CASE REPORT

Permanent isolated micrographia from traumatic basal ganglia injury



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Abstract

Micrographia is a rare neurological finding in isolation. Most cases of isolated micrographia have been found in association with focal ischemia of the left basal ganglia. Here, we present a case of post-traumatic micrographia stemming from contusion to the left basal ganglia.

Keywords Trauma · Micrographia

Introduction

Micrographia is defined as a reduction of letter size, often coupled with other impairments to writing. It is most commonly caused by degenerative diseases such as Parkinson's. Only rarely has micrographia been reported in isolation, most frequently due to focal ischemic injury to the left basal ganglia [1-4, 6, 8-12]. We here report a case of post-traumatic micrographia in a previously healthy high school student.

Case

A previously healthy 15-year-old male was found with reduced level of consciousness following an unwitnessed BMX accident. He had loss of consciousness and was agitated and had vomiting on scene. He was brought to the emergency department via EMS, at which time his GCS was 10 (E3V1M6). CT head was done (Fig. 1) showing contusion centered at the left external capsule superficial to the lentiform nucleus.

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The patient was intubated shortly afterwards and was watched briefly in the ICU. He did not have an insertion of an ICP monitor. He had repeat CT scans over a 2-day period during his stay in the ICU, showing mild interval expansion of his contusion with intraventricular progression. He was extubated on his third day of admission, at which time he was examined and found to have only mild weakness. He was then discharged a week later to the local rehabilitation hospital.

At 3-month follow-up, the patient was seen in clinic and MRI was performed (Fig. 2). No underlying lesion was noted but evidence of diffuse axonal injury was noted on the susceptibility weighted imaging (SWI) sequence. At this point, the patient had completed his



Fig. 1 CT scan showing left-sided hemorrhagic contusion centered at the junction of the putamen and the external capsule



rehabilitation and had no overt weakness. Interestingly, the patient did have concerns from school of his handwriting becoming much smaller. Samples of his writing obtained in office revealed focal micrographia, with reduced size and legibility. Detailed neurological examination yielded no other deficit. He had no other reported issues with activities of daily living. There were no concomitant extrapyramidal symptoms or signs of dystonia. The MRI was repeated at 3-year follow-up. Still no underlying lesion was demonstrated. Aging of the prior hematoma cavity and likely scar of the area are noted (Fig. 3).

We performed a detailed analysis of the patient's writing at 3-year follow-up (Fig. 4). This revealed micrographia with spontaneous printing and printing to dictation, but not with copied English or Japanese writing. Our analysis was adapted from that performed by Denes et al. [3].

Discussion

Micrographia is a reduction in size and quality of writing most often seen in conjunction with extrapyramidal symptoms in the setting of Parkinsonism. While rare, multiple prior reports of isolated micrographia following ischemic injury to the left basal ganglia [1, 4, 10–12], thalamus [6], and subcortical frontal lobe [9], as well as following pallidal DBS [2] and hypertensive left basal ganglia hemorrhage [8], have been published. Only one prior report of post-traumatic micrographia has been reported in the English literature [3]. In that case, the injury was an extensive self-inflicted gunshot wound, and the micrographia was associated with mild dystonia of the right hand and foot. In our case, micrographia was the only neurological deficit. In addition, the patient in the case reported by Denes et al. was a 43-year-old, whereas our case occurred in a 15-year-old.

Fig. 3 a T2-weighted, b FLAIR, and c SWI images of the patient at 3-year follow-up demonstrate area of gliosis and hemosiderin deposit centered on the left external capsule/putamen and less features of DAI compared with prior





a

Fig. 4 Writing samples. a Spontaneous writing of patient's mother (top) and of patient (bottom) demonstrates cramped, micrographic printing. b Writing from a copied sample does not demonstrate micrographic character. c Copied Japanese characters are not micrographic. d Writing single words as dictated reveals micrographic, cramped printing

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The neuroanatomical correlates of writing are complex. Micrographia is a sign of failure of the extrapyramidal pathway [7]. The basal ganglia are the structures most often involved, but the subthalamic nucleus and substantia nigra have been implicated as well. A detailed analysis of the circuitry involved was conducted by Inzelberg et al. [5]. They found that there is a complex interplay between motor planning in the premotor cortex and supplementary motor area and execution of writing. Micrographia was suggested to be an error in automaticity rather than planning, and the most common area implicated was the lenticular nucleus, more specifically the putamen [5]. In our patient, the hemorrhage is consistent with a gilding contusion centered at the junction of the external capsule and the putamen, resulting in damage to both structures. The external capsule is a thin layer of white matter found superficial to the putamen and deep to the claustrum. It is known to contain corticocortical association fibers and cholinergic fibers from the basal forebrain. Nakamura et al. [9] pointed out that while the left basal ganglia is the most frequently implicated anatomic structure in focal micrographia, not all left basal ganglia injuries result in micrographia. Their case report was of micrographia following a subcortical frontal lobe insult, and they thus proposed that the frontalsubcortical circuits may play a role in the pathogenesis of micrographia as a compensatory mechanism. The specific location of our patient's contusion at the junction of the putamen and the external capsule may therefore play a role in his micrographia.

We performed a short yet detailed examination of the patient's writing. The patient has never been able to do cursive handwriting, so printing was tested. The results suggested that while spontaneous writing program initiation resulted in micrographia, copied printing did not (Fig. 4). This echoes that seen in the case of traumatic micrographia reported by Denes et al. [3], with this instance being in a child. Recent studies suggest that rather than a fine motor disturbance, this type of micrographia may be predisposed to stem from basal ganglia lesions due to disruption of the frontal-subcortical circuits [9, 11]. Whereas copying is a process whereby more active attention and visual function is required, everyday writing is a quicker, more automated process and may lose subtle regulation with disruption of these circuits. Denes et al. saw this effect with cursive, which was their patient's primary form of writing; our patient prints instead and so the result is likely analogous.

Our case demonstrates the role of the lenticular nucleus in micrographia and demonstrates that a traumatic contusion can cause isolated micrographia, likely due to impairment of basal ganglia circuitry. This is the first case report to demonstrate isolated micrographia due to traumatic contusion in a pediatric patient.

Compliance with ethical standards

REB approval was not sought as this is a single case report. Informed consent was obtained from the patient and his mother prior to submission.

Conflict of interest We have no conflict of interest to disclose.

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