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Language impairment after spontaneous intracerebral haemorrhage: a systematic review of recovery, bilingual aphasia, and treatment outcomes

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Keywords
spontaneous intracerebral, aphasia, putaminal haemorrhage, thalamic haemorrhage, language recovery, hematoma evacuation, systematic review, bilingual aphasia, multilingualism, mandarin, cross-language recovery

ABSTRACT

Background and objectives: Aphasia after spontaneous intracerebral haemorrhage (sICH) may result from cortical injury or disruption of subcortical language networks. This review summarizes language phenotypes, recovery, prognostic factors, and evidence on hematoma evacuation.

Methods: Haemorrhage-specific studies reporting language outcomes were systematically reviewed, with mixed-stroke cohorts used for contextual recovery data. Language-specific surgical evidence was analysed separately from trials reporting global disability; owing to heterogeneity, findings were synthesized narratively.

Results: Putaminal and thalamic haemorrhages produced heterogeneous fluent and non-fluent aphasic syndromes. Longitudinal putaminal studies indicate that the largest gains usually occur within the first three months, while extensive corona-radiata/internal-capsule involvement and ventricular extension are associated with poorer recovery. One retrospective study reported better six-month language outcomes after endoscopic evacuation than craniotomy, but no conservative-treatment arm was included. Major randomized ICH surgery trials primarily measured global disability rather than aphasia. Bilingual haemorrhage reports showed parallel or differential impairment and recovery across languages.

Conclusions: Language outcome after sICH depends on lesion topography and network disruption. Recovery is greatest early, whereas a language-specific benefit from hematoma evacuation remains unproven.

1. INTRODUCTION

Spontaneous intracerebral hemorrhage (sICH) causes substantial mortality and disability, with outcome influenced by hematoma location and volume, intraventricular extension, secondary injury, and the integrity of surviving neural networks [1]. In the dominant hemisphere, aphasia may follow direct cortical damage or disruption of subcortical structures and white-matter pathways; therefore, clinically important language impairment may occur without direct destruction of classical perisylvian cortex [2–5].

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Aphasia is multidimensional, affecting fluency, naming, comprehension, repetition, reading, and writing, and these domains may recover at different rates [5–9]. Yet most contemporary aphasia literature concerns ischemic stroke or mixed stroke cohorts, whereas hemorrhage-specific studies are smaller and concentrated on putaminal and thalamic lesions [12–14]. A similar limitation applies to surgery: major ICH trials generally report mortality or modified Rankin Scale (mRS), which cannot establish whether naming, comprehension, or functional communication improves.

1.1. Objectives

This review evaluates (1) the phenotype and anatomical correlates of language impairment after sICH; (2) its longitudinal recovery and prognostic factors; and (3) whether hematoma evacuation is associated with language-specific benefit, distinguishing direct aphasia outcomes from global functional outcomes.

2. Materials and Methods

2.1. Design and eligibility

This systematic review followed PRISMA 2020 [21]. Eligible studies included adults with non-traumatic spontaneous intracerebral hemorrhage reporting aphasia or domain-specific language outcomes. Mixed ischemic–hemorrhagic cohorts were used only for contextual evidence unless hemorrhagic data were separately extractable. Surgical studies were included when language outcomes were reported; major randomized ICH trials without language endpoints were considered indirect evidence. Traumatic hemorrhage, isolated subarachnoid hemorrhage, tumors, vascular malformations, and hemorrhagic transformation were excluded.

2.2. Search and study selection

MEDLINE/PubMed, Embase, Scopus, Web of Science Core Collection, and CENTRAL were searched, supplemented by reference-list screening. Search terms combined intracerebral hemorrhage with aphasia/language and additional terms addressing surgery and bilingualism (including bilingual, multilingual, Mandarin, Chinese, English, L1, and L2). Two reviewers independently screened records and full texts, resolving disagreements by consensus.

2.3. Data extraction and synthesis

Extracted variables included study design, hemorrhage location and volume, ventricular extension, treatment, language assessment, follow-up, and language outcomes. Risk of bias was assessed using RoB 2, ROBINS-I, or QUIPS according to study design. Because of clinical and methodological heterogeneity, findings were synthesized narratively by lesion phenotype, recovery, bilingual impairment, and treatment.

3. Results

3.1. Evidence characteristics

The identified evidence includes hemorrhage-specific clinical and longitudinal cohorts, detailed thalamic and putaminal series, mixed-stroke recovery cohorts, one retrospective surgical comparison with aphasia outcomes, and major randomized ICH intervention trials. Hemorrhage-specific language evidence is concentrated on dominant-hemisphere deep hemorrhage; lobar language recovery and surgery are less directly studied.

3.2. Putaminal Hemorrhage

Putaminal hemorrhage demonstrates that aphasia can arise from disruption of distributed subcortical language networks. Alexander and LoVerme described heterogeneous language disturbances after left putaminal or thalamic hemorrhage [2]. In 13 patients with left putaminal hemorrhage, D'Esposito and Alexander found clearer postacute lesion–symptom relationships than in the acute phase; initial fluency was associated with later language outcome [3].

In 92 rehabilitation patients with left putaminal hemorrhage, Maeshima et al. identified aphasia in 79: 31 fluent and 48 non-fluent [6]. Non-fluent aphasia was more often associated with anterior internal-capsule involvement, whereas fluent aphasia was more often linked to posterior involvement. Larger hematomas were associated with repetition difficulty and non-fluent presentations. Because this was a selected rehabilitation cohort, these proportions and volume observations should not be treated as population prevalence or universal thresholds. Horikoshi et al. similarly associated persistent speech disturbance with extension toward the corona radiata [22].

3.3. Thalamic hemorrhage

Thalamic hemorrhage may produce a fluent or transcortical-like aphasia characterized by reduced spontaneous speech, semantic paraphasias, impaired comprehension, and relatively preserved repetition. Cappa and Vignolo reported aphasia in seven of eight patients with left thalamic lesions, with variable recovery [7]. Ozeren et al. found predominantly fluent aphasia in 18 left thalamic hemorrhages and described relatively rapid improvement [8]. However, severe persistent deficits also occur, including reported global aphasia with little recovery at 10 months [23]. In a cohort of 115 thalamic hemorrhages, Osawa and Maeshima identified aphasia in 59; aphasia/neglect was associated with poorer activities of daily living [9].

3.4. Longitudinal recovery and prognostic factors

The strongest hemorrhage-specific longitudinal data come from left putaminal hemorrhage assessed with the Standard Language Test for Aphasia. Kawanishi et al. observed improvement from one to six months, with the greatest gains during the first three months; corona-radiata extension predicted poorer outcome [4]. Komiya et al. followed 48 aphasic patients at one, three, and six months and similarly found that most improvement occurred by three months. Extension into both limbs of the internal capsule was associated with less favorable recovery across language modalities [5]. Ventricular rupture was also associated with poorer six-month performance in several tasks.

Mixed-stroke cohorts provide more granular temporal context but should not be treated as sICH-specific estimates. Wilson et al. documented rapid improvement during the first two weeks in most of 21 patients, with domain-specific differences [12]. In a larger longitudinal cohort, recovery was greatest early and then slowed across the first year [13]; lesion information and early language severity contributed substantially to prediction of later aphasia [14]. Overall, early improvement is common, but recovery is neither uniform across patients nor across language domains.

Across hemorrhage-specific studies, the most consistent prognostic signal is anatomical extent rather than volume alone. Corona-radiata and internal-capsule involvement are repeatedly associated with worse language outcomes [3–6]. Larger hematomas and intraventricular extension often accompany poorer recovery, but these factors are intertwined with overall injury severity. Acute comprehension deficits also matter clinically: Jacobson et al. showed that aphasia, particularly impaired comprehension, can affect responses to command-based assessment in acute ICH [10].

Table 1. Selected hemorrhage-specific studies with informative language outcomes.

Study	Population	Language focus	Key finding
Alexander & LoVerme, 1980 [2]	15; left putaminal/ thalamic	Clinical language profile	Heterogeneous subcortical aphasia; no clear syndrome split by site.
D'Esposito & Alexander, 1995 [3]	13; left putaminal	Multidimensional aphasia	Postacute lesion–symptom associations; initial fluency related to outcome.
Kawanishi et al., 2002 [4]	Left putaminal; longitudinal	SLTA at 1, 3, 6 months	Largest gains by 3 months; corona-radiata extension predicted poorer recovery.
Komiya et al., 2013 [5]	48 aphasic; left putaminal	SLTA at 1, 3, 6 months	Extensive internal-capsule involvement and ventricular rupture associated with worse recovery.
Maeshima et al., 2018 [6]	92 rehabilitation patients	SLTA; aphasia phenotype	79 aphasic; fluent/ non-fluent patterns related to extension and volume.
Cappa & Vignolo, 1979 [7]	14; thalamic haemorrhage	Detailed language testing	Reduced speech, semantic paraphasias, preserved repetition; variable recovery.
Ozeren et al., 1994 [8]	18; left thalamic	Aphasia assessment	Predominantly fluent aphasia; relatively rapid improvement.
Osawa & Maeshima, 2016 [9]	115; thalamic haemorrhage	Aphasia/neglect; function	59 aphasic; cognitive deficits associated with poorer ADL outcome.
Jacobson et al., 2025 [10]	Prospective acute primary ICH	Aphasia + command-response EEG	Comprehension deficits affected command-based assessment.

3.5. Bilingual and cross-linguistic language impairment after sICH

Evidence concerning bilingual aphasia specifically after sICH is sparse and consists predominantly of detailed case studies. Nevertheless, these reports demonstrate that a single hemorrhage does not necessarily affect a bilingual patient's two languages equally. Bilingual aphasia may show parallel impairment, differential impairment, selective recovery, or paradoxical recovery in which the less expected language is relatively preserved. In the broader post-stroke literature, a meta-analysis of 130 bilingual cases found overall better performance in the first language (L1) than the second language (L2), particularly among individuals who acquired L2 after childhood; early bilinguals showed more comparable performance across languages.

Premorbid proficiency and language use also influenced the difference, whereas linguistic similarity between the two languages did not independently explain it [25].

Hemorrhage-specific cases illustrate this variability. Mariën et al. described an early bilingual patient with posterior left thalamic hemorrhage who developed similarly severe aphasia in L1 and L2 together with pathological language switching, mixing, and translation impairment [26]. Conversely, Abutalebi et al. reported a Spanish–Italian bilingual after left lenticular/basal-ganglia hemorrhage whose L1 was initially better preserved than L2. Intensive therapy restricted to L2 substantially improved the treated language without equivalent transfer to L1, altering the relative performance of the two languages; longitudinal fMRI implicated interactions between language and executive-control networks [27]. Lee et al. described an opposite pattern after right basal-ganglia hemorrhage: a Korean–Japanese bilingual showed more severe impairment of Korean L1 than Japanese L2 (WAB Aphasia Quotient 32 versus 50.6). Six months of therapy directed at Korean markedly improved L1, whereas improvement in Japanese was limited [28].

Direct evidence specifically comparing Mandarin and English after spontaneous ICH remains extremely limited. However, Mandarin–English post-stroke studies provide relevant cross-linguistic information. In chronic bilingual aphasia, verb naming was more impaired than noun naming in both Mandarin and English, although the magnitude of this dissociation differed between languages depending on task demands [29]. Treatment studies have also demonstrated that therapy delivered in Mandarin can produce improvement in English, but cross-language generalization varies considerably between individuals and linguistic domains [30,31].

Mandarin additionally requires assessment of language features not captured by English-oriented aphasia batteries. In a Mandarin-language case after left-hemisphere intracerebral hemorrhage, impairment involved lexical tone perception and production, sentence reading, and Chinese-character writing in addition to conventional aphasic deficits [32]. Thus, bilingual patients should be assessed independently in each language using linguistically appropriate instruments rather than assuming that performance in one language accurately represents impairment in the other.

3.6. Surgical treatment and language recovery

Direct language-specific evidence is limited. In the observational putaminal cohort of Komiya et al., aphasia prognosis did not differ significantly between surgically and non-surgically treated patients [5], but treatment allocation was non-randomized and susceptible to confounding by indication. Xiong et al. retrospectively compared 58 dominant-hemisphere basal-ganglia hemorrhages treated by endoscopy or craniotomy and reported better six-month listening comprehension and speaking outcomes after endoscopy [11]. This supports a possible effect of operative technique on language, but does not show that evacuation is superior to conservative management.

The major randomized surgical trials answer a broader question. STICH and STICH II did not demonstrate significant primary functional benefit from early surgery [15,16]; MISTIE III did not meet its primary one-year functional endpoint [17]. ENRICH showed improved utility-weighted functional outcome, principally in lobar hemorrhage [18], whereas MIND did not show a significant primary 180-day disability benefit [19]. SWITCH evaluated decompressive craniectomy for severe deep ICH rather than language-preserving hematoma evacuation [20]. None of these trials establishes an aphasia-specific benefit because standardized language recovery was not the primary outcome.

Table 2. Surgical evidence and the language-specific inference that can legitimately be drawn.

Study	Comparison	Principal result	Language-specific inference
Komiya et al., 2013 [5]	Surgery vs non-surgical; observational	No significant aphasia-prognosis difference	Direct outcome, but confounded/ non-randomized.
Xiong et al., 2019 [11]	Endoscopy vs craniotomy	Better 6-month comprehension/ speaking with endoscopy	Technique comparison only; no medical arm.
STICH / STICH II [15,16]	Early surgery vs conservative care	No significant primary functional advantage	No aphasia-specific conclusion.
MISTIE III [17]	MIS + alteplase vs medical care	Primary functional endpoint not met	No aphasia-specific conclusion.
ENRICH [18]	Early MIS vs medical care	Functional benefit, mainly lobar subgroup	Global benefit ≠ proven language benefit.
MIND [19]	MIS vs medical care	No significant primary 180-day disability benefit	No aphasia-specific conclusion.
SWITCH [20]	Decompressive craniectomy vs medical care	Severe disability/ death outcome	Does not test language recovery after evacuation.

4. Discussion

4.1. Principal findings and anatomical interpretation

Three conclusions emerge. First, sICH-related aphasia is heterogeneous and may follow deep hemorrhage without direct cortical destruction. Second, the greatest measurable improvement generally occurs during the first three months, although later gains remain possible. Third, evidence that surgery specifically improves language is much weaker than evidence concerning mortality or global disability.

The repeated association of language outcome with corona-radiata and internal-capsule involvement supports a network model of aphasia after deep hemorrhage [3–6]. Putaminal and thalamic lesions may disrupt cortical–subcortical pathways required for lexical retrieval, speech production, and comprehension. Thus, hematoma topography and white-matter extension may be more informative for language prognosis than volume alone. Thalamic aphasia is particularly heterogeneous: relatively preserved repetition and fluent output may coexist with semantic and comprehension deficits, while some patients develop severe persistent aphasia [7,8,23,24].

4.2. Interpreting recovery

Hemorrhage-specific longitudinal studies support a clinically important recovery window during the first three months [4,5]. However, assessment beginning at one month may miss rapid acute improvement, and patients who die or cannot complete testing may be underrepresented. Composite aphasia scores can also conceal different trajectories across naming, comprehension, fluency, and writing. Mixed-stroke cohorts extend follow-up into the acute phase and first year [12–14], but their estimates should not be presented as hemorrhage-specific unless subgroup data are available.

4.3. Bilingual language organization and recovery

Bilingual aphasia adds a further level of variability to language outcome after sICH. Available hemorrhage cases show that L1 and L2 may be affected in parallel or to markedly different degrees, and the better-preserved language can change during recovery or following targeted therapy [26–28]. Consequently, language dominance after hemorrhage cannot be inferred solely from which language was acquired first.

Age of acquisition, premorbid proficiency, current language use, and rehabilitation exposure appear more relevant than linguistic similarity alone [25]. This point is particularly important when comparing typologically distant languages such as Mandarin and English. Current evidence does not demonstrate that Mandarin or English is intrinsically more resistant to hemorrhagic injury. Instead, the manifestation of aphasia may differ because the two languages place different demands on lexical, phonological, tonal, orthographic, and morphosyntactic processing [29,32].

For clinical assessment, both languages should therefore be tested separately and longitudinally. In Mandarin–English speakers, this should include not only naming, comprehension, repetition, and discourse in both languages, but also lexical-tone processing and Chinese-character reading and writing. Treatment effects in one language should not be assumed to generalize automatically to the untreated language [27,30,31].

4.4. Does surgery improve language recovery?

Current evidence does not justify a definitive language-specific benefit from hematoma evacuation. The only direct surgery-versus-medical comparison identified is observational and found no significant difference in aphasia prognosis [5]. Endoscopy was associated with better language outcomes than craniotomy in one retrospective study [11], suggesting that operative approach may matter, but without a conservative arm the effect of evacuation itself remains unknown.

Randomized ICH trials cannot resolve this question because their principal endpoints are global disability rather than language [15–20]. Hematoma removal could theoretically improve language by reducing mass effect and secondary dysfunction, while operative injury to critical white-matter pathways could have the opposite effect. Both mechanisms are plausible; only prespecified, standardized language outcomes can determine the net effect. Surgical decisions should therefore continue to be based on established anatomical and clinical indications rather than an assumption that evacuation will improve aphasia.

4.5. Clinical implications, limitations, and future research

Language should be assessed directly rather than inferred from mRS or a simple "speech present/absent" description. When feasible, evaluation should include spontaneous speech, naming, repetition, auditory comprehension, reading, and writing, with repeated standardized testing during the early phase and at approximately 1, 3, 6, and 12 months. Comprehension deficits should also be considered when interpreting command-following in acute ICH [10].

The evidence base remains limited by small observational cohorts, selected rehabilitation populations, inconsistent instruments, incomplete early assessment, and concentration on deep hemorrhage. Surgical trials provide stronger causal evidence for global outcomes but usually omit language-specific endpoints. Before submission as a completed PRISMA systematic review, the final database searches, independent screening, full-text verification, and study-level risk-of-bias assessment must be completed and the PRISMA flow diagram populated with the resulting counts [21].

Future studies should prespecify aphasia as an outcome and combine standardized language testing with precise imaging of hematoma location, white-matter involvement, ventricular extension, residual hematoma, and operative trajectory. Prospective cohorts or language substudies nested within randomized surgical trials would be particularly valuable for separating spontaneous recovery from treatment effects and for determining whether language benefit varies by hemorrhage location, timing, or surgical technique.

5. Conclusions

Aphasia after sICH reflects cortical and subcortical network injury. Putaminal and thalamic hemorrhages produce heterogeneous deficits, with extensive corona-radiata/internal-capsule involvement associated with poorer recovery. Most language improvement occurs within the first three months, although later gains remain possible. Evidence that hematoma evacuation independently improves aphasia remains insufficient because major trials primarily assess global disability. In bilingual patients, L1 and L2 may differ in impairment and recovery, supporting separate longitudinal assessment of both languages.

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