Scalp lesions incidentally discovered on the MRI scans of the head: prevalence, type and meaning

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Aims and objectives

Lesions of the scalp are commonly seen on MRI examinations of the brain and skull, though rarely reported. Their true etiology may be puzzling when the medical evaluation is based only on imaging findings. Mass lesions can be directly related to the scalp layers or be the first sign of an underlying process in the skull. To give an accurate diagnosis, it is essential that radiologist should be familiar with the anatomy of the scalp and the most frequent lesions in this region. The aim of our study was to determine the prevalence of scalp lesions as incidental findings on MRI studies performed for other reasons, and to list the most common type of lesions.

Mnemonics of the scalp anatomy is well known and consists of five histologic layers: skin, connective tissue, aponeurotic layer (galea aponeurotica), loose connective tissue and pericranium. According to Hymen LA et al., the mentioned anatomic layers can be regrouped into 3 clinically useful coverings that are distinct on modern imaging, MR and CT: skin, fatty subcutaneous space and the galea/subgalea/periosteal complex that blend with the outer table of the skull (figure 1,2).
Methods and materials

We performed a prospective analysis of 1,000 consecutive patients undergoing MRI examinations of the brain and skull at the University Hospital of Antwerp between August and October 2014, of which 836 were performed at 3T (Siemens Magnetom Skyra or Siemens Magnetom Trio TIM) and 164 at 1,5T (Siemens Magnetom Symphony TIM). All examinations were acquired using 12- or 32-channel head coils. There were 675 men and 325 women. The average age was 46.5, with a standard deviation of 22.1 years. The presumptive diagnosis was made by 2 experienced neuroradiologists, and a dermatologist. Because most of these lesions are benign, histological correlation were not available.

MRI scans of the brain included T1-weighted sagittal and/or axial images, T2-weighted axial images, Fluid attenuated inversion recovery (FLAIR) axial and/or sagittal images with fat saturation. Diffusion-weighted scans (b=1,000 s/mm2) were available in 86.7% of scans. Intravenous contrast administration of a gadolinium-chelate was performed in 72% of scans. The study was approved by an institutional review board and written informed consent was obtained from all participants. The demographic data, including sex, age at the time of presentation, main diseases, previous physical trauma, including surgeries, localization of the lesions, invasion of particular scalp layer, radiological features and indication for the MRI and CT were recorded.

The presence of scalp lesions was registered in an Excel file; the most likely diagnosis, based on imaging characteristics, was noted. The examined variables were presented as frequencies. Independent-samples t-test was used for statistical evaluation and one-way ANOVA test. A value of $p$ less than 0.05 was considered as significant.
Results

Scalp lesions were found in 73 patients, 38 (52%) men and 35 (48%) women. The average age of the patients with positive findings was 50.7 ± 24.4 years (as compared to 46.5± 22.1 years for the entire study population). Mean age of men and female were similar (mean age of men 50.32 ± 25.2 years and female 51.22 ± 23.3 years).

Among other 11 detected lesions, we found skin metastasis of the NSCLC and spinocellular carcinoma in 3 patients (4.1%), bone metastasis in 5 patients (6.8%), dermoid cysts in 1 patients (1.4%), lipomatosis in 1 patient (1.4%) and hemangiosarcoma in 1 patient (1.4%).

Lesions were most commonly localized parietal 43.2%, less commonly frontal and occipital (28.4% and 20% respectively), and temporal localization of lesions was found in only 8.1% of patients. Fig. 4. We found bimodal appearance of scalp lesions with peak in age group between 11 and 20 years old and the second peak among the patients older than 51 year (Fig. 5). In a group of younger patients the most frequent diagnosis was subcutaneous hematoma, and there was one case of skin lesion consistent with neurofibromatosis typ I. Different scalp lesions were identified among elderly patients. Scalp lesions can be classified as congenital, traumatic, inflammatory and neoplastic lesions in origine. All of them can be identified by CT and MR imaging.

In our study sebaceous cysts were found more often in male than female patients. Average size ranged between 2 to 23.8mm and thickness between 2.5 to 11mm. Sebaceous cyst is usually a well-defined oval-shaped lesion, hypodense on CT and with characteristic MRI findings of low to intermediate signal intensity on T2W, high signal intensity on T1W, on fat supressed FLAIR images have hypointense signal (Fig. 1,2,3). On performed T1W images after gadolinium injection there was peripheral discrete thin rim enhancement. They were mostly localized parietal (61%), less frequently seen frontal (17.3%) and occipital (17.3%) on the skull. Temporal localization of the cyst was detected in 1 patient (4.3%).

Subcutaneous lipomas were more often found among male than female patients, with average size ranged between 11-25.7mm and thickness between 2.6-11.7mm. They appear as encapsulated mass with very low density on CT and typical fatty tissue high T1 and T2 MR signal intensity, saturates on fat saturated sequences, hypointense signal on FLAIR images, no or minimal enhancement on postgadolinium images (Fig. 4,5,6). In 7 patients (43.7%) lipomas were found in occipital area of the skull, 4 patients (25%) had parietal and the same number of patients had frontal localization on the head. Only 1 patient (6.25%) had temporal localization of the lipoma.

Average size of subgaleal hematomas ranged between 8.1 to 97mm and thickness ranged between 4 to 14mm with no sex predominance. They appear as hyperintense
signal on T2W and FLAIR images and hypointense on T1W images (Fig. 7). Most often they were found parietal (53.7%), then frontal (31%) and temporal (15.3%) on the head.

Different skin tags were found in 13.7% of analysed patients, with average size ranged between 3.6 to 12 mm and thickness ranged between 2 to 6mm. They appear isointense with skin layer on T1W, T2W and FLAIR images without postgadolinium enhancement (Fig. 8,9). There were all benign nature. In our study they were mostly found parietal (40%) and frontal (40%) and in 2 patients (20%) occipital on the skull.
Fig. 3: Adenoma sebaceum ("sebaceous cyst") in a 67-year-old man. Axial T2W image shows an oval-shaped, sharply demarcated lesion in the subcutaneous soft tissues overlying the left parietal convexity.

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Fig. 1: Adenoma sebaceum ("sebaceous cyst") in a 67-year-old man. Axial turbo FLAIR image with fat saturation shows an oval-shaped, sharply demarcated lesion in the subcutaneous soft tissues overlying the left parietal convexity (arrow). Location, signal intensity and general appearance are pathognomonic for a sebaceous cyst.

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**Fig. 4:** Subcutaneous lipomas in 56-year old man. Axial T2 WI image show encapsulated mass with typical fatty tissue high T2 MR signal intensity, localised in the right frontal convexity.

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**Fig. 5:** Subcutaneous lipomas in 56-year old man. Turbo FLAIR fat saturation (C) images showing encapsulated mass with typical fatty tissue and hypointense signal on turbo FLAIR fat saturation images.

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Fig. 6: Subcutaneous lipomas in 56-year old man. Axial T1WI image show encapsulated mass with typical fatty tissue high T1 MR signal intensity.

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Fig. 7: Subgaleal hematoma in a 3-year-old child. Axial T2W image show hyperintense signal lesion in the subgalea area of the right parietal convexity.

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**Fig. 8:** Skin tag in a 30-year-old woman. Axial turbo FLAIR image with fat saturation image shows an oval-shaped, sharply demarcated lesion isointense with skin layer on the left parietal convexity.

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Fig. 9: Skin tag in a 30-year-old woman. Sagital T1W image show a sharply demarcated lesion isointense with skin layer overlying the left parietal convexity without postgadolinium enhancement.

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Fig. 2: Adenoma sebaceum ("sebaceous cyst") in a 67-year-old man. Sagital T1W image shows an oval-shaped, sharply demarcated lesion in the subcutaneous soft tissues overlying the left parietal convexity (arrow).

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Conclusion

Scalp lesions are common incidental findings on MRI examinations of the head, though they are rarely reported. They tend to occur in a bimodal age distribution, affecting young children and adults over the age of 55. Men are more commonly affected than women. Being familiar with the anatomy of the scalp as well as the CT and MRI patterns of most common lesions involving the scalp are helpful to reach a positive diagnosis in the majority of cases. We recommend that screening of the scalp should be performed by radiologists reading MRI examinations of this anatomic region.
References


