

CONFIRMATION OF CENTRAL VENOUS CATHETER PLACEMENT USING
ULTRASONOGRAPHIC BUBBLE TEST-A PROSPECTIVE STUDY**Dr Aakanksha Solanki**

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ABSTRACT

Ultrasonographic guidance is considered the best guide for placement of central venous catheter but there is no consensus on the best method for evaluation of proper placement and tip localization of central venous catheter. Most used method to detect central venous catheter placement is post- procedural X-ray. However, disadvantage is that performing and interpreting X-ray is time consuming and exposes the patient to radiation. This study aimed to compare the diagnostic accuracy of Ultrasonographic Bubble test, also called Saline Flush test with post-procedural Chest X-ray in above diaphragm central venous catheter placement.

KEYWORDS : Bubble test, Saline flush test**INTRODUCTION**

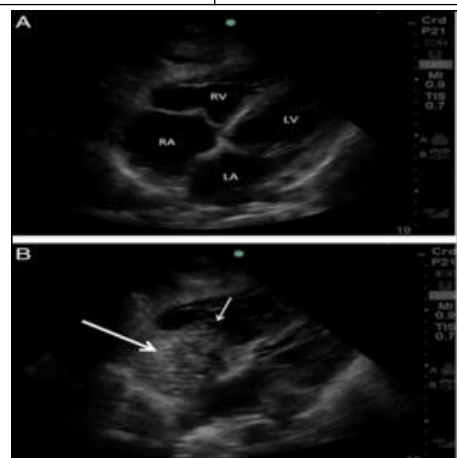
Central venous catheterization is an integral part of invasive monitoring and management in the modern era. Seldinger modified the method of venous catheterization and introduced the catheter over guidewire technique which is followed world over nowadays. Various other routes were described later on for central venous access. Complications of central venous catheterization include arterial puncture, hematoma, hemothorax, pneumothorax, arterial-venous fistula, air embolism, nerve injury, infections and thrombosis. Ultrasonography is considered the best guide for placement of central venous catheter, there is no consensus on the best method for evaluation and proper placement and tip localization. To date, the most commonly used reference standard to detect central venous catheter placement is the post procedural Chest X-Ray. However, the disadvantage is that performing and interpreting the X-ray can be time consuming and also exposes the patient to radiation. Other methods for confirming catheter placement are US guidewire visualization in the inferior vena cava or within the right atrium and electrocardiographic recognition of altered P-waves. It has also been suggested that Ultrasound may be a suitable alternative diagnostic modality for confirming correct intravascular placement. Major advantages of ultrasound over chest X-ray are that it is often performed faster and does not subject a patient to radiation. Patient with central venous catheter in internal jugular vein or subclavian vein, 10 ml bolus of saline is injected through distal port of central venous catheter and opacification of right atrium is observed in xiphoid view on ultrasonography.

Methodology

Performing a USG guided “bubble test” to confirm the endovenous presence of the catheter, was used for confirmation of proper central venous catheter placement. After insertion of the CVC, USG was needed for performing bubble test. USG thus helped in both insertions of the CVC as well as confirming the endovenous site of cvc. After puncturing the vein and cannulating it, a bolus of normal saline had to be injected through a 10 ml syringe into distal lumen of the catheter. Immediate opacification of the right atrium was observed by a point-of-care ultrasonography in the four-chamber view or subcostal (Xiphoid) view, confirming endovenous placement of CVC. Endovenous location of CVC was also checked by tube manometry technique. A stopwatch was started when a normal saline filled syringe was attached to the port of CVC. Time taken for performing bubble test was to be noted. This had to be done until the opacification of the right atrium was noted. Stopwatch was allowed to run further and stopped when chest X-ray was taken or if more than 1 hour lapsed after bubble test had been completed without chest X-ray being taken. Once the location of the catheter was confirmed, injections and infusions were started through the CVC. Chest X-ray had been

performed to confirm the position of the tip of the catheter and to see for the presence of any other complication. Data was collected regarding age, sex, diagnosis, indication for central line, site and side of catheterization, time taken to perform “bubble test” and for X-ray confirmation of the position of CVC. Occurrence of any complications, such as arrhythmias, prolonged oozing of blood at puncture site, hematoma, inadvertent carotid artery puncture, pleural puncture with or without pneumothorax or hemothorax, were noted. Bubble test was defined as failed if there will be no opacification of the right atrium even 2 s after injection of saline.

CHARACTERISTICS	INTERPRETATION
No bubbles or appearance of bubbles >6 seconds	Negative test: Extra vascular or extra cardiac placement
Few bubbles or appearance of bubbles 2-6 seconds	Negative test: Intravascular misplacement in neck veins or cvc tip position too far from right atrium.
Numerous bubbles with linear flow coming out from Superior vena cava with in 2 seconds	Positive test: Correct tip placement

**Interpretation Of Bubble Test****RESULT****Table 1: Distribution of patients according to CVC Site**

Complication	Number	Percentage
No Complication	134	93.1
Arterial Puncture	1	0.7
Hematoma	1	0.7

Malposition	6	4.2
Pneumothorax	2	1.4
Total	144	100.0

Table 2 Distribution of patients according to Time taken for test

Test	Saline flush test	Chest Xray
Positive	136 (94.5%)	138 (95.8%)
Negative	8 (5.5%)	6 (4.2%)
Total	144 (100.0%)	144 (100.0%)
P value (Chi square)	0.7853	

Time taken for Saline flush test was 2.13 ± 1.38 seconds. Time taken for Chest x-ray was 44.66 ± 9.57 minutes. So the time taken for Saline flush test was very less compared to Chest x-ray. The difference was statistically significant ($p < 0.0001$).

Table 3: Distribution of patients according to Complication

Time taken	Mean	SD	P value (t test)
Saline flush test (Second)	2.13	1.38	<0.0001
CXR (Minute)	44.66	9.57	

Complication was observed in 6.9% of the patients. Most common complication was Malposition (4.2%) followed by Pneumothorax (1.4%), Hematoma (0.7%) and Arterial Puncture (0.7%).

Table 4: Comparison of Saline flush test with Chest Xray

CVC Side	Number	Percentage
Left	46	31.9
Right	98	68.1
Total	144	100.0

The result of Saline flush test was found positive in 94.5% of the patients and negative in 5.5% of the patients. The result of Chest X-ray was found positive in 95.8% of the patients and negative in 4.2% of the patients. The difference between the result of both test was not found statistically significant ($p > 0.05$).

DISCUSSION

Total 144 patients who require central venous catheter placement were selected for the study. Majority of the patients were in the age group of 51 to 60 years (35.4%) and 41 to 50 years (24.3%). Majority of the patients (61.1%) were male and rest 38.93% were female. Among the selected patients, majority of the patients were admitted in ICU (76.4%) followed by Covid ICU (19.4%), Ortho OT (2.8%) and Surgery OT (1.4%). The Central Venous Catheter Placement site was Subclavian Vein in 61.1% of patients and Internal Jugular Vein in rest 38.9% of patients. The Central Venous Catheter Placement side was right in 68.1% of patients and left side in rest 31.9% of patients. The Central Venous Catheter size was 7.0 Fr in 62.5% of patients and 5.0 Fr size in rest 37.5% of patients. Increase in pulse rate, systolic blood pressure and Diastolic blood pressure was observed during procedure. No gross changes in vitals were observed during procedure. Time taken for Saline flush test was 2.13 ± 1.38 seconds. Time taken for Chest x-ray was 44.66 ± 9.57 minutes. The time taken for Saline flush test was significantly less compared to time taken for Chest x-ray ($p = 0.05$).

Characteristics	SALINE FLUSH TEST
Sensitivity	98.6%
Specificity	100%
Positive Predictive value	100%
Negative Predictive value	75%

CONCLUSIONS

Saline flush test gave a good confirmation of endovenous placement of CVC during its insertion under USG guidance. It consumed very less time and easy to perform. There are no known contraindications or very less complications. The Saline flush test with USG is highly specific and sensitive when compared to chest x-ray for detecting adequate central venous catheter placement. We concluded that it can be used as a good alternative to routine portable CXR. This central venous catheter placement test is simple and also feasible in the critical care setting. We suggest that prospective investigations with larger sample size are required to confirm these findings

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