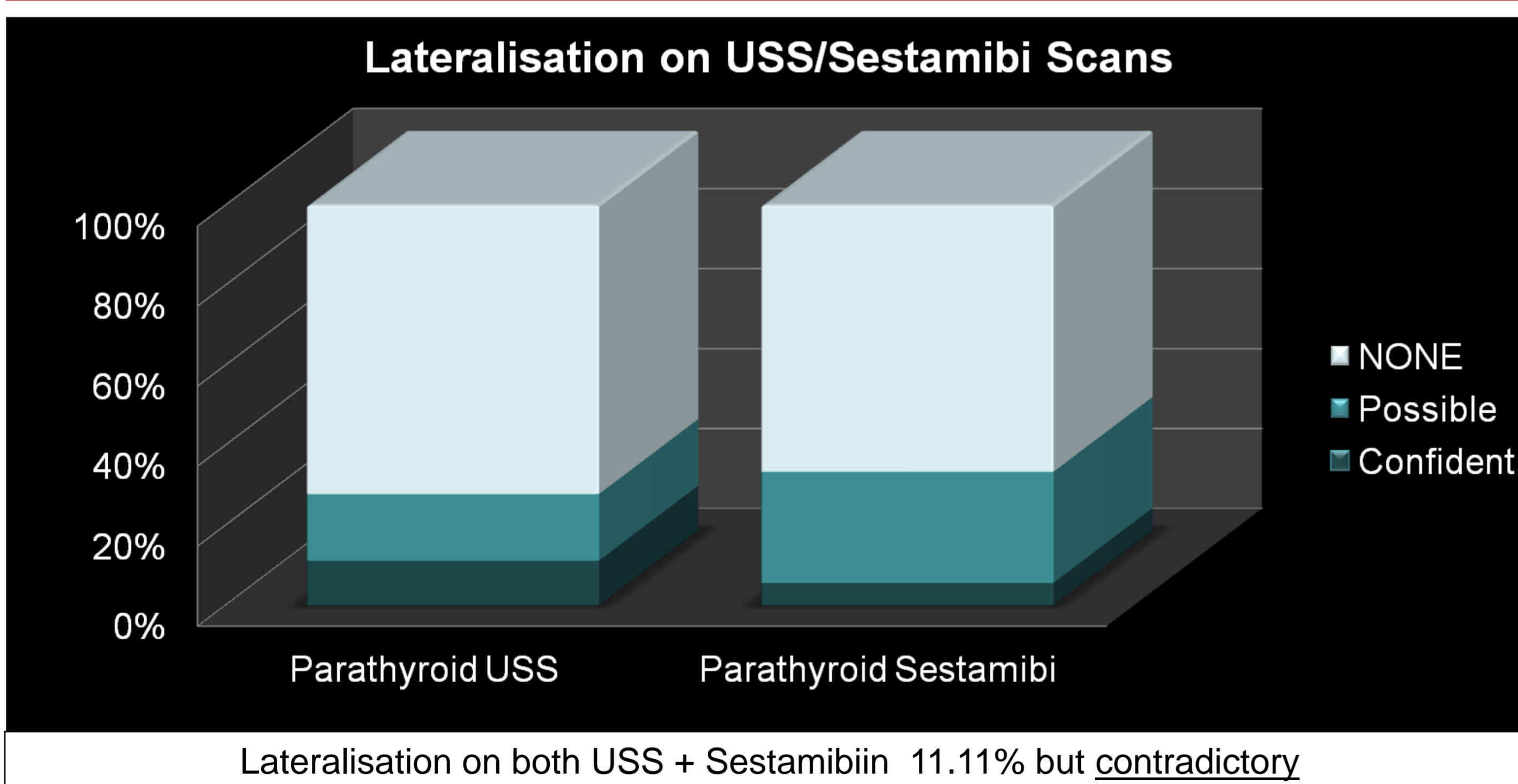


**ABSTRACT**  
 Patients with primary hyperparathyroidism (PHPT) undergo parathyroid ultrasound, Tc-99m sestamibi scan or MRI to localize hyperfunctioning parathyroid gland(s). When scans are negative or discordant we perform parathyroid hormone selective venous sampling (PTHSVS).  
 We report the results of 18 patients (4 males, 14 females, average age 58.7) with PHPT, who underwent PTHSVS followed by either focused parathyroidectomy (FP) or bilateral neck exploration (BNE) in years 2006-2013. All patients had both parathyroid ultrasound and Tc-99m sestamibi scans. Parathyroid ultrasound showed lateralisation in 27.8% (16.67% possible, 11.1% confident) and Tc-99m sestamibi showed lateralisation in 33.3% (27.8% possible, 5.56% confident). In 11.1% of patients lateralisation was present on both scans but results were discordant.  
 On average during the PTHSVS procedure samples for PTH levels were obtained from 10.78 sites. All procedures were successful.  
 PTHSVS showed lateralisation in 12 patients (66.7%). Following the results of PTHSVS 10 patients underwent FP, 2 had BNE. Histopathological results confirmed 9 adenomas (75% True Positive). In remaining three cases (25% False Positive) there was one confirmed hyperplasia and one positive PTHSVS is thought likely to contain a spurious PTH result.  
 The average ratio between the site of highest PTH level and level of PTH in inferior vena cava was 7.37 (2.61-19.38) in patients with lateralisation.  
 In 6 patients with no lateralisation on PTHSVS, 3 had BNE and 3 FP. Histopathological report in 5 patients confirmed existence of parathyroid adenoma (83.3% False Negative). One patient had hyperplasia (16.7% True Negative). Seven out of ten patients who had FP were cured during first operation. Three patients required reoperation, one of them was not cured due to anatomical localization of the adenoma.  
 Our report suggests that PTHSVS is a helpful diagnostic adjunct in localization of hyperfunctioning parathyroid gland(s). Positive PTHSVS increases the surgeon's confidence in choosing a less invasive procedure.

Primary hyperparathyroidism (PHPT) is usually caused by a solitary benign adenoma (80-85%), 2-5% of PHPT is due to 2 adenomas. Hyperplasia causes PHPT in 10-15% and parathyroid carcinoma in <1% [1].

Localisation of parathyroid adenoma preoperatively can help to minimize the extent of surgical intervention. After biochemical confirmation of PHPT diagnosis, patients have parathyroid ultrasound (USS), Tc-99m sestamibi scan (Sestamibi) or MRI to localize hyperfunctioning parathyroid gland(s).  
 When scans are negative or discordant we perform parathyroid hormone selective venous sampling (PTHSVS).  
 Following biochemical, radiological investigations and PTHSVS patients have either  
 - focused parathyroidectomy (FP)  
 - or bilateral neck exploration (BNE)

Group characteristics		
18 patients (4 males, 14 females)		
Average	Age [years]	58.7
	Calcium [mmol/L]	2.69
	Phosphate [mmol/L]	0.82
	PTH [pmol/l]	11.09
Percentage of tests performed in the whole group of patients [%]	Thyroid Function Tests	94.4
	Vitamin D levels	72.2
	Calcium/Creatinine Excretion or 24 hour urinary Calcium Excretion	94.4
	Parathyroid ultrasound	100
	Tc-99m parathyroid sestamibi scan	100
	MRI neck	5.6



**PTHSVS Procedure (years 2006-2013):**  
 - performed by the Consultant Interventional Radiologist -  
 - performed in patients with inconclusive localisation on scans  
 - 18 PTHSVS performed  
 - 100% procedures successful  
 - samples for PTH levels obtained on average from 10.78 sites per procedure  
 - PTHSVS results were reviewed in joint endocrinological-surgical clinic for interpretation  
 - **lateralisation** in 12 patients (66.7%) **PTHSVS(+)**  
 - **no lateralisation** in 6 patients (33.3%) **PTHSVS(-)**

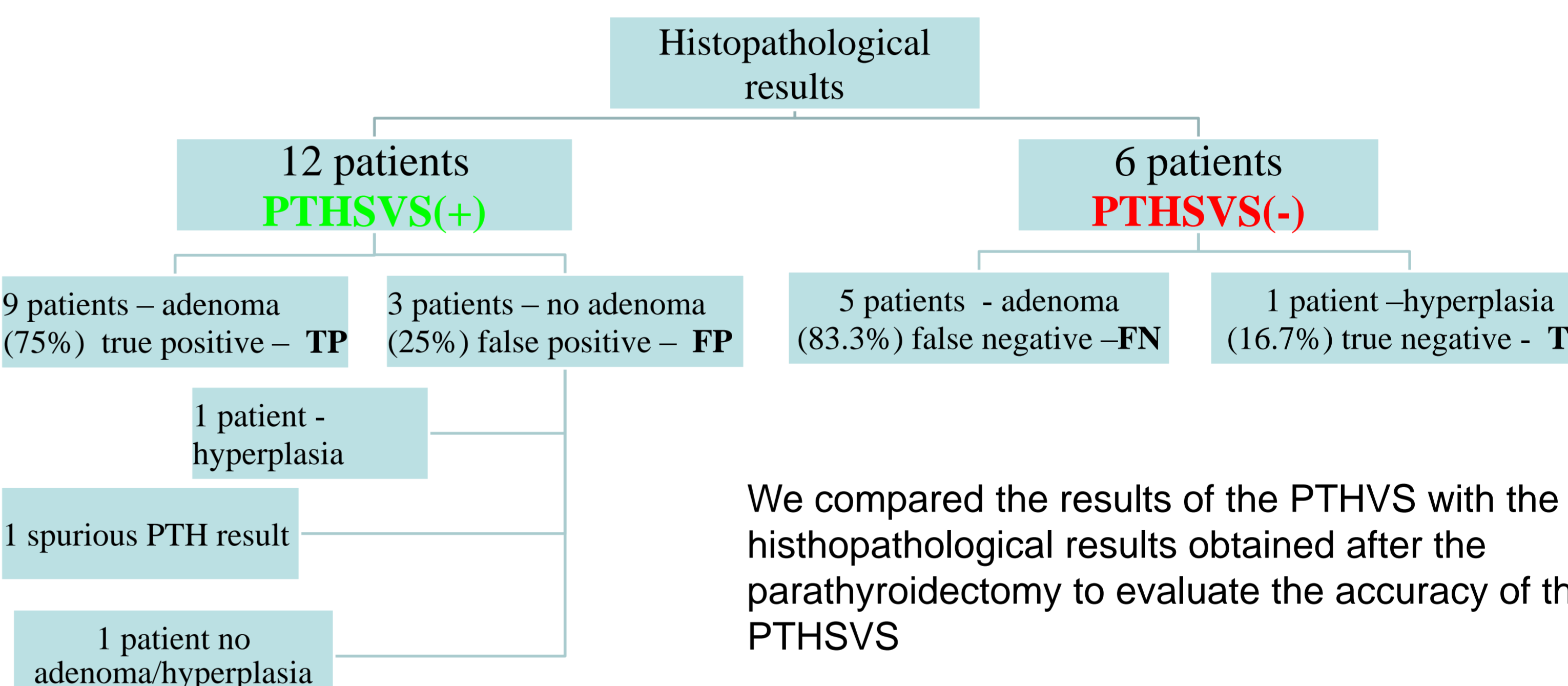
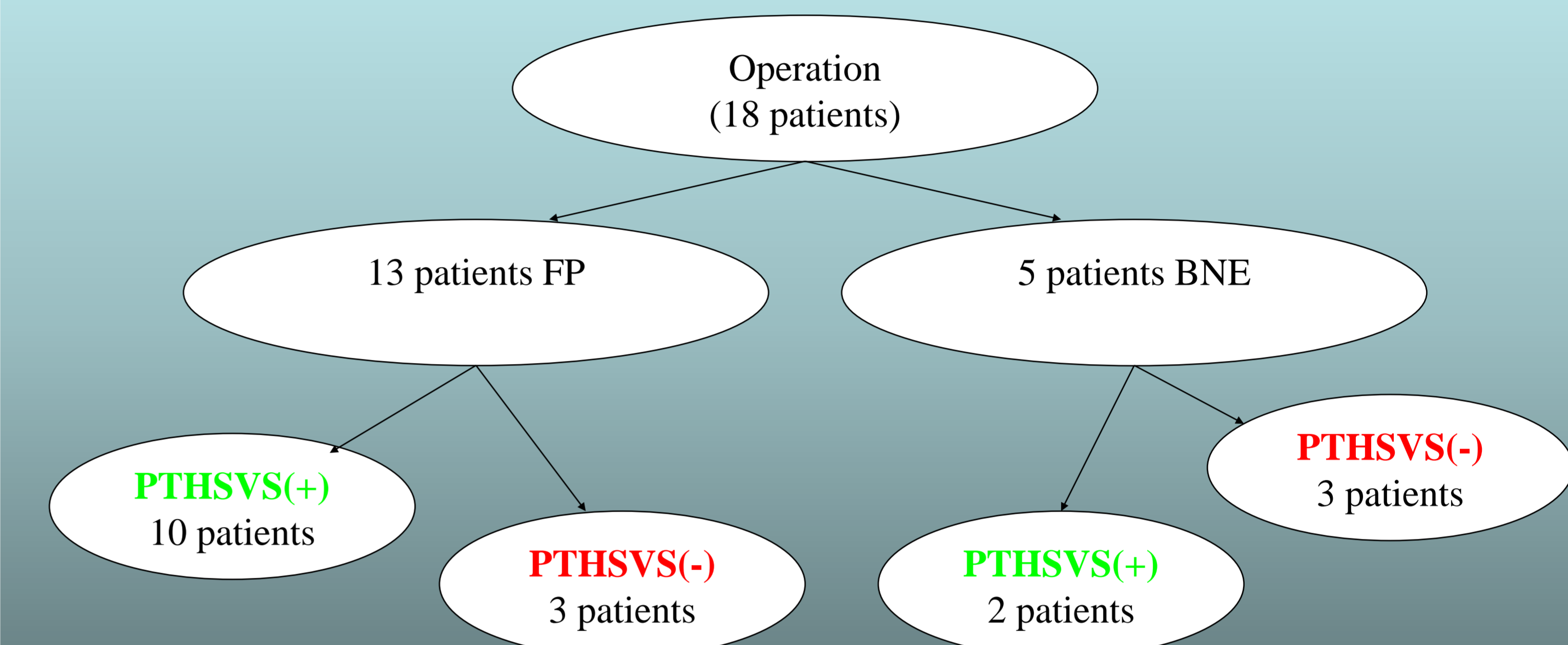
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## RESULTS

The results of the below mentioned PTH ratios show significant differences between PTHSVS(+) and PTHSVS(-) groups

PTH RATIO:	PTHSVS(+)	PTHSVS(-)
Side with higher mean PTH levels vs. side with lower mean PTH levels	2.60	1.12
Side with higher mean PTH levels vs. inferior vena cava (IVC) PTH level	3.79	1.46
Site with highest PTH level vs. IVC PTH level	7.37	1.51



We compared the results of the PTHSVS with the histopathological results obtained after the parathyroidectomy to evaluate the accuracy of the PTHSVS

PTH RATIO:	TP	FP	FN	TN
Side with higher mean PTH levels vs. side with lower mean PTH levels	2.59	2.18	1.09	1.03
Side with higher mean PTH levels vs. inferior vena cava (IVC) PTH level	3.91	2.29	1.47	1.16
Highest PTH level site vs. IVC PTH level	7.34	5.74	1.56	1.32

## Discussion

Our results of PTHSVS compared with subsequent histopathological results support PTHSVS as a useful additional test when both the parathyroid USS and Sestamibi scans are inconclusive. This is concordant with reports from other authors [2], although there are also contradictory-reports [3]. Current literature reviews support the use of PTHSVS in preparation for revision surgery in persistent PHPT [4,5]. In our hands PTHSVS enables the surgeon to choose FP rather than BNE in a significant proportion of patients with negative or discordant imaging. This is likely to result in less risk for patients and more efficient use of theatre time.

We attempted to analyse the various ratios of PTH levels to enable a better assessment of lateralisation. We suggest two PTH ratios:  
 - side with higher mean PTH levels vs. side with lower mean PTH levels  
 - or side with higher mean PTH levels vs. IVC PTH level