CLINICAL FEATURES OF MAJOR SCALP DEFECTS AT MILITARY CENTRAL HOSPITAL 108

Le Diep Linh*, Nguyen Thu Phuong*

ABSTRACT

Objectives: describe the clinical features of major scalp defects requiring surgery. **Materials and methods:** The above cross-sectional descriptive study included 16 patients with major scalp defects who received surgery at Center of Craniofacial and Plastic Surgery, Military Central Hospital 108 from September 2016 to April 2021. Participants were taken medical history, received clinical examination, and measured their defect sizes to record research indices. **Results:** Participants had an average age of 61 years old, male/female ratio = 1/1; 81.25% of them had comorbid chronic systemic diseases. The most common cause of the defects was scalp cancer, which accounted for 75%. The defects had an average area of 84.4cm^2 and mainly located in the occipital region which occurred in 87.5% of patients, alone or combined with other regions, 100% of patients had to been removed the periosteum. **Conclusions:** Major scalp defects were mainly seen in elderly people with an average age of 61 years old, the ratio of male to female was equal. Chronic diseases accounted for 81.25%, the main cause was scalp cancer and accounted for 75%, common clinical symptoms were vegetations, ulcers, periosteal loss and defects mainly occurred in compression regions.

Keywords: *Major scalp defects, scalp cancer.*

I. INTRODUCTION

The scalp has a different anatomical structure than that of the skin in other regions of the body (it is thick, poorly elastic and has hair) and is responsible for a special function as covering the skull, so when major scalp defects occur, it is compulsory to have a reconstruction surgery solution to cover the skull. These defects can be seen in many diseases (burns, infections, after tumor removal, cancer and so on). Recently, the prevalence of scalp defects after scalp cancer removal in elderly patients with many comorbid chronic diseases has increased. The defects after scalp cancer removal usually have large sizes, which may even infiltrate to the skull, expose bones and meninges. In addition, elderly patients usually have many underlying diseases. All of these lead to requirements of choice for an effective and safe reconstruction method with short surgery duration.

There have been many patients treated for major scalp defects at the Center of Craniofacial and Plastic Surgery. However, we need an objective and scientific assessment about features and properties of the defects as well as the features of patients with major defects so that we can provide the most suitable and safe reconstruction solution of covering for the patients.

In the world and in Vietnam, there have been many studies on reconstruction surgery to cover major scalp defects. However, we need study fully features of the defects to properly assess them. Therefore, we conducted this study with objectives: to contribute to providing clinical features of major scalp defects at a central hospital (final

Military Central Hospital 108
Responsible person: Le Diep Linh
Email: ledieplinh@yahoo.com
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level) as a reference source for our colleagues.

II. MATERIALS AND METHODS

2.1. Materials: 16 patients with major scalp defects who received surgery at the Center of Craniofacial and Plastic Surgery of Military Central Hospital 108 from September 2016 to April 2021.

2.2. Methods: cross-sectional descriptive study without control group, sample included 2 groups:

Retrospective group: included 6 patients, data was collected based on medical records stored in the records storage room, the records were collected according to inclusion criteria from September 2016 to March 2019

Prospective group: included 10 patients who received clinical examination, follow-up and assessment before and after surgery according to the research medical record form from March 2020 to April 2021.

2.3. Steps

Retrospective group: data was collected and research variables were taken based on medical records.

Prospective group: patients were examined, diagnosed, classified, and assessed for defects.

Patients were examined and done basic tests to identify comorbid chronic systemic diseases. They received CT scans to assess the level of invasion of the skull and meninges before surgery. Biopsies were done for histopathology to orientate the properties of the defects to plan surgery.

We classified the defects according to Mario Cherubino [1], classifying the scalp defect area into 3 groups: Small defects with area less than 5cm^2, average defects with area from 5 - 20cm^2, large defects with area more than 20cm^2.

Clinical symptoms of major scalp defects included vegetations, ulcers, bleeding and infection. In some cases, the patients had bone exposure, loss of 2 skull plates and damage to the dura mater.

III. RESULTS

3.1. General features

- Distribution by age: 18-60: 7 patients = 43.75%; > 60: 9 patients = 56.25%, in which the lowest was 38, the highest was 85, the average was 61.

- Distribution by gender: Female = Male = 8 patients = 50%

- Medical history

Table 1: ***Prevalence of comorbid chronic diseases (n=16)***

Chronic diseases	n	%
Hypertension	3	18.75
Type II diabetes	3	18.75
Atrial fibrillation	1	6.25
Lupus erythematosus	1	6.25
Psoriasis	2	12.5
Cirrhosis	1	6.25
Chronic scalp ulcers	2	12.5
Have no chronic diseases	3	18.65%
Total	16	100%

3.2. Causes of scalp defects

Table 2. ***Causes of scalp defects (n=16)***

Causes	n	%
SCC	8	50%
BCC	2	12.5%
Other cancers	2	12.5%
Necrotizing ulcer after surgery	4	25%
Total	16	100%

3.3. Clinical features.

- Locations of scalp defects.

Table 3. ***Locations of scalp defects (n=16)***

Locations	n	%
Region 1 (right temporal region)	1	6.25%
Region 2 (parietal region)	1	6.25%
Region 3 (left temporal region)		
Region 4 (occipital region)	7	43.75%
Combined region (2+4)	7	43.75%
Total	16	100%

The area of the scalp defect was calculated by formula: Length x width, in which length was the largest size of the defect and width was the largest one measured perpendicular to the length axis. In our study, the largest area of the defects was 270 cm^2, the smallest was 30cm^2, the average was 84.4cm^2. The combined defect in the parieto-occipital region had the largest area.

Table 4. ***Sizes of scalp defects (n=16)***

No.	Region	Length x width (cm)	Area (cm^2)
1	Parietal region	10x8	80
2	Right temporal region	6x5	30
3	Occipital region	9x6	54
4	Occipital region	7x5	35
5	Occipital region	6x5	30
6	Occipital region	7x6	42
7	Occipital region	7x6	42
8	Occipital region	7x6	42
9	Parieto-occipital region	18x15	270
10	Parieto-occipital region	17x15	255
11	Parieto-occipital region	15x11	165
12	Parieto-occipital region	12x10	120
13	Parieto-occipital region	10x4	40
14	Parieto-occipital region	10x5	50
15	Parieto-occipital region	8x7	56
16	Parieto-occipital region	10x4	40

- Features of the lesion.

Table 5. ***Features of local lesions at the time of admission to the hospital (n=16)***

Causes	Features of the lesion		n	%
	Bone exposure	Non-bone exposure		
Tumors (SCC, BCC, other cancers)	2	10	12	75
Necrotizing skin after surgery	2	2	4	25
N	4	12	16	
%	25	75		100

Among 16 patients, 12 patients went to the hospital for examination and treatment because of malignant tumors occurring in the head regions, in which the soft tissue around the tumor did not show signs of infection or they presented the tumors showing signs of vegetations, ulcers or bleeding, 4 patients had non-healing wounds and skin flap necrosis after craniotomy to remove brain tumors.

There were 2 patients with cancerous defects in the scalp area that invaded the skull. During surgery, we had to remove the skull and then reconstructed it with titanium mesh, 4 patients had titanium mesh for reconstruction after brain tumor surgery. 10 patients with only soft tissue or periosteum lesions did not require removal of the outer plate of skull.

IV. DISCUSSION

4.1. General features

4.1.1. Age and gender: the average age of participants is 61 years old.

Our result is similar to those of Zayakova's 2013 study on 13 patients with scalp defects reconstructed with vascularized scalp flap which showed an average age of 61.7 years [2], and of Shonka's 2011 study on reconstruction of scalp and skull defects in 56 patients with 62 surgeries, which showed an average age of 58 years [3]. In this study, scalp cancer is the main cause (50%), intracranial tumors account for 35%, and the rest is trauma.

Result of age in our study is similar to those of other authors comes from similarity about causes leading to scalp defects, i.e, after scalp tumor removal or after intracranial surgery.

The gender ratio in our study is 1:1. Male/female ratio in Mueller's 2012 study was 37/31, which showed no gender difference in the scalp defect group [4]. FCWei's 1998 study on 30 patients with scalp defects with mixed caused showed a male/female ratio as 19:10 [5]. The gender difference in FCWei's study occurred in patients with electrical burns and gunshot, and most of them were male.

4.1.2. Medical history

In our study, there are 12/16 patients (accounting for 75%) who have history of systemic or chronic diseases such as diabetes, hypertension, cardiovascular disease, and long-term use of immunosuppressive medications (Methotrexate, corticosteroids), in which there are 3 patients with diabetes and 1 patient with diabetes and comorbid atrial fibrillation. There are 3 patients with hypertension, 3 patients using immunosuppressive medications for a long time to treat lupus or psoriasis, 1 patient with alcoholic cirrhosis, 01 patient with a tumor developing on a scar base, 2 patients with scalp ulcers appeared many years before treatment. There are 4 patients with no underlying disease and no special history.

According to Mueller's study on 68 patients with scalp defects, 89.7% of patients had chronic underlying diseases, the most common as type 2 diabetes accounting for 26.5%, cardiovascular problems 16.2%, and hypertension 14.7%[4]. Comorbid diseases such as diabetes and hypertension affect the healing process as well as worsen the condition of the supply vessels and cause hypoperfusion of flap. Long-term use of immunosuppressive medications such as corticosteroids or methotrexate thins the skin's layers, reducing the skin's resistance to factors such as traction, trauma or after craniofacial surgery. Other chronic diseases such as cirrhosis, heart failure, atrial fibrillation with anticoagulation therapy increase the risks of bleeding, infection, or delayed healing after surgery.

4.2. Causes of scalp defects

75% of patients in our study has scalp defects secondary to surgical removal of scalp cancer, and the remaining has scalp defects secondary to brain tumor surgery. In the scalp cancer group, 8/12 patients (75%) have squamous cell carcinoma (SCC), 2 patients (16.66%) have basal cell carcinoma (BCC), 1 patient has convex fibrodermoid sarcoma (8.33%), 1 patient has sebaceous carcinoma. This prevalence is consistent with result of Le Van Quang's 2020 study, which shows basal and squamous cell carcinomas as the two most common types of non-melanoma skin cancer accounting for 80-90%, while sarcomas and sebaceous gland cancers are very rare [6].

The average age of the scalp cancer group is 58.2 years old, coinciding with result of Nguyen Van Thuong and colleagues' study in 2019 which shows that skin cancer is common in people over 50 years old [7]. Sunlight with strong UV rays is a risk factor for skin cancer, especially in exposed skin regions such as head, face and neck. Sunlight exposure leads to cumulative dose of UV higher and higher over time, which shows high prevalence of scalp cancer in elderly people. Now, as the average life expectancy tends to increase, prevalence of scalp cancer in particular and skin cancer of head, face and neck regions in general will do too. This can be seen in the increased prevalence of scalp cancer in domestic and foreign studies on scalp defects. FCWei's study in 1998 on 29 cases of major scalp defects found only 8/29 cases (27.5%) secondary to surgical removal of scalp tumor. Tran Thiet Son studied 87 patients with scalp defects from 1997 to 2006 found only 1% were secondary to surgical removal of tumor [8]. Shonka's study in 2011 on 62 patients with scalp defects found that 50% were secondary to surgical removal of scalp cancer [3]. Our study shows that 75% of patients has secondary to after surgery of cancers.

According to Nguyen Van Thuong and his colleagues, burn scars and chronic ulcers are also high risk factors for squamous cell carcinoma [7]. In our group of scalp cancer, there is a patient diagnosed with squamous cell carcinoma at the age of 38, quite young compared to the average age of scalp cancer. The tumor appears on a chronic burn scar base. Patients with old scars should be monitored regularly, and indicated for biopsy when they have warning signs such as itching, fluid discharge, and hyperkeratosis on the scar base.

According to Nguyen Van Thuong and his colleagues, basal cell carcinoma is the most common in non-melanoma skin cancers, accounting for 80% of cases, the second is squamous cell carcinoma [7]. Other types of

skin cancer such as sebaceous cancer or sarcoma are rare. For scalp, we find a difference, Sourza C's study in 2012 on 25 patients with major scalp defects after cancer removal shows prevalence squamous cell carcinoma as 84% [9]. In Nguyen Tran Thanh's 2019 study on the results of reconstructing major scalp defects using fasciocutaneous flaps in superficial temporal region, squamous cell cancer accounts for 83.3%[10]. In our study, squamous cell carcinoma accounts for 91.6% in the group of scalp cancers, similar to results of above authors. We can see that in scalp cancer in particular, squamous cell carcinoma is the most common, followed by basal cell carcinoma. We need to conduct more extensive studies with larger sample sizes to clarify this.

In addition to the 12 patients with scalp defects secondary to surgical removal of scalp tumor, there are 4/16 patients (accounting for 25% of the cases) in group of scalp necrosis after brain tumor surgery. These patients often have to undergo long surgeries to remove intracranial tumors, and may have undergone radiotherapy or embolization, 1 patient with lupus erythematosus received prolonged corticosteroid treatment, causing its scalp to become very thin. After surgical removal of intracranial tumors, the scalp often becomes necrotic at the distal edge of the flap.

This may result from improper dissection of the scalp flap, damage to the vascular pedicle during the process of exposing the skull, or excessive hemostasis in the region near the flap's vascular axis.

Figure 4.1. ***Scalp flap necrosis after brain tumor surgery***

Embolization is a common technique performed before surgery to minimize bleeding during operation. Postoperative scalp necrosis is usually recorded in cases after surgery for meningioma with embolization. In 1984, Richard. C recorded two cases of scalp necrosis after surgical removal of meningioma with embolization. [9]. PVA (polyvinyl alcohol) is passed through the branches of the external carotid artery (ECA) to embolize the branches which supply the meningioma. Sometimes, normal branches of the superficial temporal artery are not preserved during embolization. Even in these cases, scalp necrosis does not occur before surgery because the scalp can be supplied by the occipital, supratrochlear and supraorbital arteries, as well as branches of superficial temporal artery on the opposite side. When tumor removal is performed, formed scalp flap is only supplied by random supplying root and its own superficial temporal axis. Therefore, scalp flap necrosis has high risk to occur if normal branches of

the superficial temporal artery are not preserved. To prevent this condition, it is necessary to:

- Perform more selective embolization
- Preserve normal branches and use low pressure material injection technique
- The scalp flap is designed with a wider supplying root.

In reconstructing scalp defects after surgical removal of scalp cancer, we usually need to remove a large amount of scalp and periosteum, and even outer plate of the skull and meninges in some cases, to achieve a negative resection margin. Resection margin around the tumor is usually conventional to be 1 cm. In cases of scalp necrosis after intracranial tumor surgery, the periosteum or the entire bone plate had been removed. Both groups of causes lead to major defects, direct closure and skin grafting can not performed. Free flaps and skin expansion is only suitable for patients in good physical condition who are not candidates for our study.

Figure 4.2. ***Defects in parieto-occipital region.***

Patients with scalp defects in temporal and forehead regions who are not candidates for scalp flaps based on superficial temporal artery usually are covered by one or more random scalp flaps. They are not included in our study.

4.3. Clinical features of the defects

4.3.1. Locations of the defects

Our study has 1 patient with scalp defect in right temporal region, 1 patient in parietal region, 7 patients in occipital region and 7 patients with combined defects in parieto-occipital region. Yolanda's 2013 study on 13 patients with major scalp defects shows the most common locations, which includes 4 cases in temporal region, 2 cases in parietal region and 2 cases in forehead region [5]. Our result is different from that of Yolanda, due to differences in reconstruction methods. Our patients are old and have many underlying diseases, so they are treated using local axial flaps and mainly scalp flaps based on superficial temporal and occipital artery pedicles. These flaps are suitable for defects in parieto-occipital region, so the main scalp defects in our study occur in this region with 14/16 patients, accounting for 87.5%.

Figure 4.3. ***Defects in occipital region***

4.3.2. Defect sizes

In our study, the largest defect area is 270 cm^2, the smallest is 30cm^2, the average is 84.4cm^2. The combined defect in parieto-occipital region has the largest area. The defect's area is calculated by formula:

Length x width, in which length is the largest size of the defect and width is the largest one measured perpendicular to the length axis. The scalp is a very poorly elastic region, so meticulous planning is needed before surgery and size of the defect has great importance in choosing the surgical method.

Skin grafting, pedicle flaps, skin expansion, and microsurgical flaps are techniques that can be applied for major scalp defects. Skin grafting is a quick and easy-to-apply technique, but recipient base needs to be good enough, so it cannot be applied directly to defects after removal of tumor in which the periosteum is removed or skull plate is loss. Skin expansion requires time to place expansion bags, which is not suitable for defects that require immediate surgery. Free flap is a good cover method, but patients with many underlying diseases are not suitable to undergo long surgeries such as microsurgery. Moreover, poor vascularization in these patients causes the high risk of failure for this method. Local scalp flaps are the ideal material to cover head defects. They have all properties of the defect's removed skin, hair, suitable thickness, good vitality, and long flap pedicle that can cover major defects. Disadvantages of this flap include very limited amount of material, poor elasticity, and skin grafts to cover the flap. However, this method is the most optimal choice for patients with many underlying diseases who need immediate treatment of the defect due to short surgery duration and suitable flap properties.

4.3.3. Local conditions

10/16 patients present symptoms of vegetations, ulcers or bleeding, 3/16 patients get symptoms of scalp tumors, and the remaining 3/16 patients have necrosis after scalp surgery. 3 cases have exposed skull and all of them are secondary to treatments. Specifically, 2 patients have scalp necrosis after brain tumor surgery, 1 patient had surgery and radiotherapy at another medical facility but received no suitable cover treatment. So our patients have symptoms of tumors and ulcers consistent with study of Nguyen Van Thuong and his colleagues, who also show that tumors and ulcers are the two most common types of scalp cancer. [7].

Figure 4.4. ***Squamous carcinoma defects***

There are 2/16 patients with evidence of skull invasion on gross and histopathological examination. For these patients, covering the dural defect or reconstructed dura mater after radical tumor removal is the most urgent requirement of the operation. Microsurgery can be applied in these cases, but carries extremely high risks. Patients with many

underlying diseases as mentioned above are at high risk of failure for the microsurgical flap, the bad recipient base. Moreover, post-operative radiotherapy can cause flap contraction, delayed healing, splint exposure, meninges exposure and meningitis which lead to treatment failure. Local axial flap is almost an irreplaceable option. It can be removed immediately, has good vitality and wide cover ability, and is safer than free flap. Phase-2 microsurgery can be used to return the flap to its original position when the patient's condition improves.

Figure 4.5. ***Occipital squamous carcinoma, the tumor invades skull and dura mater***

V. CONCLUSIONS

After studying 16 patients with major scalp defects at the Center of Craniofacial and Plastic Surgery - Military Central Hospital 108, we find that:

The average age of studied patients is 61 years old, the ratio of male to female is equal.

Chronic diseases such as diabetes, hypertension, lupus erythematosus, psoriasis, and cirrhosis account for 81.25%.

The majority of major scalp defects is caused by skin cancer, which accounts for 75% (in which basal and squamous cell carcinomas account for 83.33%).

Locations of scalp defects: 9 patients have defects in 1 region and 7 patients have defects in combined parieto-occipital region.

Sizes of scalp defects: the largest defect area is 270 cm^2, the smallest is 30cm^2, the average is 84.4cm^2. The combined defect in parieto-occipital region has the largest area.

Local features of the lesions: skin lesions account for the majority: 62.5% of patients with vegetations, ulcers or bleeding, 18.75% with scalp tumors, and the remaining 18.75% of patients with necrosis after skin surgery. Bone lesions: 18.75% of patients with skull lesions, Meninges: 6.25% with meningeal lesions.

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