

Diagnostic Accuracy of pH Testing to Confirm Nasogastric Tube Placement

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Dysphagia after stroke

- Affects up to 78% of patients immediately following stroke
- Persist in 11% to 50% of stroke patients
- Associated with complications, including dehydration, malnutrition and aspiration
- Associated with a 3 fold increased risk in pneumonia, which can result in death
- Associated with poorer rehabilitation outcomes, prolonged hospital stay, dependency at discharge and social isolation







Nasogastric tube feeding

- Approximately 3000 stroke patients will require to be fed by nasogastric tubes (NGT) per year in Scotland to avoid malnutrition, dehydration and to give essential medications
- Misplacement into the respiratory tract occurs in 3% to 4%
- Serious incidents, including death, has increased by 60% between 2014-17
- Death as a result of NGT misplacement should be a "never event"







Nasogastric Tube Position



[source: google images, credit: American Nurse Today]





Checking nasogastric tube position









How accurate do you think the standard pH <=5.5 to confirm correct NGT placement?

use your phones to feedback go to <u>www.menti.com</u> and enter code

https://www.mentimeter.com/s/fd72e5019a141a11559185a2a311198c/630446489802/edit





Problems with the first line test: pH <= 5.5 False negative test (pH >5.5) can occur in

patients who secrete less gastric acid

- Receiving anti-acid medications (>40% of stroke patients)
- Achlorhydria
- Buffering by NGT feeds
- NGT aspirates cannot be obtained in up to 46% of patients
- Tester's ability to differentiate the small differences in pH
 - Colour vision, environmental factors & time







Problems with the second line test: X-ray

- Chest X-ray considered gold standard
- Repeated tests increase risk of excessive radiation
- Expensive
- Delays feeding (17-47 hours)
- Misinterpretation errors
 - More cases of serious harm/death (45% to 8%) compared to pH readings



[source: google images, credit: Patient Safety Advisory]





Modified pH/lipase stick

- A solution is to check non-acid gastric aspirates
- pH stick modified to detect human gastric lipase (HGL) (Ingenza, Roslin, Scotland)
 - Secreted from gastric fundus
 - Considered to be acid stable
- The pH stick is coated in tributyrin
 - HGL will breakdown triglycerides to release acid and alcohol
 - Therefore, the modified pH/lipase test would aim to detect both pH and HGL activity







Do you think the modified pH stick <=5.5 to confirm correct NGT placement is more accurate than the standard pH stick?

use your phone to feedback go to <u>www.menti.com</u> and enter code

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Method



- Important to avoid additional X-rays to verify the different types of aspirate
- Large number of aspirates from the stomach, oesophagus, lung and salvia were obtained from patients undergoing scope procedures
- The reference standard was direct confirmation of the type of aspirates confirmed by the operator undertaking the gastroscopy or bronchoscopy
- At the end of the procedure the research nurse tested two fresh samples using the standard and the modified pH stick
- Blinded pH testing undertaken at laboratory on two samples that were previously frozen







Participants/Samples





Distribution of pH by sample type



Accuracy of the modified and non-modified pH sticks for all gastric samples compared to non-gastric samples at the pH <=5.5

Diagnostic test	pH stick	All % (95% Cl)	Confounding factors* % (95% CI)
Sensitivity	Standard	68 (57 to 77)	73 (57 to 85)
	Modified	66 (56 to 75)	68 (52 to 81)
Specificity	Standard	79 (74 to 84)	79 (70 to 85)
	Modified	81 (76 to 85)	82 (74 to 88)
Overall	Standard	76 (72 to 81)	77 (70 to 83)
agreement	Modified	77 (73 to 81)	78 (71 to 84)

Specificity: measures the proportion of true negatives (non-gastric) that are correctly identified



Sensitivity:

measures the

proportion of

true positives

aspirate) that are correctly

(gastric

identified

*Confounding factors included antacid medication, pernicious anaemia and/or gastric surgery; CI, confidence intervals



Differences between paired fresh and frozen gastric samples

Fresh	Frozen														
	2	2.5	3	3.5	4	4.5	5	5.5	6	6.5	7	7.5	8	8.5	Total
2	42	2	0	0	0	0	0	0	0	0	0	0	0	0	44
2.5	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2
3	0	0	2	1	0	0	0	0	0	0	0	0	0	0	3
3.5	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
4	0	0	0	0	2	0	0	0	0	0	0	0	0	0	2
4.5	0	0	0	0	0	1	1	0	0	0	0	0	0	0	2
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5.5	0	1	0	0	0	0	1	1	2	2	0	0	0	0	7
6	0	0	0	0	0	0	0	1	1	0	0	1	0	0	3
6.5	0	0	0	0	0	0	1	1	2	1	0	0	0	0	5
7	0	0	0	0	0	0	0	0	0	4	1	4	0	0	9
7.5	0	0	0	0	0	0	0	0	1	1	1	4	2	0	9
8	0	0	0	0	0	0	0	0	0	0	0	0	2	1	3
8.5	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
9	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
Total	42	3	4	1	3	1	3	3	6	8	3	9	5	1	92

- There no significant differences between fresh and frozen gastric samples at pH ≤5.5 [85/92 (92%), McNemar's test=0.14, p=0.7]
- When the individual paired fresh and frozen gastric samples were observed between the observers there were only complete agreement in 57/92 (62%) of the samples [kappa=0.496, 95% CI 0.364 to 0.627].



Results summary

- The standard and modified pH sticks had a similar sensitivity
- Sensitivity was low in terms of correctly identifying gastric aspirate, regardless of whether patients were on antacids or had other confounding factors
- Two-thirds of oesophageal aspirates had a pH <=5.5
- Both sticks were able to rule out bronchial samples (100% specificity) and most of the salvia samples (98% specificity)
- Supports previous findings that testers have difficulties in differentiating between small differences in pH colours, particularly across the pH range 5 to 7







Strengths and limitations

- Included a large number of bronchial and oesophageal aspirates that have previously been under-reported
- The source of aspiration was verifiable, which would not be possible if taken directly from the NGT
- The pH of the samples were also tested by a blinded assessor to determine expectation bias
- The population undergoing scope procedures may differ from those requiring nasogastric feeding
- The pH results may be confounded by the fasting conditions or disease







What are the implications for practice?

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Conclusion

- There were no significant differences between paired standard and modified pH tests for identifying gastric aspirates in the presence and absence of antacid medications/confounding factors
- Current guidelines and training strategies need to be updated to better support healthcare professionals to accurately check the position of the NGT
- Further refinement of the modified pH stick and/or development of bedside tests are required to accurately detect NGT placement in stroke patients and other patient populations







References

- Rowat AM, Graham C, Dennis M (2018) Study to determine the likely accuracy of pH testing to confirm nasogastric tube placement. BMJ Open Gastro 2018; 5 (1): e000211. doi: 10/1136/bmjgast-2018-000211.
- Rowat AM, Graham C, Dennis M (2018) Diagnostic accuracy of a pH stick to detect gastric lipase to confirm the correct placement of nasogastric tubes. BMJ Open Gastro 2018; 5(1): e000218. doi: 10/1136/bmjgast-2018-000218.



