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Investigating the relationship between possible assessment tools (visual analogue scale, Tampa Scale of Kinesiophobia and Brief pain inventory) for SCD pain

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Abstract

Background: Pain is among the most frequent consequences of sickle cell disease (SCD) and this is of global health concern. Here, we present a relationship between three (3) possible pain assessment tools to guide and provide insight into SCD pain.

Aim: To investigate the plausible relationship between three assessment tools (visual analogue scale, Tampa Scale of Kinesiophobia and Brief pain inventory) that could be used for SCD pain

Methodology: The case-control study was located at the Ghana Institute of Clinical Genetics (sickle cell clinic) adult. The controls consisted of students of University of Ghana Medical School (UGMS) in Korle-Bu. After obtaining ethical clearance from College of Health Sciences (CHS-Et/M.1-P5.12/2023-2024), a validated pain assessment questionnaires were used for data collection. Four (4) mL of blood was collected in EDTA tube for full blood count and Hemoglobinopathy cellulose acetate electrophoresis. The data analysis was done utilizing the Statistical Package for the Social Science (SPSS) version 21 and Microsoft Excel 2016.

Results: There was a paradigm shift when tampa scale of kinesophobia (TSK) was included in the statistical analysis between visual analogue scale (VA) and Brief pain inventory (BPI) scores in SCD subjects. General characteristics, gender-matched and age-matched data had statistical significance in age, BMI, heart rate, Temperature, BPI PI, BPI PS, VA PR, VA PI, and some selected hematological parameters during ANOVA in the three groups. SS subjects appeared relatively lean and showed an increase in fear of musculoskeletal activities avoidance.

Conclusion: There was strong association between BPI, VA and TSK with a p-value of 0.000 in SCD subjects.

Keywords: Pain, Sickle cell disease, visual analogue scale, Tampa Scale of Kinesiophobia, Brief pain inventory (BPI)

Introduction

Recurrent pain is the number one cause of Sickle cell disease (SCD) related hospitalizations [1] associated with low quality of life [2], depression, functional disability, increased somatic burden and anxiety [3].

In Ghana, SCD affects 2% of all newborns annually [4]. Despite the fact that SCD can cause intravascular and extravascular hemolysis [5], it is actually characterized by normocytic intrinsic hemolytic anemia [6] brought on by defective hemoglobin and or mutation at the sixth position of beta globin gene [7]. SCD is therefore, hereditary with its hallmark being vaso occlusive painful crisis [8].

The painful experience is multidimensionally subjective, depicting a limitation in the already established neurobiological mechanism of pain and the transition from acute to chronic pain [9]. Apart from International Association for the Study of Pain (IASP) definition of pain as an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage [10], it is now evident that pain may be reported in the absence of tissue damage or any pathophysiological cause [11].

Here, we sought to investigate the plausible relationship between three (3) possible assessment tools for SCD pain, namely, the visual analogue scale (VAS), Tampa Scale of Kinesiophobia (TSK) and Brief pain inventory (BPI). VAS [12] ask SCD patients to rate pain intensity on a spectrum, either choosing a single number or subject's facial expression at the time the assessment is completed. Since it remains possible to generate interindividual variability in VAS pain-intensity scores, this research adds on with TSK and BPI. BPI [13] assesses pain severity and impact of pain on the daily activities of subjects experiencing SCD pain, while TSK [14] quantifies fear associated with movement which may be due to SCD pain. We thus anticipated that, subjects experiencing vaso occlusive crisis, might have higher TSK scores as well as higher BPI scores, hence, the focus.

Aim: To assess the visual analogue scale, Tampa Scale of Kinesiophobia (TSK) and Brief pain inventory (BPI) on pain severity in study subjects.

Methodology

Study Design, Study Site, Study Population

This was a case-control stud located at the Ghana Institute of Clinical Genetics (sickle cell clinic) in the Ablekuma South Metropolitan District of Accra. The control group were students of University of Ghana Medical School (UGMS) in Korle-Bu, Accra, Ghana.

Inclusion Criteria

- Any sickle cell disease patient above age 13 years were included irrespective of his/her genotype.
- Ballas criteria for steady state was strictly followed [15].
- Patients with SCD-related chronic complications were added in this study.

Exclusion Criteria

- Patients who had a blood transfusion within the last 3 months and those who declined to respond to the questionnaire were excluded.

Sample Size Determination And Sampling Strategy

Cochran formula was used; $n = [z^2(p)(1-p)]/e^2$. At 95% confidence interval, z =1.96, desired precision 'e' of 0.05, and SCD prevalence 'p' being 0.02, the minimum sample size was calculated.

On the field, a hundred and sixty – two (162) SCD cases were obtained, while the control population was 52 and these were matched for both age and gender, hence giving a total sample size of 214.

Sampling Strategy

Convenient sampling.

Data Collection, Tool And Methods

After obtaining ethical clearance from College of Health Sciences (CHS-Et/M.1-P5.12/2023-2024), pain severity assessment questionnaire and venous blood samples were obtained for analysis of full blood count and hemoglobin electrophoresis. These are briefly described below:

Visual analogue scale

This is a validated subjective assessment of pain. A 10cm line is used to represent the degree of pain. The zero mark is consistent with no pain whilst the 10 cm mark is consistent with the worst pain possible. Individuals were therefore required to grade their pain per this graduation.

Tampa scale of kinesiophobia

This is a 17-item questionnaire used to quantify fear associated with movement which may be due to pain. Individuals responding to the questionnaire record their responses based on the extent to which they agree with the statements. The degree of agreements ranges from strongly disagree, somewhat disagree, somewhat agree and strongly agree. These correspond to a score of 1, 2, 3 and 4 respectively**.**

Brief pain inventory

The brief pain inventory is a validated questionnaire used in the assessment of the severity and impact of pain on the daily activities of individuals with musculoskeletal diseases, malignancies and depression. It makes use of a rating scale ranging from 0 to10 where 0 is consistent with no pain and 10 is consistent with pain as bad as you can imagine. Interference of activities is also assessed using a rating scale of 0 to 10 with 0 consistent with no pain and 10 consistent with complete interference.

Cellulose acetate electrophoresis

The experiment involved migrating hemoglobin protein dissolved in an alkaline buffer through an electric field using an electrophoresis tank and sample holder. Materials included an alkaline buffer, cellulose acetate membrane, chromatographic paper, and blotting paper. EDTA whole blood was processed to obtain red blood cells, washed, and placed on the marked cellulose acetate membrane. Electrophoretic run parameters were set, and hemoglobin migration was assessed by comparing it to a reference hemoglobinopathy.

Results

Socio-Demographics

The control group appeared younger than the study group. The mean age for the SCD group was 29.65±12.20(162) while the mean age for the control group was 22.73±1.59(52). The study group was predominately composed of females with 62.7% and 49.4% of the study population had tertiary level of education. While 82.5% of the study population were single, Christians formed the bulk (89.2%) of the study population. Majority of subjects in both SCD and controls never smoked.

General Characteristics

In analysis of variance, age, heart rate, BMI, Temperature, BPI PS, BPI PI. VA PI, VA PR and some selected hematological parameters were statistically significant when VOC and Steady state were compared, as well as, when control, VOC and Steady state were compared in Sickle cell patients (Table 1). A similar trend was also observed in age - matched analysis in SCD patients less than 30 years (*See appendix for Supplementary Tables 1a and 1b*).

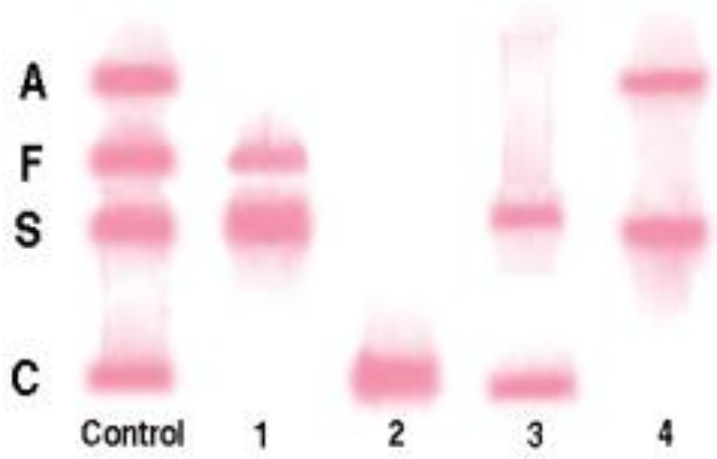

Fig. 1 Cellulose acetate electrophoretogram for the hemoglobinopathy identified in this study

Visual Analogue Scale (Va), Tampa Scale Of Kinesiophobia (Tsk) And Brief Pain Inventory (Bpi) Scores

TSK analysis indicated that SS subjects **s**howed much fear of avoidance in musculoskeletal activities (Tables 1; *Supplementary Tables 1b and 2b*). The Cronbach alpha in SCD TSK analysis was 0.643 and in controls, it was 0.594.

Table 1: General characteristics of study population

	Control			Vasoocclusive Crisis (VOC) SCD cases				p - value	Steady state SCD				p-value	
	$AA_{(39)}$	$AS_{(13)}$	p-value	$SS_{(36)}$	$SC_{(13)}$	$SF_{(2)}$	p-value	VOC x controls	$SS_{(78)}$	$SC_{(31)}$	$SF_{(2)}$ p-value		Steady state x VOC	Controls x VOC x Steady state
Gender Male Female	24 15	5 8		12 24	5 8	2 0			30 38	11 20	1 1			
Age (years)	22.77±1.61*	22.62±1.56	0.771	28.26±9.28	15.21±33.78	28.50±14.85	0.107	0.049	28.77±11.28	32.71±15.73	20.50±3.54	0.202	0.022	0.001
BMI (kg/m^2)	25.16±4.32	23.83±3.45	0.320	21.12±4.84	22.74±5.72	20.00±0.51	0.560	0.005	21.11±4.59	22.68±3.37	28.42±2.33	0.018	0.125	0.000
SBP (mmHg)	115.15±8.99	116.23±9.08	0.710	113.64±13.03	119.54±9.21	119.50±15.56	0.324	0.561	113.82±11.36	117.47±14.64	111.00±19.80	0.375	0.505	0.447
DBP (mmHg)	75.33±6.40	71.77±4.38	0.069	70.11±12.69	73.08±13.53	83.00±7.07	0.337	0.140	70.31±11.36	71.52±13.64	66.5±6.36	0.795	0.697	0.266
HR (bpm)	76.38±6.43	74.54±6.46	0.376	88.22±10.30	87.00±10.90	76.00±8.49	0.277	0.000	84.21±11.26	80.97±9.86	60.00±15.60	0.008	0.000	0.000
Temp (ºC)	36.57±0.28	36.57±0.33	0.750	36.47±0.47	36.65±0.47	37.20±0.57	0.015	0.000	36.43±0.30	36.46±0.30	36.10±0.14	0.258	0.004	0.000
BPI PS score	0.26±0.91	0±0.00	0.311	4.90±1.90	5.13±1.43	4.50±2.40	0.884	0.000	1.79±2.01	2.81±2.17	2.25±3.18	0.072	0.000	0.000
BPI PI score	0.21±0.94	0±0.00	0.427	5.54±2.64	6.55±2.02	5.35±2.90	0.458	0.000	2.45±2.78	3.58±3.15	2.35±3.32	0.185	0.000	0.000
TSK	24.21±6.09	21.92±3.38	0.204	38.06±8.27	37.38±9.54	43.00±5.66	0.690	0.000	35.03±6.54	36.58±7.97	28.50±7.78	0.222	0.149	0.000
VA PI	0.44±1.67	0±0.00	0.350	6.39±1.92	7.77±1.23	6.00±2.83	0.06	0.000	1.58±2.45	1.80±2.41	2.00±2.83	0.895	0.000	0.000
Visual analogue pain rating	0.18±0.68	0±0.00	0.348	3.09±1.37	3.62±1.12	3.00±1.41	0.416	0.000	0.81±1.27	0.90±1.30	1.00±1.41	0.931	0.000	0.000
Hb (g/dl)	12.96±1.15$_{(38)}$	11.66±1.82$_{(11)}$	0.006	8.09±1.38$_{(31)}$	10.31±0.87		0.000	0.000	7.99±1.35$_{(62)}$	10.50±1.34$_{(30)}$	12.40±3.54	0.000	0.000	0.000
Rbc (10^6/mm^3)	4.88±0.88	4.62±0.50	0.356	2.76±0.62	3.90±0.47		0.000	0.000	2.90±0.59	4.01±0.74	5.28±1.39	0.000	0.000	0.000
Wbc(10^3/mm^3)	4.14±2.46	3.18±1.80	0.236	14.76±14.20	7.87±2.50		0.092	0.000	9.73±3.00	7.20±1.91	5.65±1.34	0.000	0.001	0.000
Plt(10^3/mm^3)	236.18±104.82	257.09±48.11	0.526	461.97±184.41	265.67±117.73		0.000	0.000	401.39±136.03	279.37±78.71	195.00±49.50	0.000	0.000	0.000
MCV(µm^3)	75.89±5.82	73.73±7.60	0.317	88.10±10.21	79.33±7.19		0.007	0.000	81.93±10.64	78.47±8.44	72.30±0.71	0.147	0.012	0.000
MCHC (g/dl)	34.45±1.66	34.15±1.15	0.578	34.36±1.17	33.57±1.32		0.056	0.266	28.06±4.13	33.48±2.14	32.25±0.35	0.000	0.000	0.000

Legend: *mean ± sd SCD = Sickle Cell Disease, VA PI = visual analogue pain intensity BPI PI score = Brief pain Inventory Pain Intensity BPI PS score = Brief pain Inventory Pain Severity BMI= Body mass Index SBP= Systolic Blood Pressure DBP= Diastolic Blood Pressure HR= Heart Rate TSK= Tampa Scale of Kinesiophobia VA PI= Visual Analogue Pain Intensity Hb= Haemoglobin rbc= Red blood cell wbc= White blood cell Plt= Platelet MCV= Mean corpuscular volume MCHC= Mean corpuscular haemoglobin concentration

***Supplementary Table 1a*: Age – matched characteristics of the study population**

	<30 years					>30 years
	Controls			VOC		VOC
	$AA_{(39)}$	$AS_{(13)}$	p-value	SCD_{30}	Control x VOC p-value	$SCD_{(21)}$
Gender Male Female	24 15	5 8		12 18		7 14
BMI (kg/m^2)	25.16±4.33	23.83±3.45	0.320	20.00±4.54	0.000	23.77±4.86
SBP (mmHg)	115.15±8.99	112.23±9.07	0.316	112.70±11.40	0.498	119.24±13.08

DBP (mmHg)	75.33±6.40	71.77±4.39	0.069	72.37±12.96	0.302	69.95±12.85
HR (bpm)	76.38±6.43	74.53±6.46	0.374	86.90±11.48	0.000	88.19±9.08
Temp (°C)	36.57±0.28	36.58±0.33	0.915	36.48±0.36	0.451	36.64±0.42
BPI PS score	0.26±1.31	0.00±0.00	0.480	5.15±2.67	0.000	4.66±1.59
BPI PI score	0.22±0.94	0.00±0.00	0.406	5.14±2.07	0.000	6.69±2.02
TSK sum	24.21±6.09	21.92±3.38	0.204	36.89±9.59	0.000	37.03±6.71
VA PI	0.44±1.67	0.00	0.350	6.70±1.80	0.000	6.76±2.00
Visual analogue pain rating	0.18±0.68	0.00	0.348	3.10±1.09	0.000	3.29±1.45
Hb (g/dl)	12.96±1.15$_{(32)}$	11.66±1.82$_{(11)}$	0.008	8.78±1.61$_{(26)}$	0.000	8.5±1.63$_{(18)}$
Rbc (10^6/mm^3)	4.88±0.88	4.62±0.49	0.359	3.10±0.80	0.000	2.97±0.78
Wbc (10^3/mm^3)	4.14±2.46	3.18±1.80	0.243	13.90±15.65	0.001	11.16±4.45
Plt (10^3/mm^3)	236.18±104.82	257.09±48.11	0.529	433.23±212.82	0.000	358.56±144.06
MCV (µm^3)	75.89±5.82	73.73±7.60	0.332	85.92±9.3	0.000	85.72±11.56
MCHC (g/dl)	26.16±2.21	34.15±1.15	0.000	34.67±1.90	0.000	34.37±1.73

***Supplementary Table 1b*: Age – matched characteristics of the study population**

	<30 years							**>30 years**			
	Steady state				**VOC**			**Steady state**			**VOC**
	SS$_{(54)}$	SC$_{(17)}$	SF$_{(2)}$	p-value	SS$_{(23)}$	SC$_{(6)}$	p-value	SS$_{(7)}$	SC$_{(5)}$	p-value	SS$_{(13)}$
Gender Male Female	21 33	3 14	1 1		7 16	4 2		1 6	1 4		5 8
BMI (kg/m^2)	21.16±2.69	20.99±2.53	28.42±2.83	0.001	19.93±4.82	20.14±4.16	0.923	33.40±1.37	26.17±2.73	0.000	23.39±4.17
SBP (mmHg)	113.43±10.54	110.00±10.57	111.00±19.80	0.499	111.96±11.84	116.33±10.67	0.420	117.57±15.24	123.00±18.92	0.735	116.7±14.91
DBP (mmHg)	70.06±11.01	67.00±11.33	66.50±15.56	0.575	70.74±12.17	77.67±16.43	0.262	64.85±14.00	81.80±16.10	0.080	69.00±13.99
HR (bpm)	84.83±8.77	81.51±9.21	66.00±15.56	0.012	87.61±11.90	87.00±9.08	0.908	84.57±5.71	83.00±6.48	0.666	89.31±6.90
Temp (°C)	36.46±0.31	36.50±0.34	36.10±0.14	0.244	36.44±0.34	36.57±0.45	0.441	36.40±0.11	36.42±0.41	0.908	36.52±0.25
BPI PS score	1.79±2.07	3.20±2.41	2.25±3.18	0.015	5.11±2.18	5.07±1.95	0.968	1.70±2.13	2.88±2.01	0.356	4.51±1.27
BPI PI score	2..45±2.82	3.63±3.63	2.35±3.32	0.375	4.59±2.69	5.80±2.71	0.468	1.94±2.57	3.60±2.93	0.322	6.68±2.29
TSK sum	34.44±6.64	34.06±6.51	28.50±7.78	0.463	38.21±9.35	34.67±10.93	0.431	36.29±6.55	39.00±5.15	0.460	37.77±6.26
VA PI	1.54±2.30	1.76±2.68	2.00±2.83	0.942	6.43±1.95	7.50±0.84	0.205	0.71±1.25	1.60±2.30	0.405	6.31±1.93
Visual analogue pain rating	0.72±1.16	0.71±1.10	1.00±1.41	0.944	3.13±1.32	3.00±0.89	0.822	0.43±0.79	1.40±2.19	0.000	2.92±1.50
Hb (g/dl)	8.07±1.44$_{(42)}$	9.95±1.41$_{(16)}$	12.40±3.54	0.000	8.22±1.32$_{(20)}$	10.67±0.94	0.000	7.42±1.16	11.00±0.84	0.262	7.86±1.52$_{(11)}$
Rbc (10^6/mm^3)	2.92±0.58	3.75±0.71	5.28±1.36	0.000	2.80±0.60	4.12±0.56	0.000	2.40±0.62	4.30±0.60	0.000	2.67±0.68
Wbc (10^3/mm^3)	10.06±3.05	7.22±1.83	5.65±1.34	0.001	16.10±17.29	6.58±2.03	0.197	10.00±3.02	5.66±1.53	0.004	12.33±5.18
Plt (10^3/mm^3)	416.12±120.64	296.31±83.39	195.00±49.50	0.000	492.70±254.94	235.00±74.10	0.024	481.67±186.25	250.00±53.03	0.018	406.09±129.86
MCV (µm^3)	82.21±11.5	78.38±7.62	72.50±0.71	0.249	88.15±8.95	78.50±6.47	0.022	77.00±8.44	74.80±12.52	0.026	88.00±12.69

	1											
MCHC (g/dl)	34.16 ±1.88	34.20 ±1.22	32.25 ±0.35	0.303	34.40±2 .67	33.37±1.2 8	0.366	33.68±1.70	34.70±1.13		0.736	34.28±1.2 9

Even though visual analogue scale (VA) versus Brief pain inventory (BPI) scores in SCD subjects showed no statistical significance after analysis, the relationship had a paradigm shift when tampa scale of kinesophobia (TSK) was added (Table 2).

Table 2: Relationship between visual analogue scale (VA), tampa scale of kinesiophobia (TSK) and Brief pain inventory (BPI) scores in SCD subjects

	VA score	TSK	BPI severity score	BPI score interference score	p-value
SS	$2.57\pm3.09_{(116)}$	$35.73\pm7.27(116)$	$2.77\pm2.45_{(116)}$	$3.14\pm3.09_{(116)}$	0.000
SC	$2.90\pm3.01_{(44)}$	$36.82\pm8.34(45)$	$3.49\pm3.15_{(44)}$	$4.45\pm3.15_{(44)}$	0.000
SF	$1.00\pm1.73_{(3)}$	$35.75\pm10.05(5)$	$2.43\pm2.27_{(3)}$	$2.67\pm2.41_{(3)}$	0.000

Discussion

The current study presented a novel insight in the relationship between VA, TSK and BPI scores in SCD pain (p-value =0.000).

VAS was informative as it seems to assess the acute clinical change [16] of SCD pain of a patient. However, BPI determined the extent to which SCD pain impacted the patients' daily activities [17] and this was more robust. In SCD, much pain interfered with patient's daily activities such as work, general activity, mood, sleep quality, walking and enjoyment of life. Subjects gave responses that ranged from relatively moderate to severe pain.

An addition of TSK [18] to both VAS and BPI, provided an adjunct pain assessment tool. The Cronbach alpha for TSK analysis assessed internal consistency among the set of questions the subjects responded to. Acceptable reliable range was between 0.6 - 0.7 with a 0.8 or more being very good [19]. Thus, SCD TSK responses seemed reliable. However, a Cronbach alpha ≥ 0.95 seem to indicate redundancy [20]. Subjects experiencing VOC had relatively higher TSK values indicating their fear of movement and establishing SCD hallmark of sudden onset of excruciating musculoskeletal painful episodes.

The study population's general characteristics and age-matched data conformed to the existing literature that SCD subjects were relatively lean [21] and had unique hematological profile [22].

Among the vital signs, heart rate seemed to be elevated in SCD patients experiencing VOC and this is in conformity with suggestions from various authors that heart rate could be a useful marker [23].

Even though temperature of subjects did not seem to be elevated across study subjects, it gave statistical findings during analysis and this calls for further investigation.

Limitations

- There was selection bias since the study involved subjects who underwent medical checkups in a single referral medical institution. A diverse cohort is needed.
- There was recall bias since subjects were inherently aware of their health behaviors. This may have affected the accuracy of the clinical data taken from subjects.

Conclusion

There was an association between BPI, VA and TSK with a p-value of 0.000 in SCD subjects. Subjects experiencing VOC seem to experience increased excruciating musculoskeletal painful episodes.

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The authors declare that there is no conflict of interest.

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