1960

Review of chemosurgery in treatment of skin carcinoma

Willis Philip Mundt
University of Nebraska Medical Center

REVIEW OF CHEMOSURGERY IN TREATMENT OF SKIN CARCINOMA

Willis Philip Mundt

Submitted in Partial Fulfillment for the Degree of
Doctor of Medicine

College of Medicine, University of Nebraska

April 1, 1960

Omaha, Nebraska

TABLE OF CONTENTS

INTRODUCTION

This thesis is a review of the surgical technique developed by F. E. Mohs, M.D., at University of Wisconsin Medical School[1-2] for treatment of carcinoma of the skin. The objective is to describe the technique and to show it to be a sound and practical method, acceptable in the treatment of carcinoma.

The Mohs procedure is often confused with therapy practiced at the Dr. Nichols Cancer Sanatorium at Savannah, Missouri[3]. Because of this confusion the Nichols' technique will be discussed and differentiated from the Mohs procedure.

The term "chemosurgery" was coined by Dr. Mohs[1] to indicate that the tissues are chemically treated and then surgically excised. Mohs regrets that the term, as used by him, does not include the conotation of microscopically controlled excision. Yet the term "chemomicrosurgery" he felt was too cumbersome. It should be understood that basically the Mohs procedure entails fixation of the tissue in situ by zinc chloride, followed by systematic excision. The excised tissue is completely examined microscopically for the presence or absence of carcinoma. The microscopic examination is the essential part of the procedure and differentiates it from other methods employing the use of escharotics.

In reviewing the literature for work published on chemosurgery only five references[13-17] other than those of Mohs' are found. Mohs' own work is completely summarized and reviewed in a book[1],

Chemosurgery in Cancer, Gangrene, and Infection. In the August, 1958, volume of Surgical Clinics of North America[2], Dr. Mohs brings his experience up to date.

HISTORICAL NOTE

Various types of caustic pastes and escharotic agents have been used in the treatment of cancer since ancient times. The Egyptians used various caustic pastes composed of arsenical and mercurial compounds. The most widely used of all chemicals has been zinc chloride in one form or another. William Bainbridge[4] in his 1914 review of the treatment of cancer mentions the Dr. Fell treatment which was in vogue in England in 1857. This involved the application of a zinc chloride paste to the lesion. During this same period two Welsh farmers also had a "cancer cure" employing a caustic to remove tumor growths. This caustic was a zinc chloride compound. Zinc chloride pastes have been frequently used in numerous so called "cancer cures".

Mohs[1] first used zinc chloride in 1932 while a medical student. A research project was being carried out to compare inflammatory reaction in cancer tissue with that of normal tissue. Inadvertantly a 20% solution of zinc chloride was injected into a rat. Fixation and death of the tissue resulted. When the tissue was examined microscopically it was found that curiously enough, the chemical had acted to fix the tissue in situ exactly as formalin would have done to a bottled specimen. This observation later led

to the development of the chemosurgical technique with its pre-excisional fixation of tissue.

THE SAVANNAH, MISSOURI ESCHAROTIC METHOD

The Dr. Nichols Clinic in Savannah, Missouri has enjoyed a great popularity among the lay public in the treatment of cancer. As previously stated, the method is frequently confused with the Mohs treatment. The Nichols' technique[3] involves the application of a mercurial escharotic to the cancerous lesion. After the caustic has destroyed an area sufficiently large enough to probably encompass the tumor, the necrotic tissue is removed by curettage. The extent of the tumor is judged by the feel of the curet. When normal tissue is thought to be reached, a poultice is applied until all remaining necrotic tissue has sloughed out. This leaves a base of normal tissue which then heals. No microscopic guidance is utilized.

THE CHEMOSURGERY TECHNIQUE OF MOHS

The method developed by Dr. Mohs[1-2], is basically a microscopically controlled excision. It consists of three essential procedures: 1) chemical fixation in situ of the tissues suspected of being neoplastic; 2) excision of a layer of the fixed tissue; 3) systematic microscopic examination of the excised layer as a guide to further treatment.

Prior to using the in situ fixative paste on human patients, Mohs[1] ran a series of experiments on rats to determine if the fixa-

tive would increase the tendency for metastases to occur. It was found that the tendency for metastasis was markedly reduced. In a control group of untreated rats metastases occurred in 41.5%. In the group treated with the fixative paste, the rate was 27.8%.

To save time prior to the application of the fixative paste, the main body of the neoplasm may be removed by scalpel and/or the electrosurgical unit. That part of the neoplasm which is grossly evident is removed, leaving a saucerized surface.

Next a saturated solution of zinc chloride is applied to produce in situ fixation. In Mohs' experience it was found that the most convenient vehicle was in the form of a paste. The formula used is a combination of Stibinite (80 mesh seive) 40.0 grams, Sanguinaria canadensis 10.0 grams, and 34.5 c.c. of saturated zinc chloride solution. This paste adequately holds the zinc chloride in place on the wound, allowing it to gradually permeate the underlying area.

When the tumor is not previously excised surgically, the area is prepared by applying either dichloracetic or trichloracetic acid to make the keratin layer permeable to the fixative. The indication that the keratin layer has been penetrated by the acid is signaled by a whitening of the skin.

Following the preparation of the area, either by previous surgery or by the keratolytic, the zinc chloride paste is applied in a layer of 1-2 mm. This is an average amount and will fix the tissue

to a depth of approximately 2 mm.

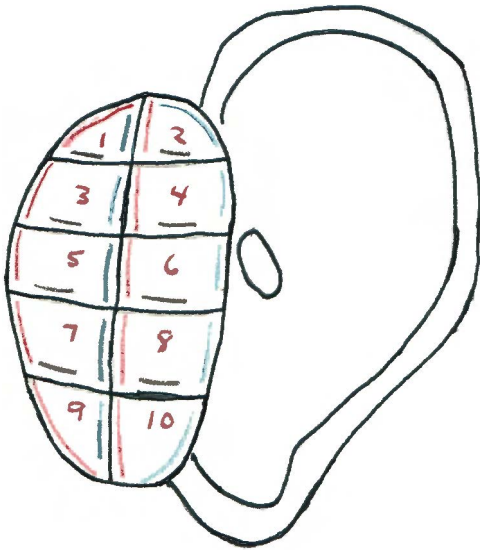
An occlusive dressing is then applied to the area. A thin layer of cotton is first used to hold the fixative in place. This is then covered with an overlapping dressing of cotton whose undersurface is spread with petrolatum in order to make the enclosure air tight. The entire dressing is covered by waterproof tape. This prevents drying of the paste.

The following day the layer of fixed tissue is excised. This is painless and bloodless as the excision is made only through killed and fixed tissue. If there is sufficient cancer present to be recognized grossly, fixative is immediately reapplied to the area. The cancerous area is recognized by its whitish color and friable consistancy. The fixative paste is left in place for a varying length of time, depending on what the operator feels is necessary for penetration, usually another 24 hours.

During excision of the second layer of fixed tissue a systematic microscopic examination of the entire area is performed. This is the most important part of the procedure and is accomplished by frozen section. The layer of tissue is divided into sections approximately 1 cm. square and the sections so prepared that the entire undersurface of the lesion is examined microscopically.

In order that the origin of each specimen is known, a map of the area is drawn. (Fig. 1) Each section is numbered and its corresponding location is noted on the map. By using colored dyes, the

Fig. 1. Details of Mapping the Lesion.



1. Each section as it is removed is given a number and marked with mercurochrome. The number corresponding to that on the map.

2. The right end of the tissue section is marked with a blue dye (washing bluing).

3. The left edge of the section is marked with a red dye (mercurochrome).

4. The inferior edge is marked with a black dye (India ink).

edges of the sections are identified as right or left, superior or inferior. It is highly important that the sections be completely identified as to location and orientation.

Each section is then placed upside down on the microtome stage so that the under surface of the flat specimen is shaved off to make the microscopic slides. If microscopic examination of these sections reveals cancer, the corresponding point in the immediately subjacent tissue on the patient is presumed to contain cancer. Each section is examined microscopically. As areas of cancer are found, their location is noted on the map. The fixative is then reapplied only to the areas in which cancer was demonstrated. It is this feature that allows selective removal of the neoplasm and maximum conservation of normal tissue. The area is then dressed.

This procedure is repeated until the entire area is microscopically demonstrated to be free of cancer. Since the excisions are under microscopic guidance it is possible to follow out the fine invisible extensions of the tumor which may be missed with the more conventional types of treatment. When the area has been found to be cancer free, there still remains a thin layer of fixed tissue. This is dressed with a double layer of petroleum gauze to prevent drying. Within several days after completion of the treatment the final layer of tissue becomes loose enough so that it may be removed surgically. This separation varies from tissue to tissue. It is more rapid in those areas with a loose connective tissue stroma

than in dense fibrous stroma, being slowest in cartilage and bone. The granulation tissue which remains is highly vascular and is resistant to infection. The wound is usually dressed with scarlet red ointment impregnated gauze. Healing is usually rapid and the tissue defects fill in well.

The necessity for analgesics during the procedure varies from patient to patient and depends somewhat on the size of the lesion. Sometimes aspirin alone will suffice, but usually one of the narcotic agents is employed preoperatively to reduce the discomfort caused by the keratolytic and fixative agents. Following the application of the fixative, aspirin and codeine are usually sufficient to ease the burning sensation most patients feel. In the treatment of large lesions it may be necessary to hospitalize the patients and use morphine or demerol.

In his clinic Mohs employs frozen sections done at the time of surgery for microscopic guidance. As each section is removed and mapped, a frozen section is prepared, the tissue being stained with an H and E stain. The microscopic examination is done immediately while the patient is still in the clinic, so that the location of cancerous areas may be determined and promptly retreated with the fixative. Mohs stresses that the success of the chemosurgical technique hinges on the microscopic examination and identification of the carcinomatous extensions.

VARIATION EMPLOYED AT NEBRASKA UNIVERSITY HOSPITAL

At the University of Nebraska College of Medicine a variation of Mohs' technique has been adopted[5]. Frozen sections are not used because of inexperience with the technique and attendant technical difficulties. Instead, the sections removed are prepared with the standard H and E paraffin block technique.

For example, the fixative paste is applied to an area and allowed to remain for 24 hours. The fixed tissue is then removed and sent to the pathology department for microscopic examination of the underside of the lesion. Paste is usually reapplied immediately to the area under treatment. Other than performing paraffin sections routinely rather than frozen sections, the method is identical to that of Mohs. The tissues are sectioned as previously described. All tissues removed are carefully mapped.

RESULTS OF CHEMOSURGERY AT UNIVERSITY OF WISCONSIN

Mohs' main area of therapy has been in the treatment of basal and squamous cell carcinomas of the skin. He reports one series of 1,554 patients from 1939-1950. A summary of this series is given in tables I, IA, II, and IIA.

Table I includes all cases with histologically proven basal cell carcinoma of the skin. Of the 1,071 cases, 34.1% were treatment failures from previous surgical and/or radiologic treatment. The indeterminate group includes those patients either dead or lost from observation prior to five years following treatment.

Table I. BASAL CELL CARCINOMA

Total number of cases	1,071
Total number indeterminate group	289
Dead from other causes without recurrence	260
Lost from observation without recurrence	29
Total number determinate group	782
Total unsuccessful results	14
Patients dead, cancer present at death	11
Patients lost from observation with cancer	3
Patients living with cancer	0
Successful results, patients free from cancer five years or more	768
Five year cure rate--$\frac{768}{782}$ X 100	98.2%

Table IA gives a distribution of the lesions as to anatomical site.

Table IA. BASAL CELL CARCINOMA DISTRIBUTION

Site	Number Lesions	Success	% Cure
Face and Head	338	338	100.0
Nose	217	212	97.7
Ear	52	49	94.2
Eyelid	91	85	93.4
Extremities and Trunk	84	84	100.0
Totals	782	768	98.2

Table II includes all cases of histologically proven squamous cell carcinoma. The lesions ranged from early to advanced and included those with previous surgical or radiation treatment. In 12.4% metastases were present when first seen.

Table II. SQUAMOUS CELL CARCINOMA

Total number of cases	483
Total number indeterminate group	127
Dead from other causes without recurrence	124
Lost from observation without recurrence	3
Total number determinate group	356
Total unsuccessful results	54
Patients dead, cancer present at death	44
Patients lost from observation with cancer	10
Patients living with cancer	0
Successful results, patients free from cancer five years or more	302
Five year cure rate--$\frac{302}{356}$ X 100	84.8%

Table IIA gives a distribution of the lesions as to anatomical site.

Table IIA. SQUAMOUS CELL CARCINOMA DISTRIBUTION

Site	Number Lesions	Success	% Cure
Face and Head	164	139	84.8
Nose	43	37	86.4
Ear	54	43	79.6
Eyelid	14	13	92.9
Extremities and Trunk	81	70	86.4
Totals	356	302	84.8

In a later publication[2] of 1958, Mohs reports a series of 2,019 patients with basal cell carcinoma of the skin and a five year cure rate of 98.6%. He also reports 869 patients with squamous cell carcinoma and a five year cure rate of 87.8%. In another 533 patients with squamous cell carcinoma of the lip, he reports a five

year cure rate of 92.1%. These figures represent an increased five year cure rate over his previous series. Included in both series are patients who had metastases to regional nodes which were removed by surgical dissection. Again, one third of all patients had had one or more courses of previous treatment by either surgery and/or radiologic means.

Mohs has employed the use of chemosurgery in treating carcinoma in various sites. Twelve intraoral neoplasms were treated by the chemosurgical technique. Results were poor. Three patients with carcinoma of the maxillary sinus were treated. One patient remained cancer free after four years. One patient died of metastases. A third patient died three months after treatment of an undetermined febrile disease with no evidence of recurrence. Eight patients with carcinoma of the larynx were treated. Two were free of recurrence after four years. Most of the neoplasms treated were in advanced stages or had already metastasized. Thirteen cases of carcinoma of the parotid gland have been treated by chemosurgery with a 54.5% five year cure rate. Seven squamous cell carcinomas of the penis have been treated with successful results in five patients. Thirty-four cases of squamous cell carcinoma of the vulva were treated with a five year cure rate of 55.6%. Thirty-one cases of malignant melanoma treated with a five year cure rate of 38.7%. Twenty cases of sarcoma have been treated with five year cure rate of 55.5%.

COMPARATIVE RESULTS IN TREATMENT BASAL AND SQUAMOUS CELL CARCINOMA

Since chemosurgery has been used mainly in the treatment of basal and squamous cell carcinoma of the skin, Mohs' results should be compared with similiar series. A review of the literature reveals only several series approximately as large as those published by Mohs.

Magnussen[6] reported in 1935 a series of 1,343 patients with basal and squamous cell carcinoma of the skin treated by radiologic, surgical, and electrosurgical methods at the Radiumhemmet in Sweden for which the five year cure rate was reported as 82.6%.

In 1952 Magnussen[7] reported a series of 6,128 patients from 1921-1947. Of these 3,104 were indeterminate and 3,024 determinate using Mohs method of statistics. Of the 3,024 determinate cases, 2,648 were free from cancer at the end of five years, with a five year cure rate of 87.6%.

Warren, Simons, and Rea[8] reported on 829 carcinomas of the skin seen at Huntington Hospital in Boston. These were treated with radiation or surgery or a combination of both. They state that most of the cases were diagnosed only clinically and not histologically. Only 84% of the patients were followed for five years and in these a 76% five year cure rate was effected.

McCormick[9] reported 633 patients treated with radiologic and/or surgical means for carcinoma of the skin with a five year cure rate of 77%.

Sharp and Binkley[10] reported on 1,204 patients with skin carcinoma. 983 were followed for five years or more. Of these, 475 were treated surgically and the rest by radiation. Their five year cure rate was 88.9%.

Paterson[11] reports a series of 1,033 basal cell carcinomas and 511 squamous cell carcinomas treated by radiation. He reports a 96% five year cure rate for basal cell carcinoma and 80% for squamous cell carcinoma or a combined cure rate of 90%.

Table III COMPARATIVE FIVE YEAR CURE RATES, BASAL AND SQUAMOUS CELL CARCINOMA

Series	%
Mohs	94.0
Paterson	90.0
Sharp	88.9
Magnussen	87.6
McCormick	77.0
Warren	76.0

As can be seen from Table III, Mohs' results are superior.

CHEMOSURGERY AT THE UNIVERSITY OF NEBRASKA COLLEGE OF MEDICINE

The chemosurgical technique has been used at the University of Nebraska College of Medicine only since 1958. To date, only twelve patients have been treated by this method. Dr. John F. Latenser[12], Associate in Surgery, has been the person primarily interested in this method. Five representative cases from the University of Nebraska College of Medicine are presented.

Case 1. M.Q.

This patient was an 82 year old white male who was first seen

at the University Clinics in January, 1958, with a squamous cell carcinoma of the left ear. This had been treated in the past with X-ray. In February, 1958, the patient was advised to have a surgical excision, but refused. The lesion was treated with electrocautery. In May, 1958, the patient was admitted to University Hospital with a recurrence. On admission the patient had a 3 X 3 cm. lesion on the posterior surface of the left ear and a 1 X 1 cm. lesion on the right ear lobe. The majority of the left ear was removed and a wedge excision of the right ear performed. The sections from the left ear were reported as squamous cell carcinoma, those from the right ear as basal cell carcinoma.

In August, 1958, the patient was seen in tumor clinic with recurrence in the area of the left ear. This was treated with Thio-tepa injections into the tumor. The patient was seen again in September, 1958, and no improvement was noted.

In November, 1958, the patient was readmitted to University Hospital with a fungating mass in the area of the left ear. The mass was excised and revealed recurrent squamous cell carcinoma. At this time it was elected to initiate chemosurgery and the fixative paste was applied. A total of four chemosurgical procedures were performed. The last sections showed a pencil dot sized remanent of tumor in such close proximity to the left carotid artery that the case was terminated for fear of producing thrombosis in the artery.

The patient was readmitted in October, 1959, with a mass in the left neck considered to be metastatic carcinoma to the anterior cervical chain. A radical neck dissection failed to reveal any evidence of residual carcinoma at the site of the original primary. In January, 1960, the patient was readmitted with a 2 cm. firm mass in the left posterior cervical chain. A wide excision was done and revealed metastatic carcinoma.

This illustrates that the intent of the chemosurgical technique is to remove the primary site of disease only; a regional lymph node dissection must be performed to control lymph node disease in event of metastases.

Case 2. M.L.

This patient was a 69 year old white female admitted to University Hospital in January, 1959. The initial diagnosis was recurrent squamous cell carcinoma anterior to the left ear. This had previously been treated with escharotics at the Savannah, Missouri clinic. Also present was a lesion on the left forehead and a third lesion on the anterior tragus of the right ear. The radiology department felt that the lesion on the left ear was too near cartilage for radiation therapy and suggested surgical removal.

Three skin lesions were excised, one from the anterior tragus of the right ear, one from the left forehead, and one from the left ear. Pathological diagnoses were: squamous cell carcinoma of the forehead, completely excised; squamous cell carcinoma of the left

ear, incompletely excised; and basal cell carcinoma of the right ear, completely excised.

It was elected to do chemosurgery and fixative paste was applied. A total of four chemosurgical procedures were performed on the left ear until a tumor free level was reached. A split thickness graft was applied to the area ten days after the final procedure.

The patient was seen again in October, 1959, and a second skin graft performed after all local dead bone had been rongeured away and the bone covered by granulation tissue. Permanent control of the primary tumor was apparently achieved.

Case 3. F.P.

This patient was a 63 year old white male. In 1956, the patient first noted a pimple on the right cheek which gradually increased in size. In March, 1958, a diagnosis of squamous cell carcinoma of the right maxillary sinus was made and treated by antrectomy, removal of the right half of the palate, and removal of the right eye. During May and June of 1958, 6,640 Roentgens in the form of combined X-ray and radium were given, limited to the antral region. In October, 1958, another 5,000 Roentgens were given to the anterior wall of the antral region.

In October, 1958, the patient was admitted to University Hospital where a right radical neck dissection was performed. A single submandibular node proved to be involved. In April, 1959, recurrence

was demonstrated in the original site and chemosurgery begun. Tumor was demonstrated to extend across the floor of the right antrum, across the ligaments of the right temporal-mandibular joint and into the pterygoid fossa. Tumor also extended back along the margin of the hard palate and deeply into the plane of nasolabial fusion fold. In October, 1959, the patient was readmitted with recurrence on the margin of the hard palate. After three chemosurgical procedures no further tumor was demonstrable. The patient was last seen January, 1960, with no evidence of recurrence and was referred for fitting with a prosthesis to cover the defect.

Case 4. L.D.

This patient was a 58 year old white male. In 1939, the patient was struck across the right eyebrow by a heavy cable. Subsequently a lump formed, enlarged, broke down, and was surgically excised and diagnosed as cancer. In 1940, the patient was treated at the Savannah, Missouri clinic for a lesion in this area. Again in 1945, he was treated at Savannah. In 1951, the lesion recurred. In 1953, a local surgeon did an extensive resection of the frontal sinus. That same year the patient received sixty days of irradiation. In 1956, a recurrence in the area was treated with electrofulguration.

The patient was first seen in the University Tumor Clinic in 1958. A diagnosis of recurrent basal cell carcinoma was made. He received eighteen months of treatment with Thio-tepa. In July,

1959, the area was again biopsied and confirmed as a recurrent basal cell carcinoma. Surgery was refused by the patient because this might include removal of the right eye.

He was admitted to University Hospital in January, 1960, with the lesion now involving the right side of the nose, right inner canthus, both nasal turbinates, and the right frontal sinus. Two chemosurgical procedures were carried out, the patient still refusing permission to remove the right eye. The patient requested dismissal for two weeks convalensence with the intention of returning for further chemosurgery.

Case 5. R.C.

This patient was a 38 year old white male admitted to University Hospital in October, 1959, with drainage from the skin over the left maxillary sinus. The patient first noted pain in the left upper jaw in June, 1959. A wisdom tooth was removed. Subsequently a sinus tract formed and the patient was treated by a physcian who drained the left sinus through the left nasal canal. Drainage persisted and the patient was admitted to University Hospital with the tentative diagnosis of tuberculosis of the left maxillary sinus.

X-ray films of the sinus showed lytic areas compatible with a neoplastic process. On November 6, 1959, the patient was taken to the operating room and a biopsy performed, revealing squamous cell carcinoma. A total of thirteen chemosurgical procedures were performed. The last sections removed revealed no carcinoma. The

patient was dismissed January 23, 1960.

On March 7, 1960, the patient was readmitted with recurrence in the pterygoid fossa, posterior wall of the left orbit, and along the cribiform plate. An enlarged node was present in the left submaxillary area.

To date, only cases with recurrent carcinoma have been treated at the University of Nebraska Hospital by means of chemosurgery. The chemosurgical method has been employed as a last resort. Since none of the patients have been followed for more than two years, no valid conclusions can be drawn as to the results obtained.

DISCUSSION

Only five authors other than Mohs have reported working with chemosurgery. Eckblad[13] reports eight representative cases from a series of twenty-five. None were followed for five years and most cases when first treated by Eckblad were recurrent basal or squamous cell carcinomas. Similarly, Laubenheimer[14] discusses three cases of recurrent basal cell carcinoma treated by the chemosurgical technique. Lunsford[15] discusses thirty-six cases of skin carcinoma treated by chemosurgery. Shepard[16] reports on seven representative cases from Stanford using chemosurgery. Most of these were recurrent basal or squamous cell carcinomas. Szujewski[17] reports using chemosurgery for one case of recurrent basal cell carcinoma. All the authors were pleased with their results and enthusiastic over the method. None of them were able to report five year cure rates

as the majority of their patients had been followed only one or two years.

Chemosurgery has many advantages. The unmatched five year cure rate attests to its reliability. The conservation of tissue which is possible is of critical importance when removing lesions on the face, particularly of the nose and ears. Only 1-2 mm. of uninvolved tissue need be removed beyond the furtherest extent of the carcinoma. This is possible and safe because of the microscopic guidance. Plastic repair, when indicated, need not be as extensive as when it follows a more mutilating procedure. Furthermore, because of the reliability, plastic repair may be begun earlier without the fear of recurrence. The plastic surgeon[18] also prefers to work with these cases because of the more pliable and vascular tissue following chemosurgery contrasted with post irradiation cases.

Chemosurgery also extends operability to those patients who have not responded to the usual surgical or radiological techniques. Many patients formerly considered hopeless have been salvaged by the use of chemosurgery.

The operative mortality in chemosurgery is quite low. Mohs[1] reports only 0.3% in his series. The use of predominately local anesthesia in this group of patients who are usually of advanced age drastically lowers the mortality. Blood loss during the procedure is minimal. The tissue remaining after removal of the fixed tissue is well vascularized, healthy, and markedly resistant to infection.

There are disadvantages and limitations to chemosurgery. The area to be treated must be accessible, which limits its use to external body surfaces. The major objection raised to chemosurgery is the length of time needed to remove a lesion because of the many separate procedures involved, especially in the larger more complicated cases. Furthermore the method with its microscopic control requires meticulous attention to details. In view of the reliability and conservation of tissue obtained, the effort would seem worth while. Preparation of the frozen sections also presents a technical difficulty which can be solved only by experience.

The time needed to perform chemosurgery can be shortened with use of the proper facilities. Mohs has a small clinic devoted entirely to chemosurgery. He employes one full time and one part time technician to prepare the frozen sections. This greatly speeds up the process. The tissue removed is read within 15-30 minutes, enabling the surgeon to decide whether or not more tissue needs to be removed or whether the area is cancer free. Many times Mohs will perform two complete procedures in the same area in one day. The majority of his patients are handled on an out-patient basis which sharply cuts the overall cost of surgical care.

Mohs is the first to state that even though chemosurgery as described sounds fairly simple, experience and training in the procedure is necessary to obtain good results. By experience the operator learns how far the fixative will penetrate, how to excise

the specimens en bloc to facilitate the microscopic examination, and how to read the microscopic frozen sections.

SUMMARY

The chemosurgical technique as developed by Dr. F. E. Mohs has been presented, reviewed, and the results compared with the standard methods of treatment.

The method of Mohs is not to be confused with that practiced at the Savannah, Missouri clinic, where escharotic pastes are applied to areas of suspected tumor and the resulting necrotic areas removed by curetage. At no time is microscopic guidance utilized.

Mohs' technique employes the use of a zinc chloride paste. This paste is applied to the area to be treated and fixes the tissues in situ. The fixed tissue is then removed in segments of convenient size for making frozen sections. Each section is labeled to locate it on a map of the area.

The fixed tissue is then subjected to a microscopic examination which includes the undersurface and periphery of all the tissue removed. Cancerous areas are noted on the map and the fixative paste is then reapplied to those areas. The procedure is repeated until no microscopic evidence of carcinoma is found. In this manner all microscopic extensions of the cancer are followed out and removed.

In a series of over 1,500 patients with basal and squamous cell carcinoma of the skin, Mohs has achieved a five year cure rate

of 94.0% in spite of the fact that one third of the patients were treatment failures following standard surgical and/or radiologic treatment.

Five comparative series of patients treated for basal and squamous cell carcinoma by standard surgical and/or radiologic means have been presented. Five year cure rates ranged from 90.0% to 76.0%.

The use of chemosurgery at the University of Nebraska College of Medicine has been discussed and five representative cases presented. No five year cures can be reported since the patients have been followed for less than two years.

Five other authors' results in the use of chemosurgery has been presented. Their patients, too, have been followed for only one to two years. The majority of their cases were also recurrent carcinomas.

The advantages of chemosurgery have been presented. Foremost is the degree of reliability which is shown by the superior five year cure rate. Conservation of tissue is obtained, no wide resections being necessary because of the microscopic control. Blood loss is minimal and operative mortality low.

The disadvantages of chemosurgery include the increased length of time and the increased amount of pain in the larger more complicated cases. However, these cases are precisely the cases in greatest need of the protection afforded by the technique. Preparing

the microscopic sections creates a problem which can only be overcome by practice.

CONCLUSION

Mohs has created an alternate means of attack on the problem of basal cell and squamous cell carcinoma, useful for either early primary cases, advanced cases and recurrent cases. Judging from the paucity of the reports in the literature, the method is being neglected.

There are some who would classify Mohs' technique as merely another form of the age old escharotic method. However, Ackerman and del Regato[19] have this to say: "Mohs raised the escharotics from their indiscriminate use by quacks to a scientific level. By pains taking, plane by plane, histopathologic control, and by tracing the remaining areas to be treated, Mohs has succeeded in curing rather notable cases of carcinoma of the skin."

Sutton[20] has this to say in reference to Mohs' procedure: "I judge it an error of policy to chase a tumor from the middle outward." In reply, Mohs' results speak for themselves. His five year cure rate for basal cell carcinoma of the skin is 98.6%. The best five year cure rate, using standard methods of treatment, reported in the literature[11] is only 96.0%. In the treatment of squamous cell carcinoma Mohs' five year cure rate is 87.8%. The best five year cure rate with standard techniques is only 80.0%.

With the results obtainable, chemosurgery is an invaluable

addition to the armamentarium already existing for treatment of carcinoma. One can only hope for more wide spread use than exists at present.

Acknowledgement must be given to Dr. Donald M. Fitch and to Dr. John F. Latenser for the advice, encouragement, and aid rendered in preparation of this thesis.

BIBLIOGRAPHY

1. Mohs, F. E., Chemosurgery in Cancer, Gangrene, and Infection, Springfield, Ill., Charles C. Thomas, 1956.

2. Mohs, F. E., Chemosurgical Treatment of Cancer of Face and Lips: A Microscopically Controlled Method of Excision, Surg. Clinics of N. Amer., Aug., 1958.

3. Nichols, Perry, The Value of Escharotics, Kingsport, Tenn., Kingsport Press Inc., 1948.

4. Bainbridge, W. S., The Cancer Problem, New York, N. Y., The MacMillan Comp., 1914.

5. Fitch, D. M., Personal communication to the author.

6. Magnussen, A. H. W., Skin Cancer with Special Reference to Radium Treatment, Acta Radiol., Suppl. 22: 287, 1935.

7. Radiumhemmet Staff, Report of Dec. 31, 1952, on patients registered at the Radiumhemmet 1921-1952, Stokholm, K. L., Beckman Boktryckeri, 1953. Cited by: Mohs, F. E., Chemosurgery in Cancer, Gangrene, and Infection, Springfield, Ill., Charles C. Thomas, 1956.

8. Warren, S., and others, Cutaneous Carcinoma Diagnosed Clinically Without Biopsy, Result of Treatment in Consecutive Series, J. A. M. A., 114: 1619, 1940.

9. McCormick, N. A., Report on the Survival of Patients Treated for Cancer from 1935-1947 Inclusive, Canad. M. A. J., 69: 288, 1953.

10. Sharp, G. S., and Binkley, F. C., The Treatment of Carcinoma of the Skin, Am. J., Roentgenol., 62.2: 606, 1952.

11. Paterson, R., and others, The Results of Radium and X-ray Therapy in Malignent Disease, Second Statistical Report from the Holt Radium Institute, Manchester, Edinburgh, 1946, E & S Livingstone. Cited by: Ackerman, L. V. and del Regato, J. A., Cancer-Diagnosis, Treatment, and Prognosis, St. Louis, C. V. Mosby Co., 1954, p. 180.

12. Latenser, J. F., Personal communication to the author.

13. Eckblad, G. H., Chemosurgery, U. S. Armed Forces M. J., 2: 1631, 1951.

14. Laubenheimer, R., and Curtis, A. C., The Chemosurgical Treatment of Far-Advanced Cutaneous Carcinoma, A. M. A. Arch. Dermat., 74: 659, 1956.

15. Lunsford, C. J., and others, Use of Chemosurgery in Dermatological Practice, A. M. A. Arch. Dermat, and Syph., 68: 148, 1953.

16. Shepard, R. A., and Wood, D. A., Chemosurgery, Stanford M. Bull., 8: 193, 1950.

17. Szujewski, H. A., Microscopic Guidance in the Treatment of Skin Cancer, Plast. and Reconstruct. Surg., 5: 524, 1950.

18. Anderson, L. L., Personal communication to the author.

19. Ackerman, L. V., and del Regato, J. A., Cancer-Diagnosis, Treatment, and Prognosis, St. Louis, C. V. Mosby Co., 1954, p. 167.

20. Sutton, R. L., Disease of the Skin, St. Louis, C. V. Mosby Co., 1956, p. 1235.