Acute vestibular syndrome in the ED

Original Article

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A multicenter retrospective cohort study on incidence and diagnostics in emergency department patients with acute vestibular syndrome

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Abstract

Objective: Acute vestibular syndrome (AVS) is a common symptom presented by emergency department (ED) patients. Differentiating peripheral from central etiology poses a challenge and clinical practice lacks a uniform diagnostic approach. This study aims to provide insight on incidence and diagnostics in ED patients presenting with AVS in the Netherlands.

Methods: A multicenter retrospective cohort study on ED patients presenting with AVS in two hospitals during 3 years. Primary endpoints are incidence, diagnostics and diagnosis at ED versus follow-up. A secondary endpoint includes therapy.

Results: 500 AVS cases were included. The annual incidence was 0.1%. 85 ED patients (17.0%) were diagnosed with stroke, 285 (57.0%) with non-stroke and 130 (26.0%) with an unsure etiology. At follow-up, diagnosis was corrected in 145 patients (29.0%), with stroke missed in 29 (5.8%). A triad of clinical tests (HINTS) was reported in 106 (21.2%) patients, a CT in 342 (68.2%) and a MRI in 153 (30.6%). Antiplatelet therapy was prescribed in 135 cases. In 69% of these, initial diagnosis was corrected to non-stroke. For 8 patients who received thrombolysis, initial diagnosis was corrected in 3. Of those patients where stroke was initially not identified, 23 (79%) received suboptimal treatment in lieu of antiplatelet therapy.

Conclusion: The annual incidence of AVS in Dutch ED patients is 0.1%. ED diagnosis is often uncertain, with one-third of diagnoses corrected. This study substantiates clinical practice lacks a uniform diagnostic pathway with an overuse of CT and underuse of HINTS. Further research on optimal diagnostic approach is warranted to improve treatment of AVS.

Keywords
Acute vestibular syndrome in the ED
Vertigo, emergency department, patient outcome assessment, retrospective studies, Netherlands

Capsule summary
What is already known: In emergency department patients with acute vestibular syndrome, differentiating peripheral from central causes poses a major clinical challenge.
What is new in the current study: Comparing diagnosis at discharge from the emergency department with diagnosis at follow up reveals that the initial diagnosis is corrected in a substantial number of cases, highlighting that the diagnostics and treatment in these patients require improvement.
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Introduction

Acute onset continuous isolated vertigo or dizziness, defined as acute vestibular syndrome (AVS), is a relatively common main symptom presented at the emergency department (ED), estimated at 2.6 million (2.5-3.3%) ED visits in the United States (US) annually [1,2]. Of note, it is difficult to make a statement on the incidence of dizziness, as this complaint is described variably (e.g. vertigo, spinning sensation, lightheadedness). According to the Grace-3 guidelines AVS is defined as acute dizziness without other neurological symptoms or other cause of dizziness, which is continuously present and persists at time of evaluation[3]. The incidence of AVS in ED patients in the Netherlands is unknown. The etiology of AVS can be roughly categorized into two groups: peripheral or central. Peripheral causes, such as neuritis vestibularis, are generally considered benign and constitute a majority. In contrast, diagnosis of a central cause (mostly a posterior circulation ischemic stroke), is less prevalent and may constitute a life-threatening neurologic event[4,5]. Studies report incidences of stroke as an underlying cause in 3-6%[6–8], with two smaller studies reporting incidences of 10-25% in selected populations of patients with at least one risk factor for cardiovascular disease (CVD)[9,10]. In clinical practice, and in particular in the ED, differentiation between peripheral and central causes poses a difficult task. Posterior circulation strokes frequently present with ‘isolated’ vertigo, i.e. without additional focal neurological signs and therefore lack well established ‘red flags’ that may indicate a central cause[11]. A standardized diagnostic guideline was not available prior to this study[12,13]. Various diagnostic tools, such as the HINTS exam (i.e. Head Impulse test, observation of Nystagmus and Test of Skew) and several imaging modalities have been evaluated. The HINTS, when performed by trained physicians, has been shown to be more accurate in identifying a posterior circulation stroke compared to magnetic resonance imaging (MRI) < 48 hours after symptom onset[14]. HINTS performance of less specialized physicians remains unsure[14]. While a CT is frequently performed in these patients, the sensitivity of CT for early-presenting acute ischemic stroke has been shown to be as low as 10%[15]. Patients presenting with AVS may be misdiagnosed with a peripheral cause instead of a central etiology, and vice versa[16]. As a result, stroke diagnoses may be missed and this may impose a critical impact on morbidity and mortality, with indications for acute thrombolysis and secondary prevention (e.g. antiplatelet
Acute vestibular syndrome in the ED therapy) not identified[16]. In contrast, patients who are incorrectly diagnosed with a stroke at initial presentation may be overtreated.

In the Netherlands, similar to other countries, consensus on a standardized diagnostic approach is lacking at the time of this study. To improve acute diagnostics and treatment of patients presenting with AVS, the first step is to provide insight in how we perform now. In addition, incidence of AVS in ED patients in the Netherlands is unknown. This multicenter study aims to provide insight on incidence and current diagnostic approach in ED patients presenting with AVS in the Netherlands. Furthermore, we identify to what extent diagnosis is corrected after follow up and its effects on over and undertreatment.
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Methods

Study design
This multicenter retrospective cohort study was conducted at the ED of two large teaching hospitals: Jeroen Bosch hospital (JBH) (s Hertogenbosch, the Netherlands) and St. Antonius hospital (SAH) (Nieuwegein and Utrecht, the Netherlands).

Study population
Inclusion criteria were main complaint of AVS in patients aged 18 years or older, presenting at the ED between January 1st, 2016 and January 1st 2019 (Jeroen Bosch hospital) and October 13th, 2017 and October 13th, 2020 (St. Antonius hospital). We included patients with AVS, defined as acute dizziness without other neurological symptoms or other obvious cause of dizziness, which is continuously present and persists at time of evaluation at the ED[3]. Exclusion criteria were trauma capitis or lumbar puncture prior to onset of symptoms, pregnancy and dizziness as part of an epileptic seizure. If a patient presented multiple times with AVS, only the first ED visit was included.

Outcome measures
The primary outcome measures included incidence of AVS as a main symptom at the ED, diagnostic approach (i.e. HINTS exam and imaging through non contrast computed tomography (NCCT) and/or magnetic resonance imaging (MRI)) at ED presentation and diagnosis at ED presentation and after follow up of six months.

Diagnoses at ED presentation and follow up were divided into three groups: stroke (i.e. ischemic, hemorrhagic, transient ischemic attack), non stroke (usually vestibular neuritis)) and unsure (i.e. differentiation between peripheral or central etiology was not clear to the treating physician). The final diagnosis after follow-up was confirmed or corrected by a neurologist based on clinical course and imaging if performed (CT or MRI). This final diagnosis was considered as the golden standard. The follow up was based on documentation in the electronic medical record for a duration up to 6 months post the emergency department visit. A missed stroke diagnosis was defined as a ‘non stroke’ or ‘unsure’ diagnosis at ED
Acute vestibular syndrome in the ED presentation, corrected to ‘stroke’ after follow up. Patients were evaluated by either a neurologist or ED physician and all cases were discussed with a neurologist before assigning a diagnosis.

The secondary outcome measures were: prescribed therapy (i.e. thrombolysis and secondary prevention through antiplatelet medication), number of hospitalized patients and length of stay in days.

Data collection
Software packages Microsoft SQL Server Management Studio and CTcue Amsterdam were used to search and select medical records on predefined terms in Dutch such as ‘vertigo’ (see supplemental material 1, which lists the search terms in Dutch and English). From these identified records, two independent assessors of each hospital selected patients eligible for inclusion (D.W.A.M.Z. and P.M.M. for JBH and R.E. and S.V. for SAH). Discrepancies were resolved by a third independent assessor (K.E.J. for JBH and M.S.S. for SAH). The primary and secondary parameters were subsequently manually collected.

Data analysis
Data was analyzed using IBM Corporation SPSS Statistics, version 26. Normally distributed numerical data were analyzed through one way ANOVA, non-normally distributed data through Kruskal Wallis tests. For binary data a chi square test, or in case of small numbers a Fisher Freeman Halton exact test, was used. A two-tailed p value of < 0.05 was considered statistically significant.

Ethical approval
Ethical approval for this study was waived by the ethics review committee on July 15th, 2019 for JBH and February 14th, 2020 for SAH.
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Results

Study population
A total of 149,661 ED visits of patients ≥ 18 years old were registered during the study period, of which 10,220 medical records matched the predefined search terms (see supplemental material 1). Of these, 500 patients had AVS. The selection of study population is shown in figure 1 (Fig. 1).

Baseline characteristics
The baseline characteristics are shown in table 1. Stroke patients were significantly older male. Hypertension, dyslipidemia, nicotine abuse, atrial fibrillation at ED presentation and a history of cardiovascular disease (CVD) and atrial fibrillation were also found to be predominantly present in stroke patients.

Incidence
During the three study period a total of 149,661 ED visits were registered for both hospitals, which translates to an annual number of ED visits of roughly 28,000 for JBH and 22,000 for SAH. A total of 500 ED visits during the three study period were due to AVS. This equals a total annual incidence of AVS in adult ED patients of 0.1%.

Diagnosis at ED and follow up
Eighty-five (17.0%) patients were diagnosed with stroke at ED presentation (table 2) and 285 (57.0%) were diagnosed as non stroke. Diagnosis was unsure in 130 (26.0%) patients. After follow up, diagnosis was corrected in 145 (29.0%) cases. Final diagnosis after follow up consisted of 89 (17.8%) stroke diagnoses, 380 (76.0%) non stroke diagnoses and 31 (6.1%) unsure diagnoses. The stroke group includes 86 (96.6%) ischemic strokes and 3 (3.4%) hemorrhagic strokes.

Twenty-nine (5.8%) ED patients who were initially diagnosed as non stroke (n=9) or unsure (n = 20) were corrected to a stroke diagnosis after follow up. This group was defined as 'missed stroke'. In contrast, in 25 of
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85 (29.4%) ED patients initially diagnosed with stroke, diagnosis was corrected to non stroke (N = 20) or unsure (N = 5) after follow up.

Diagnostic approach

The diagnostic tools used at ED presentation and follow up are shown in table 3.

At ED presentation a HINTS exam was reported in 106 (21.2%) patients. A NCCT was performed in 342 (68.2%) cases. MRI was performed in 14 (2.8%) of patients and a computed tomography angiography in 9 patients (1.8%). During follow up, MRI was conducted in 139 patients (27.8%), predominantly in stroke and unsure cases (p value < 0.001).

Therapy and hospitalization

The therapies prescribed at ED presentation are shown in table 4.

Of 85 patients diagnosed with stroke at ED presentation, 8 received thrombolysis. In 3 of these thrombolysis cases, diagnosis was changed to non stroke after follow up. In addition, clopidogrel and acetylsalicylic acid were prescribed in 104 (20.8%) and 31 (6.2%) cases respectively (either diagnosed as stroke or unsure at ED presentation). In 72 (5%) of these patients, diagnosis was corrected to non stroke after follow up and therefore this group inappropriately received antiplatelet therapy.

Regarding therapy opportunities for patients whose stroke diagnosis was initially missed at ED presentation (N = 29), 10 would have been eligible for secondary prevention by antiplatelet therapy and 23 for thrombolysis (exclusively based on evaluation of timeframe and contra indications)[17].
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Discussion

This multicenter study is the first to report on incidence and diagnostic approach of AVS in ED patients in the Netherlands. The annual incidence of AVS is 0.1%. In addition, daily clinical practice shows underreporting of HINTS and overuse of NCCT. Final diagnosis is corrected in nearly one-third of ED patients.

The annual incidence concluded in this study is considerably lower than previous reported in studies from the United States (2.5-3.3%)[1,2]. In the Netherlands, patients are generally seen first by a general practitioner (GP), who then refers selected high-risk patients to an ED. Therefore, a substantial number of low-risk patients with AVS may be ‘filtered out’ and not presented at an ED. In addition, our study used a strict symptom definition (e.g. only isolated vertiginous dizziness), whereas other studies used a broader definition of dizziness[18].

At ED presentation, 17.0% of patients with AVS were diagnosed with stroke. This is in line with previous studies that showed stroke incidence ranging from 10-25% in selected populations of patients with at least one risk factor for CVD[9,10]. The ‘gatekeeper’ function of Dutch GP’s may explain this comparable high stroke rate in relatively higher risk patients in our study. Other studies reported remarkably lower incidences of stroke ranging from 3-6%[6–8], which may again be explained by the broader definition of dizziness that has been applied.

In this study, diagnosis at ED presentation was corrected after follow up in roughly one-third of cases. This is lower than the conversion rate of 44.0% reported by Royl et al[5]. It should be noted however, that follow up was only available in one-fourth of their patients. Due to our retrospective study design, our follow up was dependent on final reported diagnosis. It was assumed that if patients did not return, the diagnosis was right. In addition, this study showed a substantially lower incidence of missed stroke of 5.8% versus 35% reported by Kerber et al[6]. In Kerber et al patients were assessed by ED physicians, whereas in this study patients were either seen by an ED or neurology physician. It is unknown to what extent this may have
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influenced the conversion rate, but lack of a true golden standard and patient selection may contribute to this difference.

Regarding diagnostics, a HINTS exam was reported in only 21.2% of patients, while based on literature, this may now be considered as the golden standard[3]. This is consistent with other reports (10-30%)[12,19–21]. Due to our retrospective study design, we were dependent on reported HINTS exams, which might result in an underestimation. Despite this, the noteworthy underuse may be due to neurologists and ED physicians not feeling sufficiently competent in applying or interpreting the HINTS exam. In addition, unfamiliarity with this examination may also play a role. Our findings underline the importance of better education in performing HINTS exam on the ED.

A NCCT was conducted in 68.2% of ED patients. This is considerably higher than reported by Saber Tehrani et al. who found 39.2% of ED patients with dizziness receive a NCCT in the US[22]. This may be due to the selection of high-risk patients in the Dutch setting compared to the US. However, this imaging modality has a poor performance in detecting posterior circulation strokes, with a sensitivity of only 7-10% and may lead to physicians being falsely reassured of a peripheral etiology[15]. Presumably, the main reason for conducting a NCCT is to rule out intracranial hemorrhage. However, in ED patients with dizziness without focal neurological symptoms, screening for intracranial hemorrhage rarely shows a positive result. The extensive use may be due to its readily availability and lower cost compared to MRI.

One-third of patients received a MRI, of which the majority was performed during follow-up and only 2 % at the ED. The relatively low number of MRIs performed at the ED is in accordance with the findings by Saber Tehrani [22] and may primarily be attributable to the organization of patient flow from the ED to admission in the Netherlands. In Dutch EDs, MRI availability is relatively limited, and to minimize patient stay times at the ED, MRIs are typically conducted after patient admission to the ward rather than during the initial ED visit. Additionally, although a delayed MRI has greater sensitivity in detecting cerebral infarctions compared to an early MRI [15], it remains to be determined whether increasing the number of MRIs is necessary if the HINTS protocol is more effectively taught and implemented.
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A stroke was missed at ED presentation in 5.8%. One-third of these cases would have been eligible for additional antiplatelet therapy. Furthermore, exclusively based on evaluation of timeframe and contra indications, 79.3% of missed stroke patients would have been eligible for thrombolysis[17]. Although untreated ischemic stroke is associated with an increased morbidity and mortality, it has to be taken into account whether thrombolysis is desirable in AVS. In case of mild symptoms, administration of thrombolitics may not be justified due to its potential severe side effects[23].

Over 50% of ED patients were admitted for inpatient observation. A majority (79.2%) of these patients had an unsure diagnosis at ED presentation, whereas a minority had underlying stroke. Earlier differentiation of AVS etiology may prevent costly admittance at the hospital.

Recently a guideline focused on this particular patient group was published[3]. Our study substantiates the need of application of these guidelines, which may help to improve knowledge and training of emergency physicians on this subject. For instance, training of EP’s on performing the HINTS exam, minimizing unnecessary use CT scan or MRI. These adaptations may also lead to an important cost reduction. And hopefully, a better selection of patients that are suffering from a stroke who need treatment and adequate follow-up.

An important limitation of this study includes its retrospective design, which allows for missing data and selection and reporting bias due to non-blinding of researchers for outcome. The lack of a true golden standard for the diagnosis is a challenge. We consider the HINTS examination, when performed by adequately trained physicians, as the most appropriate test (GRACE-3). However, in our study only 21% of patients underwent the HINTS examination. We had to comply with the best available diagnosis. In addition, data on follow up was only available from the two teaching hospitals. Although unlikely, if patients presented at another medical care facility it is unknown whether alternative diagnoses were made, possibly implying an underestimation of missed strokes.

Another limitation is that we focused exclusively on AVS, i.e. patients with continuous dizziness. It should be noted that patients with episodic (non-continuous) dizziness/vertigo may also have had a TIA. Finally, it remains a challenge to conduct research on dizziness, given the highly variable descriptions of symptoms.
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and the evolving definitions in recent years. We used strict inclusion criteria, which may have led to an underestimation of incidence.

An important strength of this study is its multicenter design. To our knowledge this is the first multicenter study to provide insights into the incidence and diagnostic pathway of AVS within Dutch ED’s. Additional strengths encompass the substantial study cohort and comprehensive assessment of eligibility by multiple evaluators.

In summary, the annual incidence of AVS in Dutch ED’s is 0.1%, with a central etiology in roughly one-sixth of ED patients. The initial diagnosis is corrected after follow up in nearly one-third of cases. This study substantiates that differentiating stroke from non stroke causes at the ED poses a difficult clinical challenge. Daily clinical practice lacks a uniform diagnostic approach, with only minority of patients receiving a HINTS exam and overuse of NCCT. With the current diagnostic workup, strokes are missed and patients are at risk for over and undertreatment. To improve patient care, further research on an optimal and uniform diagnostic approach is warranted.

Ethical statement
Ethical approval for this study was waived by the ethics review committee on July 15th, 2019 for Jeroen Bosch hospital and February 14th, 2020 for St. Antonius hospital.

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Conflicts of interest None declared

Acknowledgements None declared

Author contributions
Renske E.H.M. Bijl - Writing-original draft, writing-review & editing, investigation, data curation, formal analysis
Domenique W.A.M. Zaunbrecher - Data curation, investigation, analysis, writing-review & editing
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Petra M. de Muynck - Data curation, investigation, analysis, writing–review & editing

Ryanne Eggink - Data curation, investigation

Evian Willems - Data curation (supporting), investigation

Ronique Timmer - Data curation (supporting)

Sam Koning - Writing–review & editing

Maricke S. Sanders - Validation, writing-review & editing, supervision

Kim E. Jie - Conceptualization, methodology, supervision, validation, writing-review & editing
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References


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#### Diagnosis at ED presentation

<table>
<thead>
<tr>
<th></th>
<th>Stroke (N = 85)</th>
<th>Non stroke (N = 130)</th>
<th>Unsure (N = 285)</th>
<th>Total (N = 500)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age in years, median (IQR)</td>
<td>74.0 (19)</td>
<td>66.0 (25)</td>
<td>73.0 (14)</td>
<td>0</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Male sex, n (%)</td>
<td>51 (60.0)</td>
<td>106 (37.2)</td>
<td>64 (49.2)</td>
<td>0</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>History of CVD, n (%)</td>
<td>46 (54.1)</td>
<td>87 (30.2)</td>
<td>55 (42.3)</td>
<td>0</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Family history of CVD, n (%)</td>
<td>13 (28.3)</td>
<td>34 (30.9)</td>
<td>24 (40.7)</td>
<td>285 (67.0)</td>
<td>0.324</td>
</tr>
<tr>
<td>Hypertension, n (%)</td>
<td>57 (67.1)</td>
<td>131 (46.0)</td>
<td>68 (52.3)</td>
<td>0</td>
<td>0.003</td>
</tr>
<tr>
<td>Dyslipidemia, n (%)</td>
<td>63 (74.1)</td>
<td>136 (47.7)</td>
<td>82 (63.1)</td>
<td>0</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Diabetes mellitus, n (%)</td>
<td>19 (22.4)</td>
<td>44 (15.4)</td>
<td>20 (15.4)</td>
<td>0</td>
<td>0.294</td>
</tr>
<tr>
<td>Nicotine abuse, n (%)</td>
<td>45 (56.6)</td>
<td>99 (38.1)</td>
<td>52 (43.0)</td>
<td>38 (7.6)</td>
<td>0.021</td>
</tr>
<tr>
<td>Atrial fibrillation at ED, n (%)</td>
<td>13 (15.3)</td>
<td>11 (4.3)</td>
<td>8 (6.7)</td>
<td>37 (7.4)</td>
<td>0.002</td>
</tr>
<tr>
<td>History of atrial fibrillation, n (%)</td>
<td>17 (20.0)</td>
<td>24 (8.4)</td>
<td>13 (10.0)</td>
<td>0</td>
<td>0.010</td>
</tr>
</tbody>
</table>

SD = standard deviation, CVD = cardiovascular disease, ED = emergency department
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Table 1: Baseline characteristics
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Table 2: Diagnosis at ED and follow up

<table>
<thead>
<tr>
<th>Diagnosis at ED</th>
<th>N = 500</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stroke, n</td>
<td>60</td>
</tr>
<tr>
<td>Non stroke, n</td>
<td>20</td>
</tr>
<tr>
<td>Unsure, n</td>
<td>5</td>
</tr>
<tr>
<td>Total, n (%)</td>
<td>85 (17.0)</td>
</tr>
</tbody>
</table>

| Stroke, n      | 60      |
| Non stroke, n  | 273     |
| Unsure, n      | 87      |
| Total, n (%)   | 500 (100.0)|

* 86 (96.6%) ischemic strokes, 3 (3.4%) hemorrhagic strokes

ED = emergency department
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Table 3: Diagnostic tools at ED and follow up

<table>
<thead>
<tr>
<th>Diagnosis at ED presentation</th>
<th>N = 500</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Stroke</td>
</tr>
<tr>
<td></td>
<td>N = 85</td>
</tr>
</tbody>
</table>

**Performed at ED**

<table>
<thead>
<tr>
<th></th>
<th>n (%)</th>
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<tbody>
<tr>
<td>HINTS, n (%)</td>
<td>9 (10.6)</td>
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<table>
<thead>
<tr>
<th></th>
<th>n (%)</th>
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<tbody>
<tr>
<td>NCCT, n (%)</td>
<td>82 (96.5)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MRI, n (%)</td>
<td>1 (1.2)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CTA, n (%)</td>
<td>3 (3.5)</td>
</tr>
</tbody>
</table>

**Performed during follow up**

<table>
<thead>
<tr>
<th></th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NCCT, n (%)</td>
<td>0 (0.0)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MRI, n (%)</td>
<td>39 (45.9)</td>
</tr>
</tbody>
</table>

ED = emergency department, HINTS = Head Impulse Test, Nystagmus and Test of Skew, CT = computed tomography, MRI = magnetic resonance imaging, NCCT = Non contrast computed tomography

*Obtained through Fisher Freeman Halton exact test due to maximum of allowed small expected
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Table 4: Therapy at ED presentation and hospitalization

<table>
<thead>
<tr>
<th>Diagnosis at ED presentation</th>
<th>N = 500</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Stroke</td>
</tr>
<tr>
<td></td>
<td>N = 85</td>
</tr>
</tbody>
</table>

#### Therapy prescribed at ED

<table>
<thead>
<tr>
<th>Therapy prescribed at ED</th>
<th>N = 85</th>
<th>N = 285</th>
<th>N = 130</th>
<th>N = 500</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trombolysis, n (%)</td>
<td>7 (8.2)</td>
<td>0 (0.0)</td>
<td>1 (0.8)</td>
<td>8 (1.6)</td>
</tr>
<tr>
<td>Clopidogrel, n (%)</td>
<td>48 (56.5)</td>
<td>1 (0.1)</td>
<td>55 (42.3)</td>
<td>104 (20.8)</td>
</tr>
<tr>
<td>Acetylsalicylic acid, n (%)</td>
<td>15 (17.6)</td>
<td>0 (0.0)</td>
<td>16 (12.3)</td>
<td>31 (6.2)</td>
</tr>
</tbody>
</table>

#### Hospitalization

<table>
<thead>
<tr>
<th>Hospitalization</th>
<th>Inpatient, n (%)</th>
<th>Length of stay in days, median (IQR)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N = 85</td>
<td>N = 285</td>
</tr>
<tr>
<td></td>
<td>64 (75.3)</td>
<td>2 (4)</td>
</tr>
<tr>
<td></td>
<td>109 (38.2)</td>
<td>0 (1)</td>
</tr>
<tr>
<td></td>
<td>103 (79.2)</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>276 (55.2)</td>
<td>N/A</td>
</tr>
</tbody>
</table>

*ED = emergency department

*Obtained through Fisher Freeman Halton exact test due to maximum of allowed small expected cell counts

** Obtained through Kruskal-Wallis Test
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Legends for illustrations

Figure 1: Flowchart of study population selection

EMR = emergency medical record, ED = emergency department, AVS = acute vestibular syndrome

* Or one of its related terms or synonyms (see supplemental material 1, which lists the search terms in Dutch and English)