

ACCURACY OF LABORATORY INVESTIGATIONS ON JOINT FLUID FOR INFECTION

**Pakistan
November 2015**

360 SAMPLES OF JOINT FLUID

FROM COMBINATIONS OF –

- Infected joint arthroplasties
- Aseptic loose arthroplasties
- Acute and chronic septic arthritis
- Gouty arthritis
- Various inflammatory arthritides
- Intraoperative specimens after
Debridement and irrigation
- Sympathetic effusions with
adjoining osteitis or cellulitis
- Acute and chronic trauma
- Avascular necrosis

THE FOLLOWING PARAMETERS WERE STUDIED

Appearance – (Colour turbidity)

Viscosity, Mucin Clot

Red cell count

White cell count

Differential count

Synovial vs Blood sugar

Microscopic examination

re crystals and bacteria,

Bacterial culture and sensitivity

LOCAL & SYSTEMIC SIGNS OF INFECTION

We determined the probability and severity of systemic effects of infection judged by clinical, laboratory and radiological appearances and classified patients accordingly into 5 groups

VISCOSITY & MUCIN CLOT

EASY CHEAP INACCURATE

TP + TN – 144 FP + FN - 131

Positive predictive value in Group 4 & 5 92.3%

Negative predictive value in Group 1 & 2 98.0%

EVALUATION OF DEGREE OF INFECTION

POINTS	CLINICAL	LABORATORY	RADIOLOGICAL
0	No abnormality	Ferritin to iron Ratio less than 7:1	Normal spongeosa Negative isotopes
1	Local warmth	 Ferritin	Sclerosis
2	Lymphadenopathy Induration	MCV MCH  Serum Iron	No change Obliterated marrow
3	Inflammation Oedema	Anaemia	New smooth Periosteal reaction
4	Pyrexia Exudate	Raised Neutrophils CRP ESR PCT Plasma Viscosity	New bone, or lysis New sequestrum

POINTS AWARDED

POINTS		GROUP
0-2	Definitely no infection	1
3-4	Probably not infected	2
5-7	Equivocal infection	3
8-9	Probably infected	4
10-12	Definite infection	5

When separating probable
Non-infected (Group 1&2) from
Probable infection (Group 4&5)
We excluded the 13 samples with
equivocal infection (Group 3) but
included them in unsorted analyses

FORMULAE FOR ANALYSING STATISTICS

Sensitivity (TP rate)	$= TP / (TP + FN)$
Specificity (TN rate)	$= TN / (TN + FP)$
Accuracy %	$= \frac{TP + TN}{TP + TN + FP + FN} \times 100$
Predictive value of a positive results	$= TP / (TP + FP)$
Predictive value of a negative result	$= TN / (TN + FN)$

TURBIDITY

Subjective Interpretation

Clarity: Clear, opalescent,
cloudy, turbid, purulent

Colour: Dark yellow, light yellow,
colourless, pink, red

TURBIDITY

Group	All	1 & 2	4 & 5
Sensitivity	97.04%	100.00%	97.35%
Specificity	40.04%	41.96%	50.00%
Accuracy %	75.46%	44.44%	94.97%
Predictive value of a positive result	72.43%	7.14%	<u>97.35%</u>
Predictive value of a negative result	89.66%	<u>100.00%</u>	50.00%

TURBIDITY COMMENTS

EASY COSTS NOTHING

TP 197, TN 52, FP 75, FN 6

Sensitivity good, specificity poor

Frequent FP for many reasons

Clear fluid in Group 1 & 2 very reliable

Good positive predictive value Group 4 & 5

Better negative predictive value Group 1 & 2

VISCOSITY & MUCIN CLOT

Viscosity: Observe how a drop drips from a pipette

Mucin Clot: Observe reaction when joint fluid dropped into acetic acid

VISCOSITY

Increased Normal Decreased

Group	All	1 & 2	4 & 5
Sensitivity	54.17%	50.00%	53.50%
Specificity	49.53%	54.35%	30.00%
Accuracy %	52.36%	54.26%	52.10%
Predictive value of a positive result	62.76%	2.33%	<u>92.31%</u>
Predictive value of a negative result	40.77%	<u>98.04%</u>	3.95%

TOTAL WHITE CELLS

Critical 1000/mm³

Group	All	1 & 2	4 & 5
Sensitivity	83.00%	66.67%	83.51%
Specificity	77.17%	80.36%	44.44%
Accuracy %	80.73%	80.00%	81.73%
Predictive value of a positive result	85.13%	8.33%	<u>96.91%</u>
Predictive value of a negative result	74.24%%	<u>98.90%</u>	11.43%

TOTAL WHITE CELLS

TP 166, TN 98, FP 29, FN 34

Moderate sensitivity

Predictive value selective for

Group 1 & 2 vs 4 & 5

TOTAL WHITE CELLS

Group 1 & 2 False positive due to –

- Acute and chronic trauma (Charcot)

- Adjacent infection (bone, skin)

- FB, AVN, RA, Gout

- Local ulcer, granuloma

Group 4 & 5 False negatives due to –

- Indolent biofilm or non virulent bacteria

DIFFERENTIAL WHITE CELL COUNT

Critical 60% polymorphs

Group	All	1 & 2	4 & 5
Sensitivity	91.10%	100.00%	91.11%
Specificity	52.78%	54.17%	25.00%
Accuracy %	77.26%	55.56%	88.30%
Predictive value of a positive result	77.33%	6.38%	<u>96.47%</u>
Predictive value of a negative result	77.03%	<u>100.00%</u>	11.11%

DIFFERENTIAL COUNT

TP 174, TN 57, FP 51, FN 17

Good sensitivity, poor specificity

Many FP spoils accuracy for the
same reasons as for Total Count

BACTERIA ON MICROSCOPY

Group	All	1 & 2	4 & 5
Sensitivity	8.96%	<u>0.00%</u>	9.42%
Specificity	96.21%	95.73%	<u>100.00%</u>
Accuracy %	43.54%	94.12%	13.93%
Predictive value of a positive result	78.26%	0.00%	<u>100.00%</u>
Predictive value of a negative result	40.97%	<u>98.25%</u>	5.46%

BACTERIA ON MICROSCOPY

COMMENTS

TP 10, TN 127, FP 5, FN 183

Cheap very insensitive and inaccurate

Predictive value selective for

Group 1 & 2 vs 4 & 5

BACTERIA ON CULTURE

Group	All	1 & 2	4 & 5
Sensitivity	58.85%	50.00%	59.60%
Specificity	94.81%	94.17%	100.00%
Accuracy %	72.97%	93.44%	61.54%
Predictive value of a positive result	94.62%	12.50%	<u>100.00%</u>
Predictive value of a negative result	59.81%	<u>99.12%</u>	11.11%

BACTERIA ON CULTURE

COMMENT

TP 123, TN 128, FP7, FN 88

Positive culture – Most Valuable

Important for diagnosis & therapy

Identity and sensitivity crucial

The few FP due to contamination

40% FN due to indolence of biofilm

Better rate on tissue sample ($\pm 30\%$)

This low sensitivity a consistent finding

SYNOVIAL SUGAR vs BLOOD SUGAR

Critical 40%

Group	All	1 & 2	4 & 5
Sensitivity	61.90%	<u>0.00%</u>	62.59%
Specificity	89.42%	88.37%	100.00%
Accuracy %	73.31%	87.36%	66.23%
Predictive value of a positive result	89.22%	0.00%	<u>100.00%</u>
Predictive value of a negative result	62.42%	<u>98.70%</u>	22.39%

SYNOVIAL SUGAR 40% OF BLOOD

TP 91, TN 93, FP 11, FN 56

No TP in Group 1 & 2

11 FP in Group 1 & 2 associated with loosening,
poly wear, trauma, AVN and leukaemia

15 TN in Group 4 & 5 due to clean joint
with infection elsewhere

56 FN in Group 4 & 5 due to
indolence in biofilm or non-virulence
Bacteria found in interface not joint

Predictive value selective for 1 & 2 vs 4 & 5

ALPHA DEFENSIN

- Sensitivity 97%
- Specificity 96%