

Effect of tremors on handwriting in patients at end stage renal diseases and on chronic hemodialysis.

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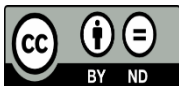


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ABSTRACT

For document experts, determining the reasons behind tremors in handwritten strokes is never easy. When they faced shaky line writings, they conclude that the document is a fake, even if this may not always be the truth. Some genuine writers who are elderly, illiterate, or experiencing other health problems may also have tremors in their handwriting. Patients with chronic hemodialysis develop metabolic abnormalities, myopathies, and cognitive impairment with a subsequent effect on the quality of the handwriting. To assess the effect renal impairment and chronic hemodialysis on handwriting. This study included 50 patients on chronic hemodialysis for end-stage renal disease. Their handwritings were evaluated in comparison to earlier records from the hospital and prior paperwork. To determine whether there were any tremors in the up, down, or both strokes, their handwriting was analyzed using a hand lens. 82% of the patients having down strokes tremors compared to their prior writings. Appearance of tremors in individual handwriting is a good indicator of development of motor dysfunction.



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1. INTRODUCTION

End stage renal diseases can induce evident tremors in writings of such patients indicating development of motor dysfunction. The field of forensic document examination is significantly impacted by handwriting tremors. Determination the possible cause of tremors observed in handwriting samples is always a challenge for a forensic document examiner. This could be significant if there are doubts regarding the accuracy of a document authored by a person with actual motor impairment (Leung et al., 2024).

The error that affects almost everyone's thoughts is that the corrugated lines are indications of forgery. It is always assumed that such jerky writings are the product of forgery, even though this may not be correct. When compared to a healthy, mature writer, the handwriting of genuine writers who are illiterate, elderly, or suffering from certain medical conditions typically exhibits unstable non-rhythmic strokes because of poor neuromuscular coordination [1].

Dialysis-related arterial hypotension can directly result in neurological problems, including dialysis dementia, dialysis dysequilibrium syndrome, hypertension encephalopathy, and cerebrovascular accidents. Additionally, hemodialysis is linked to the exacerbation of atherosclerosis and accelerates the development of Wernicke's encephalopathy, hemorrhagic stroke, subdural hematoma, osmotic myelinolysis, opportunistic infections, intracranial hypertension, and neuropathy [8].

Therefore the main objective of this article is highlighting the type of tremor in handwriting specimens of patients receiving chronic hemodialysis. It will also aid in listing the main causes of tremors in handwriting and differentiate types of tremors from one another.

2. Subjects and methods

Fifty patients were included in this cross-sectional study. Patients were at end-stage renal disease receiving regular hemodialysis three times a week at the El-Minia University hospital's hemodialysis unit from January to December, 2023.

The study's inclusion criteria were that patients had to be aged from 20 to 60 years old, of either gender, in generally stable hemodynamics, and have completed the primary level of education that ensures they can read and write.

The study's exclusion criteria were, illiterate, trauma or fracture in the upper limb, taking psychotropic drugs or experiencing withdrawal from them, vision problems or any other neurological and local neuromuscular disorders.

Participants were asked to fulfill a form that the researchers had created, the participants' Arabic handwriting samples were gathered and all participants utilized the same papers, pens, and supporting surface to assess the minute variations in handwriting characteristics (Figure 1).

The samples of the handwriting of each participant were examined by the aid of magnifying hand lenses in daylight and both samples before and after hemodialysis were examined for assessment.

3. Results

Each subject provided demographic information, including age, gender, place of residence, educational attainment, employment status, and handedness, as indicated in Table (1).

As shown in table 2& chart 1 there were statistically significant down strokes tremors ($P < 0.001$) after chronic hemodialysis. Pre dialysis showed no tremors in all cases 50(100%) compared to 41(82%) with down strokes tremors, 2(4%) with upstroke tremors, 5(10%) with up & down strokes, and 2(4%) with no tremors (Figure 2).

4. Discussion

Tremor is indicated by an involuntary, rhythmic, and recurrent movement of the pen from side to side. These tremulous strokes are instant changes from the desired direction of the pen lines and are attributed to nervous impulses affecting the muscles indicating loss of control of the pen. There are many different reasons for handwriting tremors. Some of reasons including aging, illness, and drug abuse [6].

Other causes are writer's cramps and pathological or psychiatric disorders. Pathological tremors resulting in a convulsive manner of writing independent of the will and therefore beyond the control of the writer.

Wavering and broken strokes forming the letters of a writer's signature will deviate from the normal style, but they retain sufficient individual characteristics [2].

Current study revealed presence of tremors in down strokes in 82% of the cases, tremors in up & down strokes in 10% of the cases, tremors in up strokes in 4% of the cases and absence of tremors in 4% of the cases. Presence of tremors in the affected writings as compared to their normal writings indicates overall inability of subjects to execute writings in a smooth manner that observed in smooth strokes at some places as observed by [13]. This indicates a sudden loss of the control over the used pen. This is due to experiencing osmotic demyelination syndrome in patients at end-stage renal disease, it may develop as a result of the renal disease itself, or due to osmotic changes induced by dialysis [12].

Chronic hemodialysis may be associated with tremors due to dyselectrolytemia such as hypomagnesemia and hypokalemia which causes depression of nerve and muscle functions consisting of decreased tendon reflexes, muscle flaccid paralysis, and impaired consciousness terminating in coma [7].

Most of the disorders to evoke tremors are usually included in those suppressing the central nervous system. One of them is the impaired function of basal ganglia that may play a role in the pathogenesis of asterixis. It was reported that there were functional or organic disturbances in the basal ganglionic region of the patients with hepatic encephalopathy using MR imaging and proton magnetic resonance spectroscopy [9].

Bhagwath, (2001) examined the writings of elder people who experience tremors as a result of a weak neuromuscular condition. In these situations, writings will be slower and exhibit a tremor that is frequently rhythmic, with shaky and broken strokes. Despite all of these deteriorations, the writer's internal consistency is still obvious.

Illiterate and uneducated people have a wider range of tremors as the writing process is unfamiliar to them,. Despite the lack of control, the writing is strong detected by heavy pen pressure. The lines of an experienced writer in poor health are typically lighter, more tremulous, weaker, and finer than the powerful lines of an ignorant writer [5].

Tremors due to illness resulted in weak brain-muscle coordination is the cause of tremor in these specific situations. In these situations, writings exhibit inconsistency. When under a lot of stress, a writer will not be able to write in their own distinctive manner. Sometimes handwriting might become so different leading to distorted word shape. Handwritings may temporarily improve, but writers never return to their maximum skill level [6].

Drug and medication-induced tremors may alter a person's writing style and even writing ability. erratic pressure, tremor, or other irregularities in writing are caused by nervousness and restlessness. Spasms are abrupt, involuntary spasms of the muscles. Caffeine causes vibratory tremor. Muscle relaxants can sometimes cause mild, irregular, or fading pen pressures [3].

[10] explained how alcohol intoxication can cause tremors: Alcoholism results in tremor, jerking, and uncontrollable muscle activity. Handwriting appears unpredictable due to overwritten portions, irregular strokes, and breaks in pen lines.

Tremor is most easily detected and most frequently found sign of forgery. Tremor results from slow writing or drawing. When a writer slow down to copy or trace a line, the line will become wavier. A fine wave

causes corrugation in the writing line, tiny side to side motion that can be seen under magnification [14].

Some forgers attempt to imitate writing that contains tremor which is much harder to duplicate. Genuine tremors are more erratic than tremor of forgery. In cases of fake tremor, the forger has a tendency to develop a rhythmic movement with higher frequency than the genuine case. The forger will usually not place tremor on curves but will execute a smoother stroke than the known writer could have made (Kipouràs, 2022).

Tremors due to forgery are also seen clubbing up with other inherent signs of forgery like blunt starts and endings, abnormal pen pauses, abnormal pen lifts, retouching and patching, which can be significant in discriminating such forms of tremors from genuine tremors [11].

5. Conclusion

Identification of tremors in questioned document examination is considered a big challenge and patients on chronic hemodialysis develop tremors in down strokes that can facilitate the process of identification.

This study recommends that forensic document examiners should be aware about each type of tremors while dealing with questioned document.

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Figure 1. showing the model of the handwriting request.

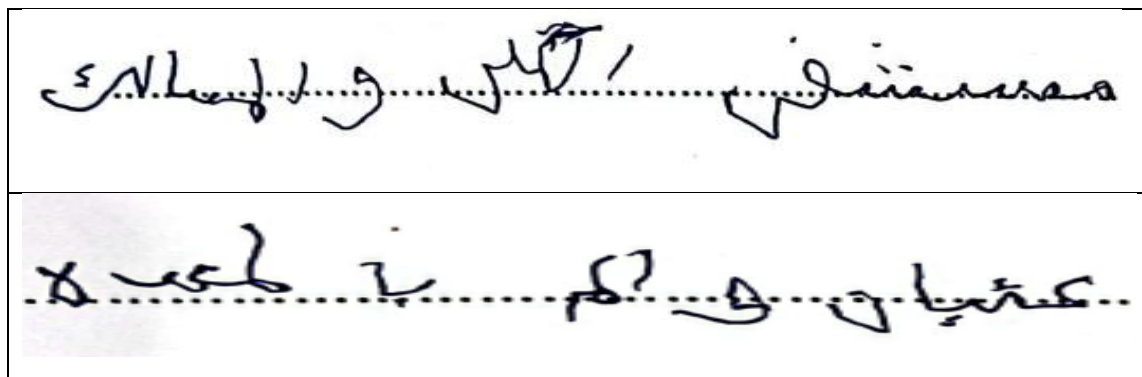


Fig. 2 showed down strokes tremors that associated with chronic hemodialysis.

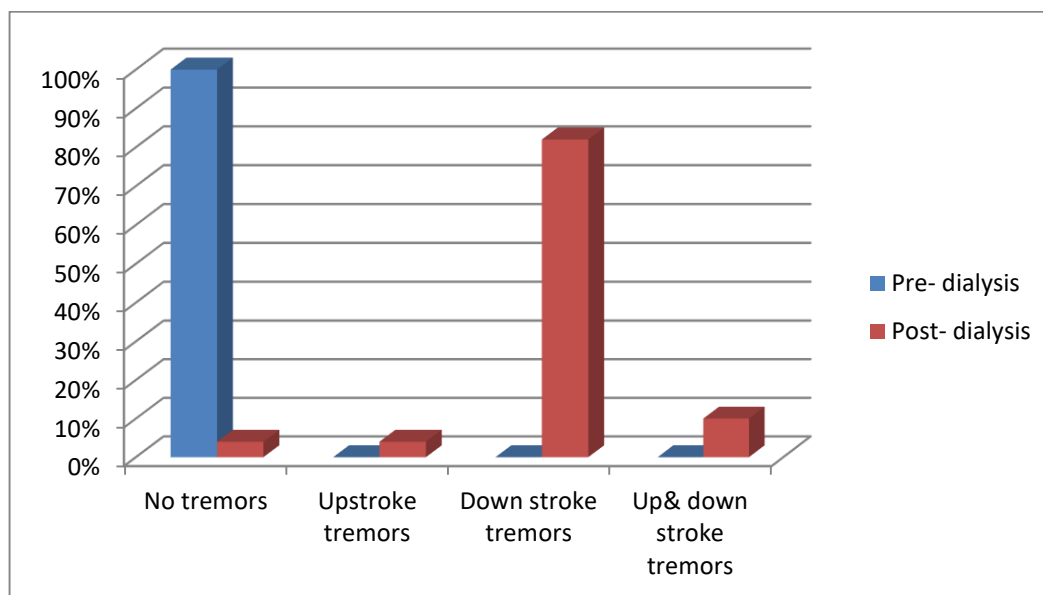


Chart (1) Tremors before and after the dialysis.

Table (1): shows demographic details of participants in the study.

| | | |
|--------------------------|----------------------|----------|
| Age | <i>Range</i> | (27-60) |
| | <i>Mean ± SD</i> | 46.6±9.7 |
| Gender | <i>Male</i> | 27(54%) |
| | <i>Female</i> | 23(46%) |
| Residence | <i>Rural</i> | 17(34%) |
| | <i>Urban</i> | 33(66%) |
| Educational level | <i>Low</i> | 9(18%) |
| | <i>Medium</i> | 20(40%) |
| | <i>High</i> | 21(42%) |
| Work | <i>Not work</i> | 15(30%) |
| | <i>Free business</i> | 19(38%) |
| | <i>Employee</i> | 16(32%) |
| Handedness | <i>Right-handed</i> | 41(82%) |
| | <i>Left-handed</i> | 9(18%) |

-Different parameters with number of subjects and percentage of each parameter.

Table (2) Tremors before and after the dialysis.

| | | Pre-dialysis | Post- dialysis | P value |
|----------------|------------------------------------|---------------------|-----------------------|-------------------|
| | | N=50 | N=50 | |
| Tremors | <i>No tremors</i> | 50(100%) | 2(4%) | <0.001* |
| | <i>Upstroke tremors</i> | 0(0%) | 2(4%) | |
| | <i>Down stroke tremors</i> | 0(0%) | 41(82%) | |
| | <i>Up& down stroke tremors</i> | 0(0%) | 5(10%) | |

- Wilcoxon signed rank test for ordinal qualitative data between the two times within each group

- *: Significant level at P value < 0.05