

Autonomic Auras: Left Hemispheric Predominance of Epileptic Generators of Cold Shivers and Goose Bumps?

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Summary: *Purpose:* Autonomic seizures in temporal lobe epilepsies associated with “cold shivers and goose bumps” as a principal ictal sign or aura have only rarely been studied.

Methods: Sixteen patients with autonomic auras [cold shivers or cold sweats (n = 11), goose bumps (n = 4), one patient showed both ictal signs] were analyzed.

Results: Lesions were detected in 12 patients. The etiology was heterogeneous [cryptogenic, arteriovenous (AV)-malformation cyst, trauma, hippocampal sclerosis]. Eight patients underwent epilepsy surgery. The localization and

lateralization of the focal epileptic activity in the temporal lobes was determined either by magnetic resonance imaging lesions, EEG, ictal signs, or single-photon emission computed tomography imaging.

Conclusions: The patients with temporal lobe epilepsies associated with “cold shivers and/or goose bumps” showed a left hemispheric predominance of the focal abnormality in the temporal lobe. **Key Words:** Visceral—Autonomic epilepsy—Aura—Temporal lobe epilepsy—Lateralization—Presurgical evaluation.

Initial seizure signs are important indications for lateralization or localization in focal epilepsies. A group among the various aura symptoms is called visceral or autonomic auras. Auras with visceral or autonomic signs were reported by Gowers (1) in 18% of patients with focal and secondary generalized epilepsies. Later phenomena were precipitated by electrostimulation (2,3) from different parts of the temporal lobe. Further research was done by Mulder et al. (4), Gastaut (5), and Liporace and Sperling (6) concerning visceral epilepsy. In addition to epigastric or abdominal signs, cardiovascular, respiratory, pupillary, genital, vasomotor, urinary, hypersecretive, and pilomotor signs were reported. The previous investigations mentioned leave one question unanswered: Do singular visceral types of auras give information regarding the localization or lateralization of the epileptic activity by which they are caused?

Cold shivers and/or pilomotor excitation (goose bumps, goose flesh, cutis anserina, horripilation) are less frequently reported ictal signs that can be associated with other autonomic signs (7–13). Brody et al. (8) and Green et al. (11) described cases with tumors in the right hemisphere and pilomotor seizures. Other publications re-

ported single cases of a pilomotor seizure in focal epilepsies due to a lesion in the left hemisphere (13). With regard to presurgical evaluation for epilepsy surgery, the question arises whether the latter autonomic ictal signs may be related to a predominant lateralized hemispheric seizure generator in the limbic system.

METHODS

Of 420 patients with pharmacoresistant temporal lobe epilepsies, 16 patients with cold shivers/sweats or goose bumps were retrospectively identified. Of the 420 patients with pharmacoresistant epilepsies evaluated for epilepsy surgery, 214 were operated on. One hundred five and 109 patients were operated in the left and right temporal lobes, respectively. The patients were inspected by means of EEG, long-term video-EEG recording (30- to 64-channel scalp, sphenoidal, or invasive subdural electrodes), magnetic resonance imaging (MRI) and single-photon emission computed tomography (SPECT). Sixteen patients with autonomic (cold shivers, pilomotor signs) symptoms were examined for the lateralization of this focal abnormality. Neuropsychological testing was performed in all patients, including a sodium amytal test in seven patients. The clinical data are summarized in Table 1. The results of the preoperative investigations were correlated to the type of autonomic aura (cold shivers, cold sweats, or goose bumps). The probability of a lateralization of the focal epileptic activity to the left

Revision accepted.

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TABLE 1. Clinical data

| No | Age (yr) | Sex | Personal description of aura | Goose bumps | Cold shivers | First manifestation of seizure | Etiology | Sodium amytal test | Temporal lobe |
|----|----------|-----|---|-------------|--------------|--------------------------------|-----------------------|--------------------|---------------|
| 1 | 52 | F | Difficulties in expressing oneself, nausea, cold shivers, tears | | + | 41 | Cryptogenic | — | L |
| 2 | 46 | M | Cold shivers coming up from interior of body | | + | 45 | Hippocampal sclerosis | L | L surgery |
| 3 | 37 | F | Palpitations, sweats, at the same time cold shivers and heavy breathing; before that, strange feeling occasionally coming up | | + | 11 | Cryptogenic | — | L |
| 4 | 41 | F | Nervousness mostly when thinking of food, slight feeling of nausea, cold shivers | | + | 17 | Tumor (cyst) | L | R surgery |
| 5 | 33 | F | Goose bumps, first only on the face, later everywhere | + | | 9 | Hippocampal sclerosis | L | L surgery |
| 6 | 37 | M | Visible goose bumps on left and/or right part of face extending over respective upper arm | + | | 32 | Cavernoma | — | R surgery |
| 7 | 33 | M | Hears certain pieces of music, nausea, freezing | | | 12 | Cavernoma | — | L surgery |
| 8 | 28 | F | Goose bumps on both arms together with strange feeling in stomach and the impression of having to breathe more often | + | | 14 | Trauma | L | L |
| 9 | 33 | M | Strange feeling of coldness coming up from stomach plus the impression people or things are getting smaller | | + | 13 | Cryptogenic | — | L |
| 10 | 42 | M | Nausea coming up in stomach, no urge to vomit, nonsystemic vertigo, cold shivers | | + | 8 | Hippocampal sclerosis | — | R surgery |
| 11 | 50 | M | Strange feeling coming up from stomach sometimes accompanied by goose bumps on body and arms | + | | 13 | Cryptogenic | L | L surgery |
| 12 | 41 | F | Sweaty hands, face flushes, left leg ice cold, nausea creeping up, cold shivers | | + | 7 | Cryptogenic | L | L |
| 13 | 75 | F | Sudden current-like feeling starting in chest going up into head and spreading into arms; then mushroom-like taste; cold shivers on arms, head shivers, teeth clapping, afterward feeling of heat as when having a cold, nausea | | + | 64 | Cryptogenic | — | L |
| 14 | 29 | M | Strange grinding feeling in both temples, later on forehead; then goose bumps on both arms and cold shivers | + | + | 1 | Perinatal lesion | R | L |
| 15 | 37 | F | Cold shivers on right arm plus twitches, palpitations, nausea with urge to vomit, vertigo | | + | 7 | Cryptogenic | — | L |
| 16 | 58 | F | Nausea coming up from throat, patient occasionally has to vomit, additional feeling of pressure in jaw succeeded by extreme sensitivity for cold, whole body is shivering, especially right arm | | + | 55 | AV malformation | — | L surgery |

temporal lobe in the 214 operated-on patients was 49.1%; the 95% confidence interval was 45–53%. The binomial test was used to compare with the observed frequency of focus sides in patients with cold shivers. The upper confidence level of control patients was used as the specific probability parameter.

RESULTS

Temporal lobe epilepsy was diagnosed in all patients. The clinical findings providing the lateralization in patients with cold shivers are summarized in Tables 1 and 2. Surgery was performed in eight patients. Pathological

TABLE 2. Patients with cold shivers and goose-bumps

| No. | Surgery | Lateralization | Lateralization proved by | | | |
|-----|---------|----------------|--------------------------|---------------|--------------------|-------|
| | | | MRI | EEG interict. | EEG ictal/behavior | SPECT |
| 1 | | L | xL | xL | xL | xL |
| 2 | x | L | xL | xL | — | xL |
| 3 | | L | xL | xL | xL | xL |
| 4 | x | R | xR | xR | xR | xR |
| 5 | x | L | xL | — | xL | xL |
| 6 | x | R | xR | xR | xR | — |
| 7 | x | L | xL | xL | xL | xL |
| 8 | | L | xL | xL | xL | xL |
| 9 | | L | xL | xL | xL | xL |
| 10 | x | R | — | xR | xR | xR |
| 11 | x | L | xL | xL | xL | xL |
| 12 | | L | — | xL | xL | xL |
| 13 | | L | — | xL | — | — |
| 14 | x | L | xL | — | xL | xL |
| 15 | | L | — | — | xL | xL |
| 16 | x | L | xL | xL | — | No |

MRI no, no MR performed; MRI x, pathologic finding; MRI —, no pathologic finding; MR, magnetic resonance imaging; SPECT, single-photon emission computed tomography.

findings provided by MRI, EEG, or SPECT also are summarized in Table 2. Wada testing showed a language predominance in the left hemisphere in all but one patient. The etiology was heterogeneous: three cases, arteriovenous (AV) malformation; three cases, Ammon’s horn sclerosis; one case, tumor (cyst); one case, trauma; one case, perinatal lesion; and six cases, cryptogenic.

From the patient group with pharmacoresistant temporal lobe epilepsies (n = 420), the prevalence of temporal lobe seizures associated with “cold shivers and/or goose bumps” can be estimated as 3.6%; for cold shivers, 2.6%. For goose bumps alone, the prevalence would be 1.2%.

Cold shivers as a predominant feature of autonomic auras was found in 11 patients. Autonomic auras with goose bumps were found in five patients. Both symptoms were found simultaneously in one patient. In 13 (81%) of 16 patients with cold shivers and/or goose bumps, the ictal onset was lateralized to the left hemisphere. The probability of a lateralization to the left hemisphere was significantly increased compared with controls (p =

0.0019). In the case of cold shivers, seizure onset was lateralized to the left hemisphere in 10 (83%) of 12 patients, and in the case of goose bumps, in four (80%) of five patients (see Figs. 1 and 2). Goose bumps were observed in the following parts of the body: face, upper body (n = 2), and both arms (n = 3).

DISCUSSION

Because previous investigations showed no association between aura types and EEG interictal epileptiform discharges, this suggests that auras may have no localizing values in these seizures (14). Palmini and Gloor (15) discovered a strong association between viscerosensory auras, particularly epigastric sensations, and temporal lobe epilepsies. Epigastric sensations in viscerosensory auras were reported to be associated with right temporal lobe seizures (16,17). Déjà vu illusions tended to originate in the right temporal lobe, and diffuse warm sensations or cephalic auras, in the frontal lobe (15). Few reports that deal with viscerosensory auras or

TLE: Cold shivers/goose bumps and focus lateralization

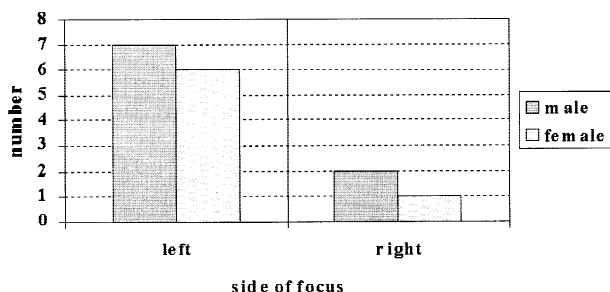


FIG. 1.

TLE: Cold shivers/goose bumps related to focus lateralization

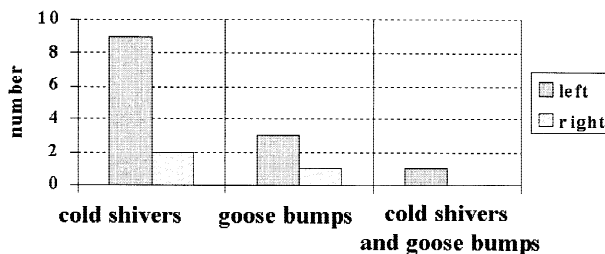


FIG. 2.

simple partial seizure with autonomic signs such as pilo-motor excitation (goose bumps) or cold shivers (6).

The results of this clinical analysis of patients with autonomic auras show that cold shivers or goose bumps are linked with a seizure onset in the left hemisphere. When evaluating the statistical analysis, one should keep in mind that the patient population is not very large. The patients with cold shivers and goose bumps were selected from a patient group with pharmacoresistant temporal lobe epilepsies. Of the 420 patients with temporal lobe epilepsies evaluated for epilepsy surgery, 214 underwent surgery. Of these 214 patients, 105 patients had a left temporal lobectomy, and 109 patients, right temporal lobectomy. From these data, there is no marked hemispheric predominance for temporal lobe epilepsies in our patient group.

In the patient group with pharmacoresistant temporal lobe epilepsies, the prevalence of autonomic seizures such as cold shivers and/or goose bumps would be 3.6%. For goose bumps alone, the prevalence would be 1.2 %.

The result of our statistical test may indicate a left dominance for generation of ictal signs such as cold shivers or goose bumps in pharmacoresistant temporal lobe epilepsies. Left lateralization is a new observation somewhat varying from previously reported cases, especially of pilomotor seizures, because of the very limited number of published cases (five cases showed a right temporal and three a left temporal onset). A multicenter analysis for the definite predominance of lateralization in autonomic seizures particularly associated with goose bumps is suggested, because pilomotor seizures are thought to be very rare.

In congruence with the observation of Ahern et al. (18), we found that anatomy (relation to temporal lobe) rather than etiology was critical for the generation of autonomic auras with cold shivers/sweats and pilomotor signs. The predominant localization of seizure generators in the temporal lobes could be explained by the fact that piloerection can be elicited by stimulation of the amygdala in animals (2). New methods used in presurgical evaluation [e.g., long-term video-EEG monitoring (both noninvasive and invasive), neuroimaging, and neuropsychology] enlarge diagnostic possibilities. In contrast to previous studies, our investigation of a larger patient group with cold shivers/sweats and pilomotor seizures permitted a lateralization with left predominance within the limbic system. This does not include the fact that in some patients, right-sided focal epileptic activity may cause this ictal phenomenon. However, other auras in temporal lobe epilepsy may be lateralized to the right temporal lobe (15,16). Our results show that autonomic auras with cold shivers are most probably associated with left temporal discharges.

As Yu et al. (13) reported, goose bumps may start unilaterally (even ipsilaterally). In our patient group with

temporal lobe epilepsies, goose bumps in other areas occurred in the body uni- or bilaterally with or without spreading.

In addition to the involvement of the amygdala, the hypothalamus, cingulum, and the insular region also must be considered for the development of visceral symptoms (7,10,19,20). With its role as a multifaceted sensory area within the context of the limbic integrating cortex (21), it must be considered in visceral manifestations of epileptic seizures.

Although the connections underlying these visceral sensations have not been clarified, stimulation of sites within the insular cortex in epilepsy patients have shown that bradycardia or depressor charges are more common with left insula stimulation (22). These observed differences may be linked to physiologic, neurochemical [neurotransmitters like γ -aminobutyric acid (GABA), dopamine, choline-acetyltransferase] and higher grey- to white-matter ratio found in the left brain (23,24). Our findings indicate that a systematic analysis of autonomic auras leads to an even more differential interpretation of subgroups of autonomic auras. The precise differentiation of these subgroups may provide important clinical hints for the lateralization or even localization in presurgical evaluation.

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