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Modified Allen's Test Using Pulse Oximeter – A Revisit To Thediscarded Method

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ABSTRACT

OBJECTIVE: The objectives of this study include to find the difference between the ulnar and radial collateral circulation to the hand, to find the difference in the ulnar and radial collateral circulation between the dominant and the non-dominant hand and to find the range and mean of latent period and compare the normal population with the patients with co-morbidities.

METHODOLOGY: Data for our study is collected from 200 persons randomly selected which includes patient's attenders and people coming for covid vaccines and 200 patients randomly selected in cardiology OPD, Nephrology OPD Diabetology OPD and ICU with the age group ranging between 18 to 70 years at Tirunelveli medical college from March 2021 to June 2021.
Data were tabularized using Microsoft Excel and analyzed using SPSS version 23.

RESULTS: According to our study, 4 to 6% of study population have radial artery predominant. Findings are uniformly consistent in both hands.In normal population, the range of latent period is 4 to 18 sec and mean <12 sec in 186 personsand >12 sec in 6 persons.In patients with co-morbidities, the range of latent period is 4 to 28 sec and mean <12 sec in 132 personsand >12 sec in 56 patient. Patients with co-morbid conditions had 13.2 times more odds of increased latent period in ulnar artery as compared to normal population and was statistically significant (p- <0.05).Though non-appearance of SpO2 is the absolute contra indication for utilizing the radial artery, the relative risk can be classified in terms of the latent period (time taken by the pulse oximeter to show normal SpO2).Based on our study, a latent period up to 12 secs is safe.With the universal availability of the pulse oximeter in the covid era, adopting this method becomes more relevant.

CONCLUSION: After analyzing the results from the study we were able to conclude that Ulnar collateral circulation was better than radial collateral circulation in 96% of non comorbid study population. No difference in ulnar and radial collateral circulation between dominant and non dominant hand was established. Finallywe noted that there is a 2 to 5 fold increase in the latent period in patients with co-morbidities compared to normal population.

KEYWORDS: Allen Test, Ulnar Collateral, Radial Collateral, Pulse Oximetry.

I. INTRODUCTION

"Use of pulse oximeter for modified Allen's test is potentially dangerous " - The journal of hand surgery 1991 - David G Levinsohon et al

Latent period (time delay for full establishment of collateral circulation) was not measured in the study and conclusion was based on comparison with doppler flowmetry.Relative paucity of studies in hand & plastic surgery journals.Radial artery is being increasingly used for cardiac catheterization, arterial pressure monitoring in ICU and for creation of AV fistula for dialysis. Contribution of radial artery to the collateral circulation is severed in surgeries like toe transfer and radial forearm flap.100% saturation means tissues are viable and will be viable as long as saturation remains 100%

A relative increase of latent period indicates a relatively poorer circulation but that does not mean death of tissues or loss of function

Aims and Objectives

1. To find the difference between the ulnar and radial collateral circulation to the hand
2. To find the difference in the ulnar and radial collateral circulation between the dominant and the non-dominant hand.
3. To find the range and mean of latent period and compare the normal population with the patients with co-morbidities.

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Methodology

Sample size calculation

Sample size= 4pq / d^2

Where p is prevalence(% of people with latent period in the normal range), q is 1–p and d is desired precision.

n= 4x90x10/ 3x3=**400**

Datas for our study is collected from 200 persons randomly selected which includes patient's attenders and people coming for covid vaccines and200 patients randomly selected in cardiology OPD, Nephrology OPD Diabetology OPD and ICU with the age group ranging between 18 to 70 years at Tirunelveli medical college from March 2021 to June 2021.

Data were tabularized using Microsoft Excel and analysed using SPSS version 23.

Technique

The supinated forearm was kept on a firm surface and SpO2 was measured. Pulse oximeter was applied over the thumb, both radial and ulnar arteries were compressed with examiner's thumb and index finger until the disappearance of SpO2 and pulse reading. Ulnar artery was released and the time taken for the appearance of SpO2 was measured. Once again both ulnar and radial arteries were compressed till the disappearance of SpO2 with the pulse oximeter being kept over the little finger. Radial artery was released and the time taken for the appearance of SpO2 was measured(pic:1to 4)

II. DISCUSSION

The Allen test was originally described in the year 1929 by Dr.Edgar V. Allen[2]. Originally he had conducted the test to diagnose occlusive disease of ulnar circulation in patients with thromboangiitisobliteras. He conducted the test by having the patients make a fist with the radial artery occluded for 1 minute followed by extending the fingers and watching for return of color[8]. The original test was modified in the 1950s for evaluation of collateral circulation before arterial cannulation[9]. A positive Allen test precludes radial artery harvest for bypass grafting. To this day, nearly 70 years after it was first described, the Allen test is still used for assessment.

Radial artery conduit for coronary artery bypass grafting was introduced by Carpentier and colleagues in 1973[5]. Allen test is the most common screening method for evaluation of adequacy of collateral hand circulation before Radial artery harvest for Coronary Artery Bypass Graft. Absence of flow in the dorsal digital thumb artery with radial artery compression is considered an absolute contraindication to radial artery harvesting. An increased latent period with the Allen test predicts absence of flow in the dorsal digital thumb artery[4]. Thus Allen test is a simple, cost-effective, effective[1,7] and non-invasive screening test.

In this study, we have examined the difference between ulnar and radial collateral circulation to the hand and the difference in the ulnar and radial collateral circulation between the dominant and the non-dominant hand. Latent period is the time delay for establishment of collateral circulation. A relative increase in the latent period is an indication of relatively poorer circulation. In this study we have studied the range and mean of latent period and compare the normal population with the patients with co-morbidities. There is no clear consensus on the cut-off point between positive and negative Allen test[3]. But generally 6 seconds is commonly used as cut-off point[3]. There is also an observer bias in deciding whether the normal palmar rubor has returned[3].

Our study concluded that Ulnar collateral circulation was better than radial collateral circulation in 96% of non comorbid study population.No difference in ulnar and radial collateral circulation between dominant and non dominant hand was established. In 70% of cases with co-morbidities the results are comparable with the normal population. There is a 2 to 5 fold increase in the latent period in patients with co-morbidities. Based on our study a latent period of up to 12 seconds is safe.

The Allen test is a clinical subjective test which does not tell us about the vascular anatomy of the hand. From the test the examiner can only interpret the functional circulatory status[6] of the hand. Allen test has high false positive and false negative rates. Thus use of this test alone will unneccesarily exclude some patients from use of Radial artery as conduit and also place some patients at risk of digital ischemia following harvest[5].

III. RESULTS

- 4 - 6% of study population have radial artery predominant.
- Findings are uniformly consistent in both hands.
- In normal population, the range of latent period is 4 to18 sec and mean <12 sec in 186 personsand >12 sec in 6persons with ulnar dominance.
- In patients with co-morbidities, the range of latent period is 4 to 28 sec and mean <12 sec in 132 patients and >12 sec in 56 patients.

- Patients with co-morbid conditions had 13.2 times more odds of increased latent period in ulnar artery as compared to normal population and statistically significant (p- <0.05).
- Though non-appearance of SpO2 is the absolute contra indication for utilizing the radial artery, the relative risk can be classified in terms of the latent period (time taken by the pulse oximeter to show normal SpO2).
- Based on our study, a latent period up to 12 secs is safe.
- With the universal availability of the pulse oximeter in the covid era, adopting this method becomes more relevant.

IV. CONCLUSION

- Ulnar collateral circulation was better than radial collateral circulation in 96% of non comorbid study population (fig:1)
- No difference in ulnar and radial collateral circulation between dominant and non dominant hand (fig:2)
- There is a 2 to 5 fold increase in the latent period in patients with co-morbidities (fig:3) compared normal population.

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Pic: 1,2,3 and 4

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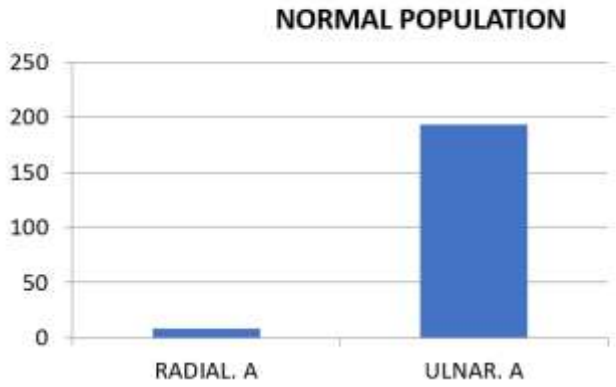
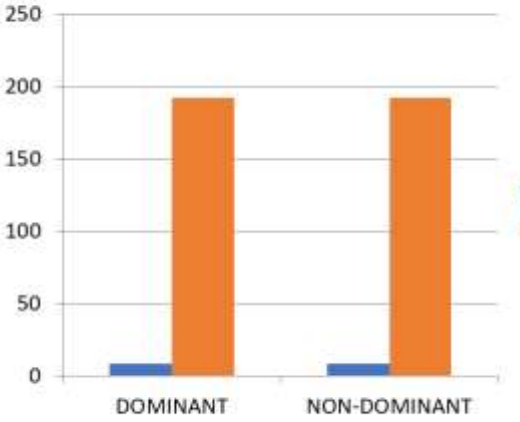
Chart: 1



ULNAR.A – 192 (96%)
RADIAL.A – 8 (4%)

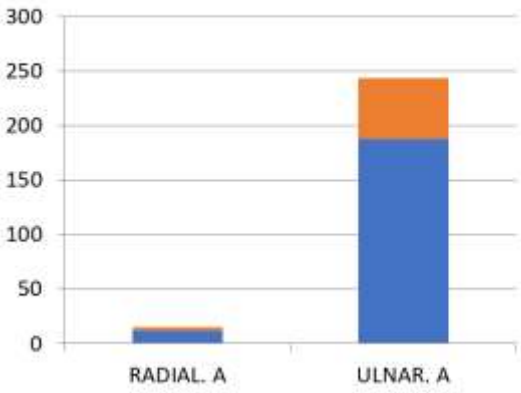
Chart: 2



DOMINANT HAND
ULNAR.A – 192 (96%)
RADIAL.A – 8 (4%)

NON-DOMINANT HAND
ULNAR.A – 192 (96%)
RADIAL.A – 8 (4%)

Chart: 3



WITH LATENCY-
RADIAL.A – 3 (25%)
ULNAR.A – 56 (29.7%)

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Latent period in normal population

LATENT PERIOD (sec)	ULNAR.A	RADIAL.A
< 12	186	6
>12	6	2

Latent period in patients with co-morbidities

LATENT PERIOD (sec)	ULNAR.A	RADIAL.A
< 12	132	9
>12	56	3

Table: 1

Ulnar artery latency

	Delay +	Delay -
Co- morbid +	56	132
Co- morbid -	6	186

Odd's ratio – 13.2
95% confidence interval (5.5 to 31.4)

P - <0.05 (0.00000) significant

Table: 2