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INTRACRANIAL NASOGASTRIC TUBE MISPLACEMENT: A SYSTEMATIC REVIEW AND PROPOSAL OF THE MOHAN SAFE-NG PROTOCOL

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ABSTRACT
Background: Intracranial nasogastric tube (NGT) misplacement is a rare but potentially catastrophic complication of a commonly performed bedside procedure. Risk is increased when skull-base anatomy is disrupted or when patients have altered sensorium.
Objective: To summarize reported cases of intracranial NGT misplacement, characterize risk factors, anatomical routes, complications and outcomes, and propose an ICU-oriented safety framework.
Methods: A systematic review of published human reports was undertaken. Peer-reviewed English-language reports published from 1980 to 2024 were considered; duplicate reports, animal studies and reports lacking adequate clinical detail were excluded. Data were summarized descriptively.
Results: Sixty-two cases from 50 studies were reported. ICU patients accounted for 79%, altered sensorium was present in 67.7%, and the cribriform plate was the most frequent route (64.5%). Meningitis/encephalitis occurred in 45.2%, intracranial hemorrhage in 19.4%, persistent neurological deficits in 25.8%, and mortality was 12.9%.
Conclusion: Intracranial NGT misplacement carries substantial morbidity and mortality. The MOHAN SAFE-NG Protocol provides a structured framework emphasizing risk assessment, oral visualization, correct measurement, airway exclusion, ultrasound as an adjunct, skull-base screening, cautious advancement, radiological confirmation and governance. Prospective validation is required.

KEYWORDS: nasogastric tube; intracranial misplacement; skull-base injury; cribriform plate; critical care; patient safety; enteral feeding; systematic review

1. INTRODUCTION

Nasogastric tubes are routinely used for enteral nutrition, medication delivery and gastric decompression. Although insertion is usually uncomplicated, malposition can result in serious respiratory, gastrointestinal and neurological injury. Intracranial placement is particularly concerning because a tube introduced through a disrupted skull base can traverse the cranial vault and cause hemorrhage, infection, cerebrospinal fluid leakage, seizures or death.

The supplied review identified altered sensorium, skull-base trauma and prior craniofacial or neurosurgical procedures as clinically important risk contexts. In critically ill patients, reduced consciousness may remove protective responses and make early detection difficult.

The purpose of this review was to consolidate published cases and use recurring risk factors and complications to develop the MOHAN SAFE-NG Protocol. The protocol is presented as a proposed safety framework and not as a validated clinical guideline.

2. Review Question and Objectives

Review question: Among patients reported in the published literature with confirmed intracranial NGT misplacement, what clinical risk factors, anatomical routes, complications and outcomes are described, and what procedural safeguards can be proposed to reduce preventable harm?

- Identify published cases of confirmed intracranial NGT misplacement.
- Describe patient and procedural risk factors.
- Characterize anatomical routes of intracranial entry.
- Quantify reported complications and outcomes.
- Develop a practical safety framework for high-risk ICU patients.

3. MATERIALS AND METHODS

3.1 Study design

This study was designed as a descriptive systematic review of published human case reports and case series describing confirmed intracranial nasogastric tube (NGT) misplacement. The review covered reports published from 1980 to 2024 and was undertaken to characterize the clinical circumstances, predisposing factors, anatomical routes of intracranial entry, associated complications and reported clinical outcomes. Because the available evidence was predominantly case-based, the findings were synthesized descriptively rather than quantitatively. Study identification, screening, eligibility assessment, data extraction and reporting were performed using a structured systematic-review process in accordance with the PRISMA 2020 recommendations [9].

3.2 Eligibility criteria

Included: human cases of confirmed intracranial NGT misplacement reported in peer-reviewed English-language literature. Excluded: animal studies, duplicate articles and reports lacking adequate clinical detail.

3.3 Search period and publication period

The literature search covered publications from 1980 to 2024, with literature identification and collection conducted over a six-month period.

3.4 Data extraction

A structured data-extraction proforma was used to collect clinical setting, risk factors, anatomical route, complications, outcomes and preventive strategies.

3.5 Statistical analysis

Descriptive analysis was performed using frequencies and percentages. Approximate case counts were calculated only as arithmetic conversions of the reported percentages and are displayed as such; they should not be interpreted as substitutes for the original patient-level data. No inferential statistics or quantitative meta-analysis were undertaken because the evidence base was predominantly composed of case reports and case series.

4. RESULTS

The literature search identified 1,268 records. After removal of 768 duplicate records, 500 records underwent title and abstract screening, of which 378 were excluded. Full-text assessment was performed for 122 articles; 72 were subsequently excluded because they did not meet the predefined eligibility criteria. Exclusions comprised 28 reports without intracranial misplacement, 18 reports with insufficient clinical information, 10 non-human studies, and 16 non-English publications. The final qualitative synthesis comprised 50 studies reporting 62 cases of intracranial nasogastric tube misplacement. The study-selection process is summarized in Figure 1 and Table 1.

Table 1. Study Selection (PRISMA Flow Summary)

Stage	Number of studies / cases
Records identified through database searching (n = 1,268)	1,268
Duplicates removed	768
Records screened (titles & abstracts)	500
Records excluded	378
Full-text articles assessed for eligibility	122
Full-text articles excluded	72
Not intracranial misplacement	28
Insufficient clinical information	18
Non-human	10
Non-English publication	16
Studies included in qualitative synthesis	**50 studies (62 intracranial NGT misplacement cases)**

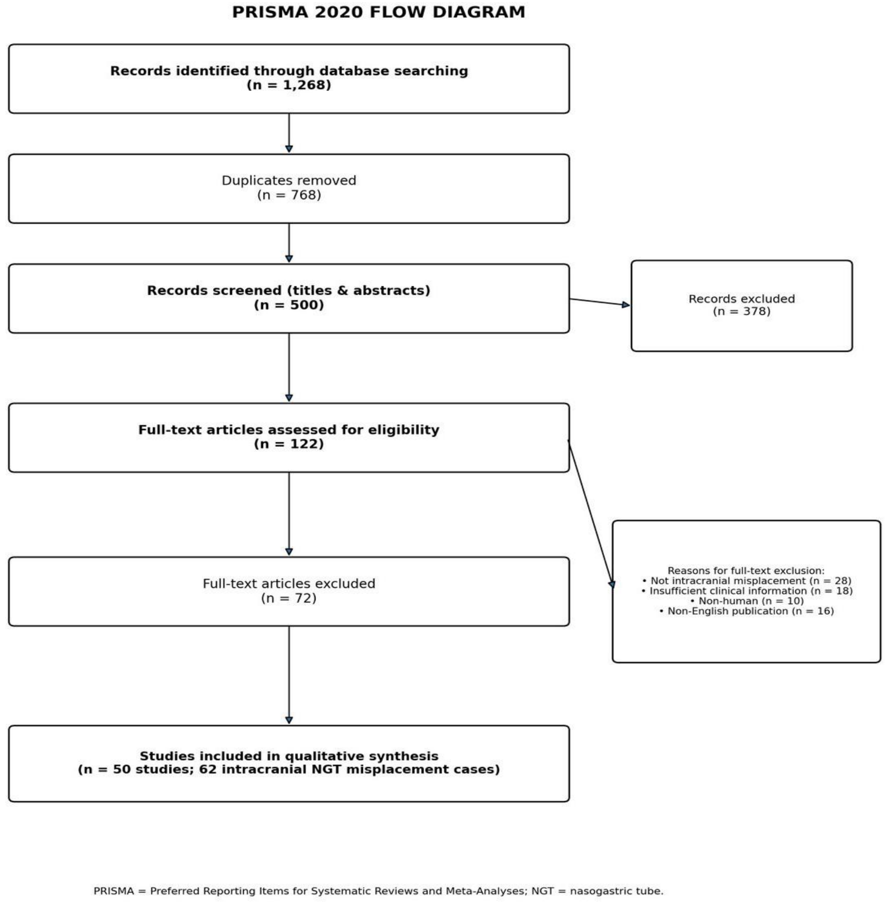


Figure 1. PRISMA 2020 flow diagram showing the reported study-selection process: 1,268 records identified, 768 duplicates removed, 500 records screened, 378 records excluded, 122 full texts assessed, 72 full texts excluded with specified reasons, and 50 studies (62 cases) included.

Table 2. Summary of reported clinical characteristics and outcomes

Variable	Reported %	Approx. cases*	Clinical relevance
ICU setting	79.0	49	High-risk critical-care population
Altered sensorium	67.7	42	Common risk context
Cribriform plate route	64.5	40	Most frequent intracranial pathway
Sphenoid/ethmoid sinus route	17.7	11	Important skull-base pathway
Meningitis/encephalitis	45.2	28	Major infectious neurological complication
Intracranial hemorrhage	19.4	12	Major hemorrhagic complication
Persistent neurological deficit	25.8	16	Important long-term morbidity
Mortality	12.9	8	Substantial fatality

*Approximate counts are derived by multiplying the reported percentage by 62 and rounding; they are not substitutes for the original patient-level dataset.

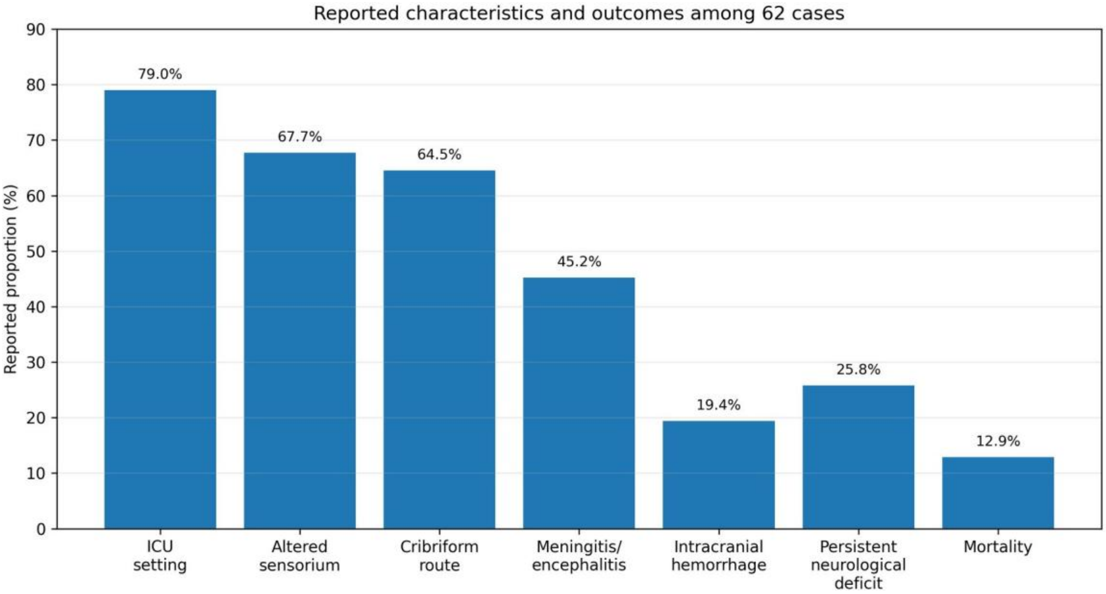


Figure 2. Reported characteristics and outcomes among the 62 cases. Percentages are derived from the reviewed reports.

4.1 Mechanism, Complications and Outcomes

The reported intracranial entry routes were predominantly related to skull-base pathways. The cribriform plate was the most frequently reported route (64.5%), followed by the sphenoid/ethmoid sinus route (17.7%). Reported complications included meningitis/encephalitis, intracranial hemorrhage and seizures. Outcomes included full recovery, neurological deficit at discharge and death. Multiple complications could occur in the same case.

Table 3. Mechanism, Complications and Outcomes

Mechanism of Misplacement	**n (%)**
Through cribriform plate	40 (64.5%)
Through sphenoid sinus / ethmoid	11 (17.7%)
Through skull base defect (post trauma/surgery)	7 (11.3%)
Unknown	4 (6.5%)
Complications Observed (Multiple in some cases.)	n (%)
Meningitis / Encephalitis	28 (45.2%)
Intracranial hemorrhage	12 (19.4%)
Seizures	9 (14.5%)
CSF leak	7 (11.3%)
Death	8 (12.9%)
Outcome	n (%)
Full recovery	28 (45.2%)
Neurological deficit at discharge	16 (25.8%)
Death	8 (12.9%)
Not reported	10 (16.1%)

4.2 Temporal Distribution of Reported Cases

The number of reported cases increased across successive publication periods. Three cases (4.8%) were reported between 1980 and 1989 while seven cases (11.3%) were reported between 1990 and 1999. The number increased to 14 cases (22.6%)

during 2000 to 2009 and reached 24 cases (38.7%) during 2010 to 2019. Fourteen cases (22.6%) were reported between 2020 and 2024. Thus, the period from 2010 to 2019 contained the largest proportion of reported cases. The temporal distribution demonstrates increasing representation of this complication in the published literature over the study period.

Table 4. Temporal Trend of Reported Intracranial Nasogastric Tube Misplacement Cases

Publication Period	**Number of Cases (n = 62)**	**Percentage (%)**
1980 to 1989	3	4.8
1990 to 1999	7	11.3
2000 to 2009	14	22.6
2010 to 2019	24	38.7
2020 to 2024	14	22.6

Total	62	100.0

4.3 Overall Pattern of Findings

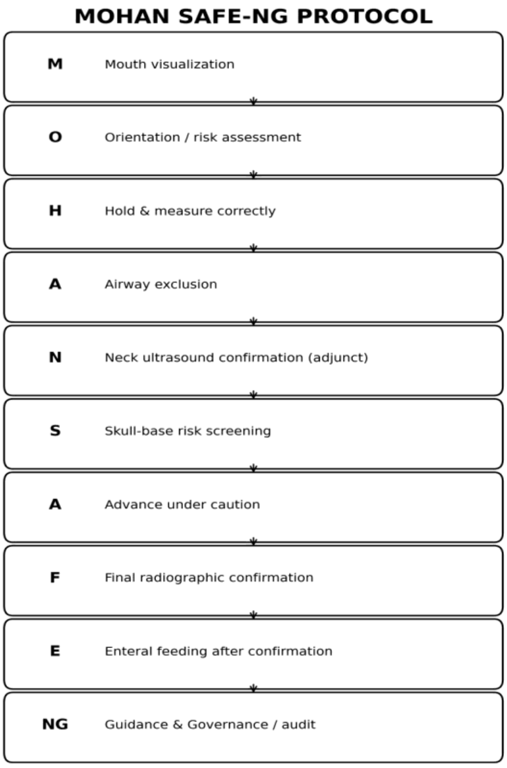
The review identified a consistent pattern involving critically ill patients, clinical risk factors and skull-base-related anatomical pathways. ICU patients accounted for 79.0% of cases while altered sensorium was present in 67.7%. The cribriform plate was the predominant route of intracranial entry at 64.5%. Meningitis or encephalitis occurred in 45.2% of cases and intracranial hemorrhage occurred in 19.4%. Persistent neurological deficits were reported in 25.8% while mortality was 12.9%. Together, these findings demonstrate that although the event is uncommon within clinical practice, the reported cases were associated with substantial neurological, infectious and fatal complications. These descriptive figures should be interpreted in the context of case-based evidence and should not be considered population incidence estimates.

Table 5. Proposed risk-stratification framework

Risk domain	Examples	Suggested response
Neurological	Altered sensorium, reduced protectiv responses	Senior review; enhanced procedura precautions
Trauma	Known/suspected skull-base or facia trauma	Avoid unconsidered blind nasa insertion; evaluate anatomy
Surgical/anatomical	Recent or previous skull-base, sinus o craniofacial surgery	Review operative history and conside specialist-guided approach
Procedural	Resistance, unusual course, repeatec failed attempts	Stop; reassess; do not force advancement
Confirmation	Uncertain bedside findings	Use definitive radiological confirmatior before feeding when indicated

5. MOHAN SAFE-NG Protocol

The acronym represents: M – Mouth visualization; O – Orientation (risk assessment); H – Hold & measure correctly; A – Airway exclusion; N – Neck ultrasound confirmation; S – Skull-base risk screening; A – Advance under caution; F – Final radiographic confirmation; E – Enteral feeding after confirmation; NG – Nasogastric



Guidance & Governance.

Figure 3. MOHAN SAFE-NG Protocol. Ultrasound is proposed as an adjunct and does not replace definitive confirmation where radiological confirmation is required.

Table 6. MOHAN SAFE-NG components

Component	Action	Purpose
M – Mouth visualization	Visualize oral cavity/oropharynx wher feasible during insertion	Detect abnormal passage/coiling
O – Orientation	Assess neurological status, trauma, skull-base risk and altered anatomy	Identify high-risk patients befor insertion
H – Hold & measure correctly	Measure appropriately and advanc gently	Reduce preventable malposition/trauma

A – Airway exclusion	Use appropriate clinical/procedural safeguards	Reduce respiratory placement risk

Component	Action	Purpose
N – Neck ultrasound	Use ultrasound as an adjunct where expertise is available	Provide additional bedside information
S – Skull-base screening	Screen for skull-base trauma or relevant surgery	Avoid hazardous blind passage
A – Advance under caution	Stop with resistance or unexpected trajectory	Prevent force-related injury
F – Final radiographic confirmation	Confirm position radiologically when indicated	Definitively establish safe tube location
E – Enteral feeding	Feed only after appropriate confirmation	Prevent administration through a misplaced tube
NG – Governance	Document, train, audit and review adverse events	Sustain safety and quality improvement

6. DISCUSSION

The principal finding is the severity of outcomes despite the rarity of intracranial NGT misplacement. The concentration of cases in ICU patients and the frequency of altered sensorium indicate that the complication is particularly relevant to critically ill patients who require enteral access but may have impaired neurological examination or altered protective reflexes.

The cribriform plate was the most frequently reported route. This anatomical pattern is clinically plausible in the presence of anterior skull-base disruption. Prior sinonasal or skull-base surgery may also alter normal barriers and anatomy. Published literature supports particular caution after skull-base procedures and emphasizes accurate confirmation of tube position.

The reported complication burden was substantial, with meningitis/encephalitis reported in 45.2%, intracranial hemorrhage in 19.4%, persistent neurological deficits in 25.8% and mortality in 12.9%. These figures arise from a case-based evidence base and should not be interpreted as population incidence or causal risk estimates.

The proposed MOHAN SAFE-NG Protocol translates the recurring themes into a practical sequence. Its most important conceptual feature is risk stratification before insertion and a requirement for definitive confirmation before feeding in high-risk or uncertain cases. The protocol is hypothesis-generating and requires prospective implementation and validation.

7. Strengths of the Study

- Focuses on a rare but potentially catastrophic patient-safety event directly relevant to critical care.
- Aggregates 62 reported cases from 50 studies, providing a broader view than an individual case report.
- Examines both anatomical mechanisms and clinical outcomes.
- Converts recurring risk factors into a practical, memorable safety framework.
- Clearly identifies the need for prospective multicenter validation rather than presenting the proposed protocol as already validated.

8. Limitations of the Study

- The evidence base is predominantly case reports and case series and is therefore highly susceptible to publication and reporting bias.
- Case reports cannot establish incidence, relative risk or causal relationships.
- Clinical definitions and outcome reporting are heterogeneous.
- Some reports may contain incomplete information regarding insertion technique, skull-base anatomy, confirmation method and long-term outcome.
- No control group or comparative intervention group was available.
- No quantitative meta-analysis was performed.
- The MOHAN SAFE-NG Protocol has not undergone prospective validation and its individual components should not be interpreted as proven to prevent intracranial misplacement.

9. Clinical and Research Implications

- Institutions should identify high-risk patients before blind nasal tube insertion.
- Known or suspected skull-base disruption should trigger escalation and consideration of alternative or specialist-guided strategies.
- Unusual resistance or unexpected trajectory should prompt immediate cessation and reassessment.
- Tube use for feeding should follow appropriate confirmation of position.
- Future studies should prospectively evaluate protocol adherence, adverse events, failed placement, confirmation accuracy and patient outcomes.
- Multicenter validation is needed before the MOHAN SAFE-NG Protocol can be recommended as a formal clinical guideline.

10. CONCLUSION

Intracranial NGT misplacement is a rare but potentially devastating complication. In the reviewed cases, ICU setting, altered sensorium and skull-base-related anatomical pathways were prominent. Meningitis/encephalitis, intracranial hemorrhage, persistent neurological deficits and mortality were substantial. The MOHAN SAFE-NG Protocol offers a structured prevention and governance framework centered on risk screening, cautious insertion and appropriate confirmation.

Prospective multicenter studies are required to establish its effectiveness.

11. DECLARATIONS

Ethics approval

Not applicable to a review of previously published cases.

Consent for publication

Not applicable to aggregated published literature.

Funding

No funding was received for this study.

Conflicts of interest

The authors declare no conflicts of interest.

Data Availability Statement

The data supporting the findings of this study are available from the corresponding author upon reasonable request. Requests for access to the data will be evaluated in accordance with applicable ethical, institutional and confidentiality requirements.

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Disclosure statement:

The authors declare that they have no conflicts of interest or financial relationships that could have influenced the design, conduct, analysis or reporting of this study.

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