

Ischemic Time in Traumatic Vascular Injuries: Awareness, Practice, and Challenges in a Southern Nigerian State

Christian Emeka Amadi¹ and Rex Friday Ogoronte A Ijah^{2*}

¹Consultant Cardiothoracic and Vascular Surgeon, Department of Surgery, University of Port Harcourt Teaching Hospital, and Lecturer, Cardiothoracic and Vascular Surgery Unit, Department of Surgery, University of Port Harcourt, Port Harcourt, Rivers State, Nigeria

²Consultant General Surgeon, Department of Surgery, Rivers State University Teaching Hospital and Lecturer, PAMO University of Medical Sciences, Port Harcourt, Rivers State, Nigeria

***Corresponding Author:** Rex Friday Ogoronte A Ijah, Consultant General Surgeon, Department of Surgery, Rivers State University Teaching Hospital and Lecturer, PAMO University of Medical Sciences, Port Harcourt, Rivers State, Nigeria.

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Abstract

Aim: The aim of this study was to investigate the awareness, practice and challenges associated with the application of the knowledge of ischemic time in the care of surgical patients with traumatic vascular injuries among medical doctors in Port Harcourt.

Background: Traumatic vascular injuries can arise from military, civilian and even diagnostic and therapeutic procedures. The prevalence and significance of trauma as a public health concern has been severally reported. In the care of patients with traumatic vascular injuries involving the limb, there has been emphasis on ischemic time with a historical progression from limb amputations, through various forms of vascular repairs to microvascular repairs and replantation.

Materials and Methods: A questionnaire-based cross-sectional descriptive study was carried out among public tertiary and private medical doctors in Port Harcourt using the convenience sampling method, and analysed using SPSS version 20.0.

Results: A total of 460 respondents were recruited in this survey. One hundred and seventy-two respondents (37.4%) affirmed that ischaemic time in vascular injuries is interval between severance of vascular supply to a tissue and onset of tissue death. Opinion on success rate for the care of vascular injuries also varied among respondents, with 143 (31.1%) indicating 10% - 40% success rate, etc. Two hundred and sixty-nine (58.5%) respondents encountered challenges in the care of vascular injury patients including human, material, and environmental.

Conclusion: Knowledge of ischemic time was low. There is need for training and retraining of medical personnel to improve knowledge and care for patients with traumatic vascular injury.

Keywords: Traumatic Vascular Injuries; Ischemic Time; Awareness; Practice; Challenges; Port Harcourt; Nigeria

Introduction

Traumatic vascular injuries can arise from military, civilian and even diagnostic and therapeutic procedures [1-4]. The prevalence and significance of trauma as a public health concern has been severally reported [5-8]. In the care of patients with traumatic vascular injuries involving the limb, there has been emphasis on ischemic time with a historical progression from limb amputations, through various forms of vascular repairs to microvascular repairs and replantation [5,9-14].

Tourniquet ischemia is an important issue in traumatic vascular injury patients as some of them present to emergency room with tourniquet already applied, and also tourniquet may be used in the operative care of these patients. Physiological changes like gradual build-up with time of venous partial pressure of carbon-dioxide, a fall in the pH and a time-bound fall in oxygen have been reported [15]. Muscle tissue fatigue (at pH of 7.0) and rigor (at pH of 6.0) has been reported [16,17]. A one-hour critical timing with a ten-minute release

thereafter, has been reported for tourniquet application in these patients, though this timing is said to be influenced by age, time, temperature, and local conditions [18]. However, this timing is capable of being increased with the use of heparin and hypothermia [19]. Two-hour tourniquet time has also been described using pneumatic cuff tourniquet for a large pool of surgical procedures [20].

Also associated with traumatic vascular injury is the phenomenon ischemia-reperfusion injury, which has been described in detail in a previous report [21]. This follows effort aimed at restoration of blood flow to ischemic tissue to prevent tissue necrosis. Acute inflammatory response therefore results from molecular and biochemical changes in the vessel wall [22-24]. Ischemic post-conditioning is said to confer some protection through the pro-survival Survivor Activating Factor Enhancement (SAFE) pathway [25]. In Australia, 52 patients with traumatic vascular injury were reported over a 5-year period [26]. In this study [26] only one patient had amputation done from failed vascular reconstruction. In a study in South Africa, early diagnosis was key in the management of 100 patients who had traumatic vascular injury observed over a six-year period, in which lower limb injuries were seen in 83 patients with only 16 having amputation [27].

Though trauma, diabetic foot, and peripheral vascular disease are known globally [28,29] as the common reasons for limb amputation, trauma with irreversible vascular injury appears to top the list in our hospitals [28,30-32]. Sometimes amputations carried out as a last resort for our patients with traumatic vascular injuries are avoidable if the right things were done at the right time [33-36]. Also advances made in vascular and microsurgery have led to global reduction in limb amputation where man-power and equipment are available [32].

Aim of the Study

The aim of this study was to investigate the awareness, practice and challenges associated with the application of the knowledge of ischemic time in the care of surgical patients with traumatic vascular injuries among medical doctors in Port Harcourt, Nigeria.

Materials and Methods

A cross-sectional descriptive study was carried out from September 2020 to April 2021, among medical doctors in public tertiary and private healthcare facilities in Port Harcourt, the capital of Rivers State, South-South of the Federal Republic of Nigeria. The study settings were the specialist out-patient clinics and grand rounds (for the public tertiary hospitals) and regular meetings and clinics (for the private hospitals).

Included in the survey were specialists, medical officers, senior registrars, registrars, and house officers. After obtaining the approval of the Research Ethics Committee of the University of Port Harcourt Teaching Hospital, 500 semi-structured questionnaires (earlier pre-tested in a similar work environment) were administered to medical doctors using the convenience sampling method, and 460 were retrieved. Data was analyzed using the Statistical Package for the Social Sciences (SPSS) version 20.0.

Results

A total of 460 respondents (medical doctors) were recruited for the survey. The demographic characteristics presented in table 1 indicated that 303 (65.9%) were males and female respondents were 157 (34.1%). Majority (337: 73.3%) of the respondents were between 25 and 40 years old while only 1.7% were aged 60 years and above. Two hundred and thirty-five (51.1%) had spent between 1 and 10 years in service and 297 (64.6%) medical doctors worked in the public sector while 84 (18.3%) worked in both public and private health facilities.

Variables	Numbers	Percentage
Sex		
Male	303	65.9
Female	157	34.1
Age		
Less than 25 years	48	10.4
25- 40 Years	337	73.3
41 - 60 years	67	14.6
Above 60 years	8	1.7
Marital Status		
Single	188	40.9

Married	268	58.3
Divorced	4	.9
Religion		
Christianity	445	96.7
Islam	11	2.4
No religion	4	.9
Years in service		
Less than 1 Year	93	20.2
1 - 10 years	235	51.1
11 - 20 years	92	20.0
21 - 30 years	28	6.1
More than 30 years	12	2.6
Doctor category		
Private	79	17.2
Public	297	64.6
Both	84	18.3
Category of private		
Specialist	123	26.7
General Practitioner	53	11.5
Not Applicable	284	61.7
Category of public		
Surgeon	44	9.6
Senior registrar	72	15.7
Registrar	200	43.5
House Officer	89	19.3
Not Applicable	55	12.0

Table 1: Socio-demographic characteristics of respondents (n = 460).

Table 2 showed that 435 (94.7%) were aware of ischaemic time in vascular injuries. One hundred and seventy-two respondents (37.4%) affirmed that ischaemic time in vascular injuries is the interval between severance of vascular supply to a tissue and onset of tissue death, while 84 (18.3%) were of the opinion that it is the interval between time of injury and time of surgery. There were varied other responses, however, four hundred and forty (95.7%) respondents agreed that urgency should be attached to care of traumatic vascular injury. One hundred and twelve (24.3%) respondents opined that ischaemic time for vascular injury of the upper limb is up to one hour, while others gave variable answers. Two hundred and ninety-one (63.3%) respondents were conscious or aware of the availability of vascular specialists in Rivers State.

Variables	Numbers	Percentage
Heard of Ischemic time in vascular injuries		
Yes	435	94.7
No	8	1.7
Don't know	17	3.6
What Ischemic time in vascular injuries is		
Interval between time of injury and time of surgery	84	18.3
Interval between application of tourniquet and time of release of tourniquet	33	7.3
Interval between severance of vascular supply to a tissue and onset of tissue death	172	37.4
None of the above	4	.9
All of the above	104	22.6
Don't know	63	13.7
Any urgency attached to care of vascular injury		
Yes	440	95.7

Not Sure	20	4.3
What Ischemic time vascular injury of upper limb is		
Less than 30 minutes	33	7.2
Up to 1 hour	112	24.3
Up to 1 hour 30 minutes	87	18.9
Up to 2 hours	56	12.2
Up to 3 hours	68	14.8
Up to 6 hours	68	14.8
More than 6 hours	16	3.5
Don't Know	20	4.3
What Ischemic time vascular injury of lower limb is		
Less than 30 minutes	32	7.0
Up to 1 hour	44	9.6
Up to 1 hour 30 minutes	32	7.0
Up to 2 hours	76	16.5
Up to 3 hours	144	31.3
Up to 6 hours	104	22.6
More than 6 hours	8	1.7
Don't Know	20	4.3
Awareness of presence of vascular specialist in Rivers State		
Yes	291	63.3
No	109	23.7
Not Sure	60	13.0

Table 2: Awareness of Ischaemic time in traumatic vascular injuries (n = 460).

The practice/application of ischaemic time knowledge in care of vascular injury patients is indicated in table 3. Two hundred and sixty (56.5%) respondents had at a point in time cared for patients with vascular injury. Seventy-one respondents opined that the time taken to operate on a vascular injury patient was 1hour 30minutes, while others gave varied answers ranging from “up to 3 hours” to “one week”. Two hundred and thirty-five (51.1%) respondents asserted that it takes up to 1 hour 30 minutes to refer a vascular injury patient for specialist care. There were varied other responses. Opinion on success rate for the care of vascular injuries also varied among respondents, with 143 (31.1%) indicating 10% - 40% success rate; 64 (13.9%) asserting to less than 10% success rate; and 41 (8.9%) pegging it at 41% - 60%.

Variables	Numbers	Percentage
Ever cared for patient with vascular injury		
Yes	260	56.5
No	184	40.0
Not Sure	16	3.5
Time taken to operate on a vascular injury patient		
Up to 1 hour 30 minutes	71	15.4
Up to 3 hours	48	10.4
Up to 6 hours	76	16.5
Up to 24 hours	37	8.0

Up to 48 hours	40	8.7
Up to 1 week	8	1.7
Not Applicable	180	39.1
Time taken to refer a vascular injury patient to specialist		
Up to 1 hour 30 minutes	235	51.1
Up to 3 hours	69	15.0
Up to 6 hours	12	2.6
Up to 24 hours	28	6.1
Up to 48 hours	32	7.0
Up to 1 week	8	1.7
No Response	76	16.5
Opinion on success rate in caring for vascular injury patient		
Less than 10% success rate	64	13.9
10% - 40% success rate	143	31.1
41% - 60% success rate	41	8.9
61% - 80% success rate	44	9.6
91% - 100% success rate	12	2.6
None	28	6.1
No Response	128	27.8

Table 3: Practice (Application) of Ischaemic time knowledge in care of vascular injury patients (n = 460).

Table 4 presented the challenges encountered by the respondents in the care of a vascular injury patients. Two hundred and sixty-nine (58.5%) respondents encountered challenges in the care of vascular injury patients including human (68 = 14.8%), material (48 = 10.4%), human and material (148 = 32.2%), and environmental (12 = 2.6%) challenges.

Variables	Number	Percentage
Encountered challenges in the care of a vascular injury patient		
Yes	269	58.5
No	83	18.0
Not Sure	76	16.5
No Response	32	7.0
Challenges encountered in the care of a vascular injury patient		
Human	68	14.8
Material	48	10.4
Environmental	12	2.6
Human and Material	148	32.2
All of the above	56	12.2
No Response	128	27.8
Other challenges encountered in the care of a vascular injury patient		
No ICU space	12	2.6
Delay in intervention	28	6.1
Lack of finance/Cost of care	60	13.0
Late arrival/presentation to hospital	16	3.5
None	344	74.8

Table 4: Challenges encountered while applying knowledge of ischaemic time in care of traumatic vascular injury patients (n = 460).

Table 5 shows detailed human and material challenges identified by respondents. The following were the asserted responses: lack of adequate knowledge of what to do (120 = 26.1%), lack of an assistant with needed knowledge of what to do (52 = 11.3%), uncooperative patient (140 = 30.4%), and lack of specialist vascular surgeon (116 = 25.2%). Material challenges identified were lack of instrument/equipment to use (252 = 54.8%), lack of sutures to use (212 = 46.1%) and lack of drugs to use (180 = 39.1%). Other material challenges encountered include: absence of intensive care unit space, delay in intervention, lack of finance/cost of care and late arrival/presentation to hospital.

Variables	Yes		No		No Response	
	Number	%	Number	%	Number	%
Human challenges encountered in the care of a vascular injury patient						
Lack of adequate knowledge of what to do	120	26.1	188	40.9	152	33.0
Lack of an assistant with needed knowledge of what to do	52	11.3	256	55.7	152	33.0
Uncooperative patient	140	30.4	168	36.5	152	33.0
Lack of specialist vascular surgeon	116	25.2	192	41.7	152	33.0
Material challenges encountered in the care of a vascular injury patient						
Lack of instrument/equipment to use	252	54.8	56	12.2	152	33.0
Lack of sutures to use	212	46.1	96	20.9	152	33.0
Lack of drugs to use	180	39.1	128	27.8	152	33.0

Table 5: Detailed human and material challenges encountered in the care of a vascular injury patients (n = 460).

Discussion

The demographic characteristics of our study showed that majority of the respondents were between 25 and 40 years of age. This represents the active workforce in any organization, who also should know about what obtains in their hospitals of practice. Half of the respondents had been in medical practice for between one and ten years. This duration of practice also bears some influence on the quality of information provided by the respondents, as they could be considered knowledgeable enough to provide information on traumatic vascular injuries from their experiences. Majority worked in the public sector, while a few worked in both public and private settings. Most respondents were also aware of the availability of specialist care for vascular injuries in Port Harcourt. This implies that there was awareness of the availability of referral center among primary duty doctors. However, the impact or usefulness of this information in patient care will be dependent on actions and inactions between the recognition of traumatic vascular injury in a needy patient and the time of surgical intervention.

Almost all the respondents were aware of ischemic time for traumatic vascular injuries (in terms of having heard of the terminology) and also the need for urgency. However, the consciousness of the right meaning of ischemic time was expressed by less than half of the respondents. This finding is detrimental to proper care of traumatic vascular injury patients as knowledge in a way drives action. If the meaning of ischemic time is not well appreciated by those who should care, it means that necessary action i.e. referral may not be prompt occasioning delay. A similar view has been expressed in an earlier report in South-Eastern Nigeria, which emphasized that physicians were not familiar with the hard and soft signs of vascular injuries [33]. Early recognition has been described as key to good outcome of traumatic vascular injuries [37]. Delay in diagnosis, referral and commencement of treatment has been severally described as a major factor hindering the care of patients with traumatic vascular injuries in Nigeria [33,38,39]. These injuries are noted to be more prevalent in the South-South and South-Eastern parts of Nigeria [33,40-43].

The fact that very few respondents were aware that following timely intervention, the success rate in management of traumatic vascular injuries is very good, shows a huge knowledge gap and impacts negatively on the general care of the traumatic vascular injured

patient. Also, the common nature of the problem in society is highlighted by the fact that at least half of the respondents had attended to patients with traumatic vascular injury. Reports of vascular injuries in other parts of Nigeria corroborates this opinion of respondents [33,38,39,44-46]. The tourniquet time for the upper limb is 90 minutes while that of lower limb is 2 hours [47] and hence, efforts should be made to achieve a restoration of distal blood flow within the tourniquet time of the affected limb as outcome is much better. Vascular repairs or interventions following vascular injuries are successful within the golden 6 hours post injury [48] however, outcomes are better within the first 3 hours and much improved within one hour of injury [49]. Though, with collaterals preserved following vascular injuries, more delayed repairs or restoration of blood supply distally could be successfully done [43]. The wide variation in the answers given by respondents - from 1 hour 30minutes to one week - as being the time taken to operate on patients with traumatic vascular injury suggests that some patients may have ended up with avoidable limb amputation as a consequence of delayed action. The needed urgency in the care of these patients was therefore not being applied. It is therefore not surprising when the success rate of the practice was low.

Challenges encountered in the care of patients with traumatic vascular injury, were duly categorized as human, material and environmental. The most common, as asserted to by more than half of respondents was the human challenge. Poor knowledge of what to do, lack of specialist vascular surgeon, lack of knowledgeable assistant, and uncooperative patient were highlighted human challenges. Needed materials for care were also described to be lacking. Late presentation to hospital and inability to finance the cost of treatment were also significant challenges reported by respondents among their patients. The predictive factors for amputation in traumatic vascular injuries are: delay in hospital presentation, presence of shock, severe open fracture, limb ischemia, gangrene, source of injury, age, sex, occupation, and mangled extremity severity score, as reported by Adegbehingbe., *et al* [5]. Unlike previous publications that were centre-based, our city-based study highlights issue of late presentation with some human and material challenges. Lack of an organized referral system, patients financial challenges, and poor transportation have been identified as being factors that occasion delay in the care of these patients in Nigeria [39].

Limitation of the Study

The convenience sampling method, a non-probability method, was used for data collection for this questionnaire-based study.

Conclusion

Although awareness of ischemic time appears to be high in our study, the actual knowledge of what it is, what to do, and the application of the same knowledge was low. This calls for improvement in enlightenment on traumatic vascular injuries among medical practitioners in our area of practice.

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Ethical Statement

The approval of the research ethics committee of the University of Port Harcourt Teaching Hospital was obtained before the study was done.

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The study was privately sponsored by the researchers.

Conflict of Interest

None declared.

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