

Statistical analyses

Data were entered using Epi-Info software, version 6.04d and analysed using Stata software, version 7 for Windows. Categorical variables were compared using Chi-squared test or using Yates' corrected Chi-squared test, if the theoretical numbers were between three and five, and Fisher's exact test if the theoretical numbers were lower. Continuous variables were compared using the non-parametric Wilcoxon test. The study included a descriptive analysis, univariate analysis of factors associated with infectious complications and a multivariate analysis by logistic regression (in a backward stepwise approach). Independent factors associated with an infectious complication were studied for each type of surgical procedure. The variables were kept in the multivariate model if they remained significantly associated with infectious complications after adjustment for other factors in the model ($P < 0.05$).

Results

A total of 3491 dermatological surgical procedures were performed during the three-month survey, from an average of 45 (range 29–70) patients recorded by each dermatologist. The age of the patients ranged from 13 to 91 years with a mean of 51.4 years. Patient characteristics are shown in Table I.

Table I Characteristics of the patients included

Characteristics	Yes *N* (%)	No *N* (%)
Male gender	1575 (45.1)	1916 (54.9)
Anticoagulant treatment	91 (2.6)	3400 (97.4)
Anti-aggregant treatment	213 (6.1)	3278 (93.9)
Immunosuppressive treatment	57 (1.6)	3434 (98.4)
Antibiotics for previous infection	26 (0.7)	3465 (99.3)
Diabetes mellitus	95 (2.7)	3396 (97.3)

The surgical procedures were classified as follows: 87.9% of simple excisions with suture [1721 with an overall scar of <2 cm (49.3%) and 1350 with an overall scar >2 cm (38.7%)] and 12.1% of excisions with a reconstructive procedure [41 full skin grafts (1.2%) and 379 skin flaps (10.8%)]. Face and neck were the predominant anatomical locations with 1905 surgical procedures performed in this area (54.5%) (including 106 noses). A total of 979 surgical procedures concerned the trunk (28%) and 599 involved limbs (17.2%). The average follow-up period was 10 days, irrespective of the type of surgical procedure. The mean duration of procedures varied significantly according to type [simple excisions: 20.1 min (range: 8–60), and excisions with a reconstructive procedure: 45.8 min (range: 15–70)]. Haemorrhagic complications occurred in 86 (2.5%) surgical procedures, more frequently in reconstructions (7.1%) than in simple excisions (1.8%) ($P < 0.05$).

Most of the procedures ($N = 2584$) were performed in a private office, 64% of them were in the examination room and 36% were in a specially designated room. Of the 907 surgical procedures performed in a hospital setting, 18.5% were in the examination room, 63% were in a specially designated room and 18.5% in an operating theatre. In all, 77.5% of the simple excisions and 48.1% of excisions with a reconstructive procedure were performed in a private office. For the surgical procedures not performed in an operating theatre, dermatologists used sterile consumables more frequently for skin grafts or skin flaps than in the simple excisions, and more frequently in hospital settings than in private offices, whatever the type of procedure (Table II).

The use of disposable instruments was rare: 1.7% in private offices and 0.8% in hospital settings. In private offices, the management of instruments comprised dry-heat sterilization for 1383 (53.5%), surgical procedures and moist heat autoclave for 1152 (44.5%), whereas in hospital settings, autoclave use was predominant. The antiseptic agent used for surgical site preparation was an alcoholic solution of chlorhexidine gluconate for 66.3% of patients. Antibiotic prophylaxis was prescribed for 67 patients (1.9%), more frequently in immunocompromised patients (12.5 vs 1.7%; $P < 0.05$) and patients with diabetes mellitus (6.4 vs 1.8%; $P < 0.05$), or when a reconstructive procedure was performed (6 vs 1.4%; $P < 0.05$).

Post-operative infection occurred in 67 patients (1.9%), with a mean of 6.3 days (2–12 days) between the procedure and the onset of the first signs. Superficial suppuration accounted for 94% of surgical site infections (SSIs), while four SSIs (5.9%) were classified as abscess. Antibiotic treatment was prescribed for SSIs in 15 of 67 patients (22.4%). Infections occurred more frequently in the excisions group with a reconstructive procedure (4.3%) than in the simple excisions group (1.6%) [odds ratio (OR): 2.75; 95% confidence interval (CI): 1.58–4.78; $P < 0.001$]. Of 106 nose- or nostril-located surgery, three cases of SSI occurred (2.8%).

Infectious complications were more frequently associated with the type of surgical procedure, the male gender and immunosuppression. Longer duration of surgery was associated with infections in the excision with reconstruction group [median 60 (range: 20–99) vs 45 (range: 15–90); $P < 0.001$]. After stratifying the type of surgical procedure, only haemorrhagic complications were associated

Table II Infection control practices

	Private office ($N = 2584$)		Hospital ($N = 907$)	
	Simple excision ($N = 2382$)	Reconstructive procedure ($N = 202$)	Simple excision ($N = 689$)	Reconstructive procedure ($N = 218$)
Sterile gloves ($N = 2582$)	67.5	83.7	83.7	99.4
Sterile drape ($N = 2403$)	60.9	82.7	80.7	97.6
Mask ($N = 860$)	11.7	37.6	40.9	70.9
Sterile gown ($N = 133$)	0.08	1.5	4.1	28.3

All values are percentages.

with infection occurring after simple excisions [SSI in five of 56 haemorrhagic complications (8.9%) and 44 SSI of 3007 surgical procedures without haemorrhagic complications (1.5%); $P = 0.002$]. For the group of excisions with a reconstructive procedure, other factors were associated with infections: male gender, immunosuppressant treatment and non-use of sterile gloves.

The incidence of infection occurring in the group of excisions with a reconstructive procedure was 14.7% when sterile gloves were not used and 3.4% with sterile gloves ($P < 0.001$). No link was observed in the simple excisions group between infectious complications and the wearing of sterile gloves (1.7% without and 1.6% with gloves). The frequency of surgical site infection was not significantly different for procedures performed in offices or in hospitals; for simple excision procedures, 1.6 vs 1.6% respectively, and for excisions with reconstruction, 5.9 vs 2.7% respectively. When the dermatologist wore sterile gloves, the incidence of infectious complications did not differ if the surgical procedure was performed in a private office (1.8%) or in a hospital setting (1.8%).

The results of the multiple logistic regression model showed that only one factor remained significant for infections occurring in the simple excisions group. Patients with a haemorrhagic complication were six times more likely to develop an SSI than patients without (OR: 6.6; 95% CI: 2.52–17.3; $P < 0.001$). Multivariate analysis by logistic regression identified the male gender, immunosuppression, not wearing sterile gloves and haemorrhage as independent factors for infections occurring after excisions with a reconstructive procedure (Table III).

No link was established between the occurring infectious complication and the type of room where the surgical procedure was performed, nor with the other conditions that were studied.

Discussion

Many dermatologists now offer surgery for tumour excision.[1] However, there have been very few studies of the incidence of infections associated with dermatological surgery.[4] In this study, we have shown that the infection rate for these procedures is 1.9%. This includes minor superficial suppuration requiring additional antibiotic treatment, accounting for 15 cases out of 3491, i.e. 0.4%. The incidence was higher for excisions with a reconstructive procedure. Infections following dermatological surgery have been rarely reported; toxic shock syndrome and necrotizing fasciitis have been described after excision of a malignant melanoma.[5,6] In a published series, the rate of infectious complications varied.[7–9] It was difficult to compare our data with others because different surveillance methods were used but also because of varying surgical techniques according to the practitioner. Our data were provided by dermatologists from the Surgical Group of the Société Française de Dermatologie who have received specific surgical training on excisions with a reconstructive procedure. This choice could bias the findings, but it did enable us to include a larger number of procedures during the study period and more homogeneous surgical techniques. An infection rate of 7.6% was reported by a German team, who carried out a prospective study at a university medical

Table III Logistic regression analysis odds ratios (OR) and 95% confidence intervals (CI) for infectious complications following excisions with reconstruction procedure

Variables	Incidence of infections (%)	Unadjusted		Adjusted[a]	
		OR	*P*-value (95% CI)	OR	*P*-value (95% CI)
Male gender					
No	1.1	1	0.008	1	0.035
Yes	6.3	5.96	(1.32–26.9)	5.46	(1.12–26.54)
Immunosuppressive treatment					
No	3.2	1	<0.001	1	0.008
Yes	29.4	12.5	(3.68–42.43)	9.99	(1.83–54.3)
Haemorrhagic complication					
No	2.6	1	<0.001	1	0.000
Yes	26.6	13.81	(4.70–40.58)	11.29	(3.43–37.16)
Wearing sterile gloves					
No	14.7	1	0.001	1	0.009
Yes	3.4	0.20	(0.06–0.61)	0.18	(0.05–0.65)

[a] Adjusted for all other variables shown in the table.

centre, focusing on 1450 patients.[7] The lower infection rate observed in our study may be due to under-reporting of infections related to the duration of follow-up. Infections arising after suture removal would have been missed. However, a link between the surgical procedure and these infections would have been difficult to establish. A prospective study, assessing the incidence and nature of the complications associated with Mohs micrographic surgery, focused on 1358 procedures for skin cancers; the incidence of complications was 1.6%.[8] In a retrospective study, the infection rate in 1047 outpatients receiving dermatological surgery was 2.3%, and patients who received antibiotic prophylaxis were excluded from the trial. In the study on Mohs surgery, the mean area of the infected defects was twice that of the non-infected group and procedures performed on the ear were found to have a higher rate of wound infections.[9] We found no difference in the incidence of infectious complications between the two types of simple excision surgical procedures with an overall scar of <2 cm or with a scar >2 cm.

The infection rate for procedures performed on the nose or nostril location was higher than other anatomical locations. It is known that certain anatomical areas such as the ear or facial region, have a higher risk of developing a wound infection.[9–11] Furthermore, a longer procedure duration led to a greater risk of infections in accordance with other reports.[12]

Infection control practices varied according to the place where the procedure was performed, with the type of procedure and with patient characteristics. These results suggest a need for infection control guidelines in this area. Excisions with a reconstruction procedure, or patients with pre-existing infection risks led to greater use of sterile disposable single use equipment. There was a significantly higher risk of infectious complications when no sterile gloves were worn for excisions with a reconstructive procedure, even after controlling for other factors. There is no published evidence that dermatological surgical procedures are riskier when carried out in a private office as opposed to a hospital setting. Furthermore, little is known about the sterile conditions required for this surgery.[13–15]

No link was established between post-operative infection and antibiotic prophylaxis. In the majority of procedures, antibiotic prophylaxis is not needed because the overall incidence of infection is low and rarely serious.[16,17] However, Haas and Grekin recommended that dermatologists consider prophylaxis for patients who have cardiac anomalies, prosthetic devices or are immunosuppressed but there is no evidence that prophylaxis would decrease the rate of infections after cutaneous surgery.[18] Further investigation appears to be necessary before a definitive recommendation can be made for or against antibiotic administration in this context.

This study has provided a first estimate of the incidence of infectious complications associated with dermatological surgery among French practices. A controlled trial is needed to confirm that the infection risks in dermatological surgery carried out in a private office as opposed to a hospital setting are no different. Hospital theatres are not required for all these procedures. Nevertheless, it is clear that excisions with a reconstructive procedure, or certain anatomical sites such as the nose, may require stricter infection control precautions.

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