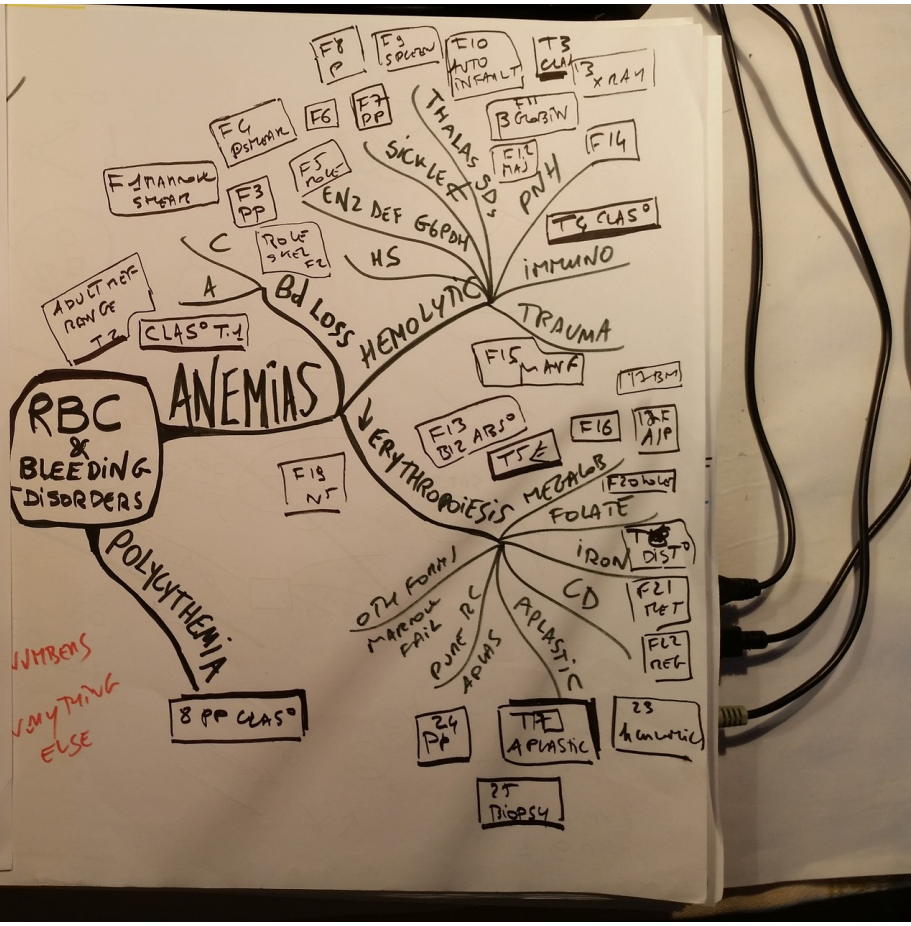
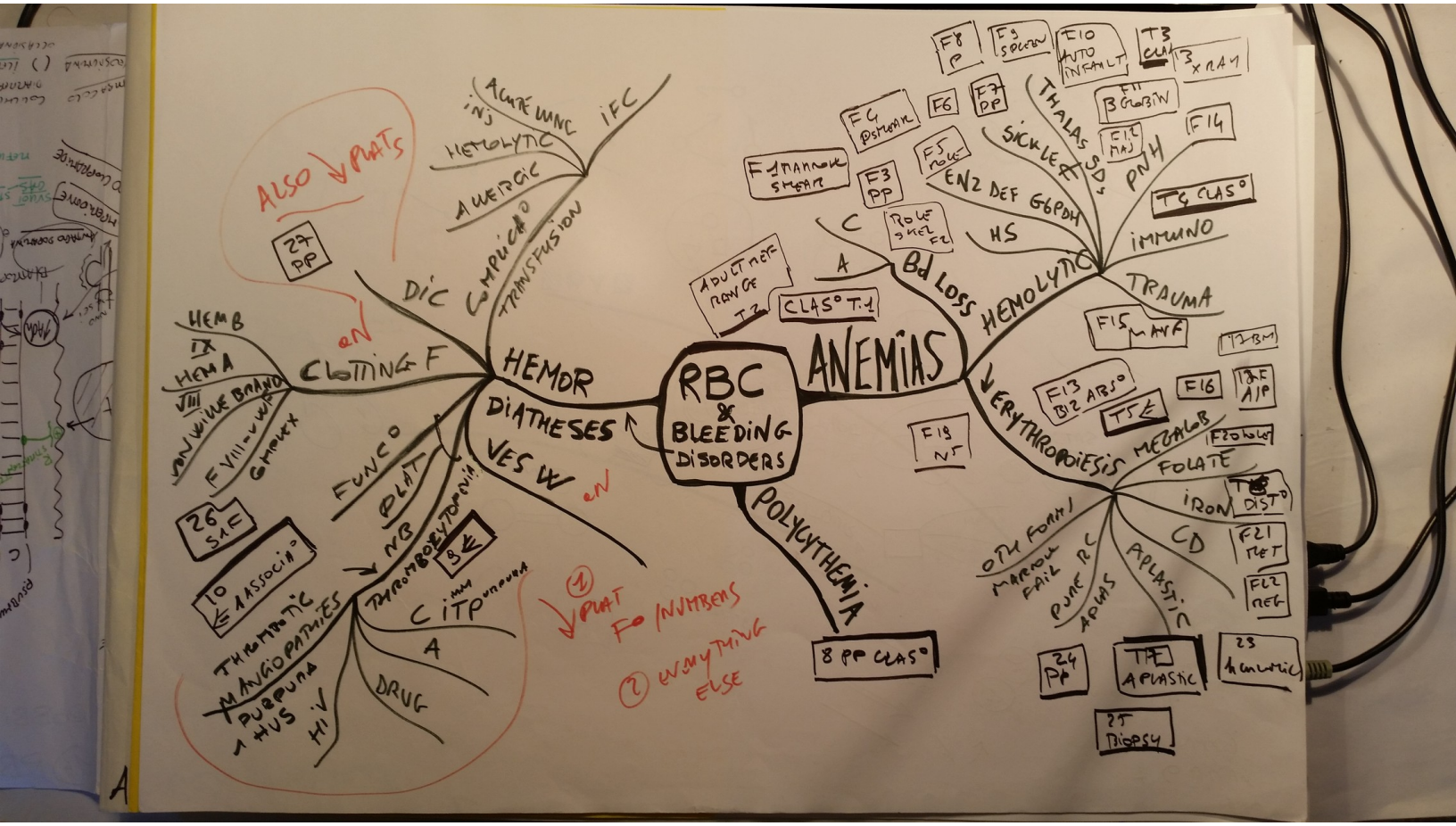
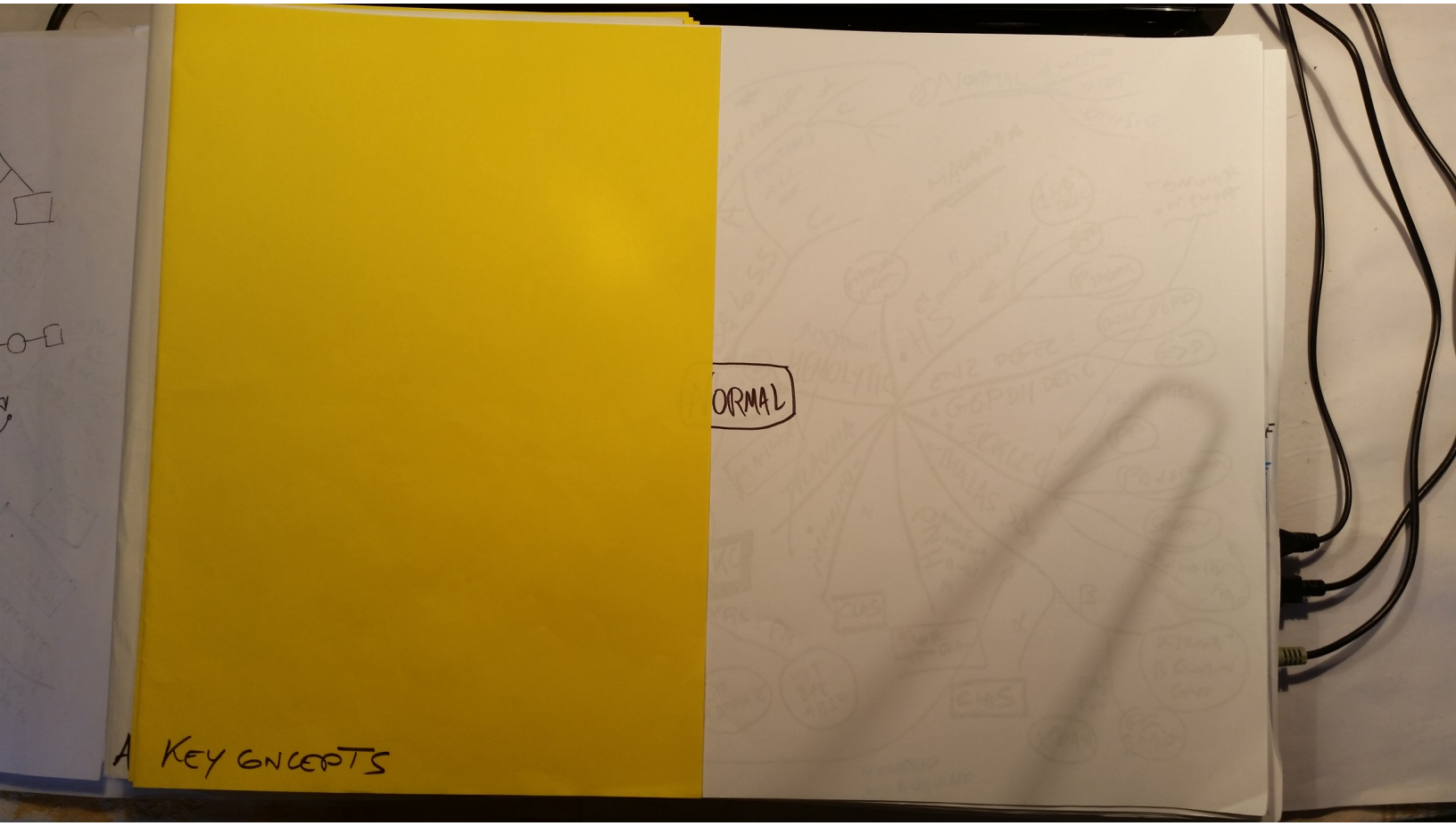
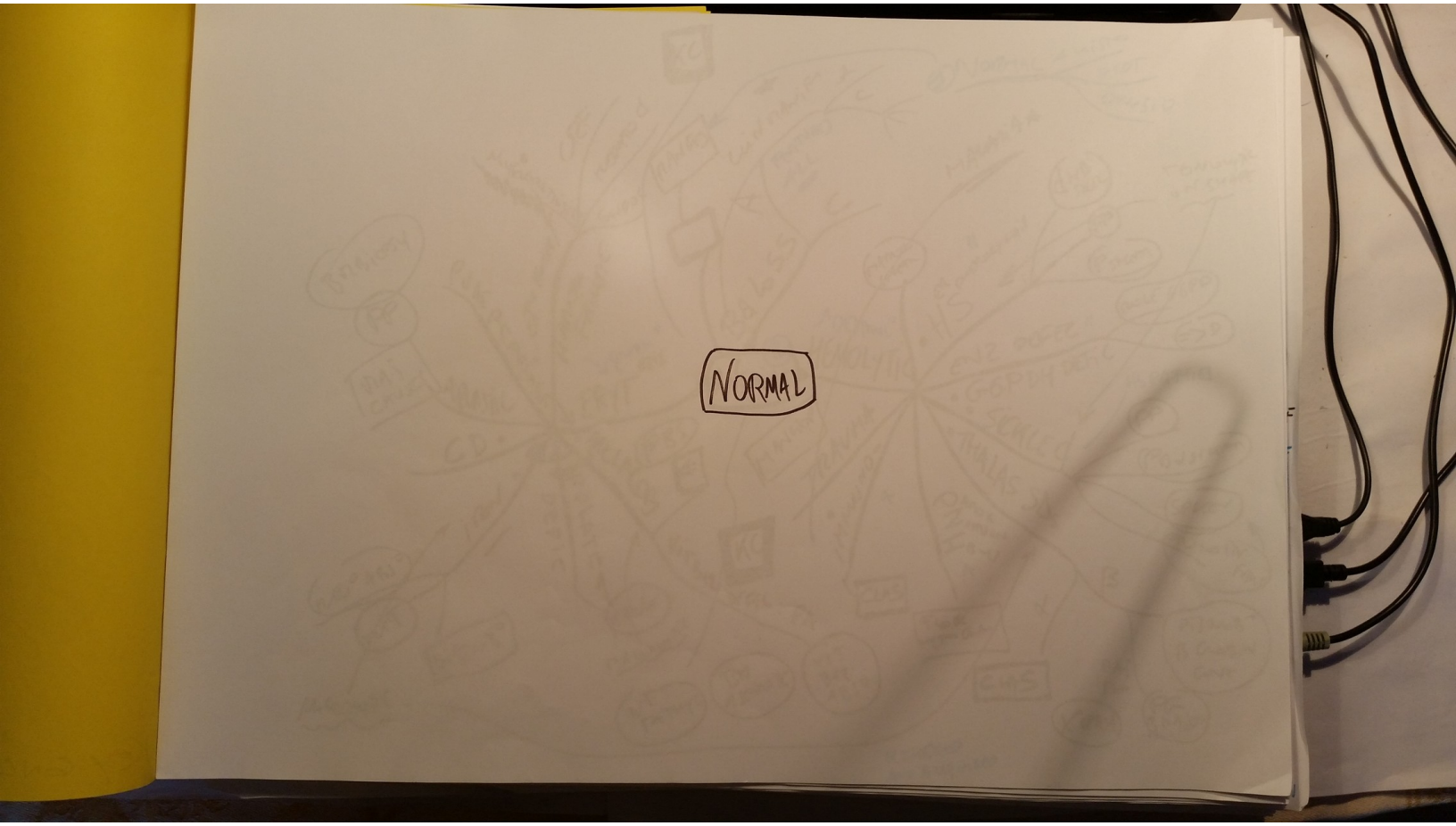
ROBBINS

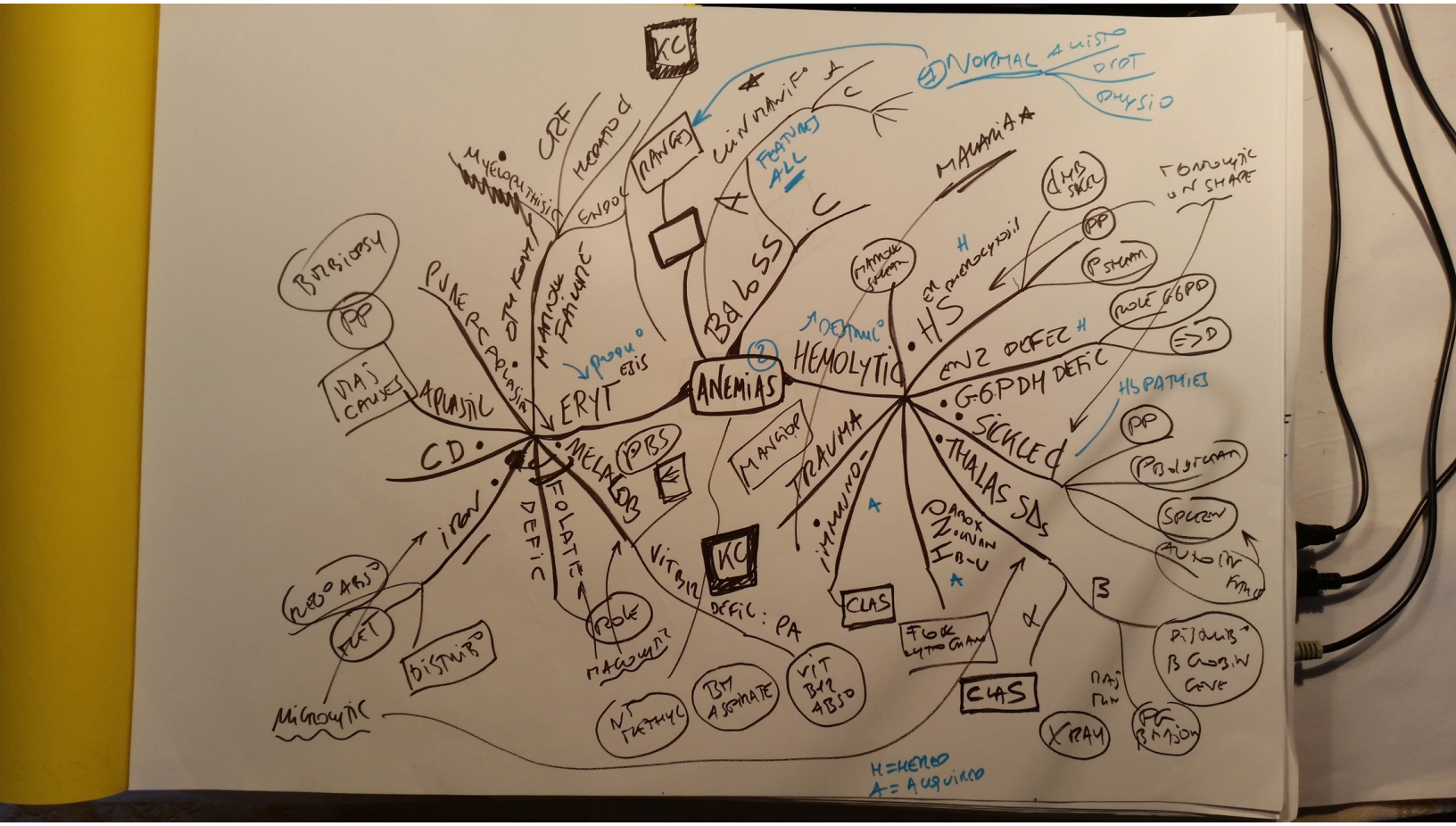
(9) RBC & BLEEDING DISORDERS

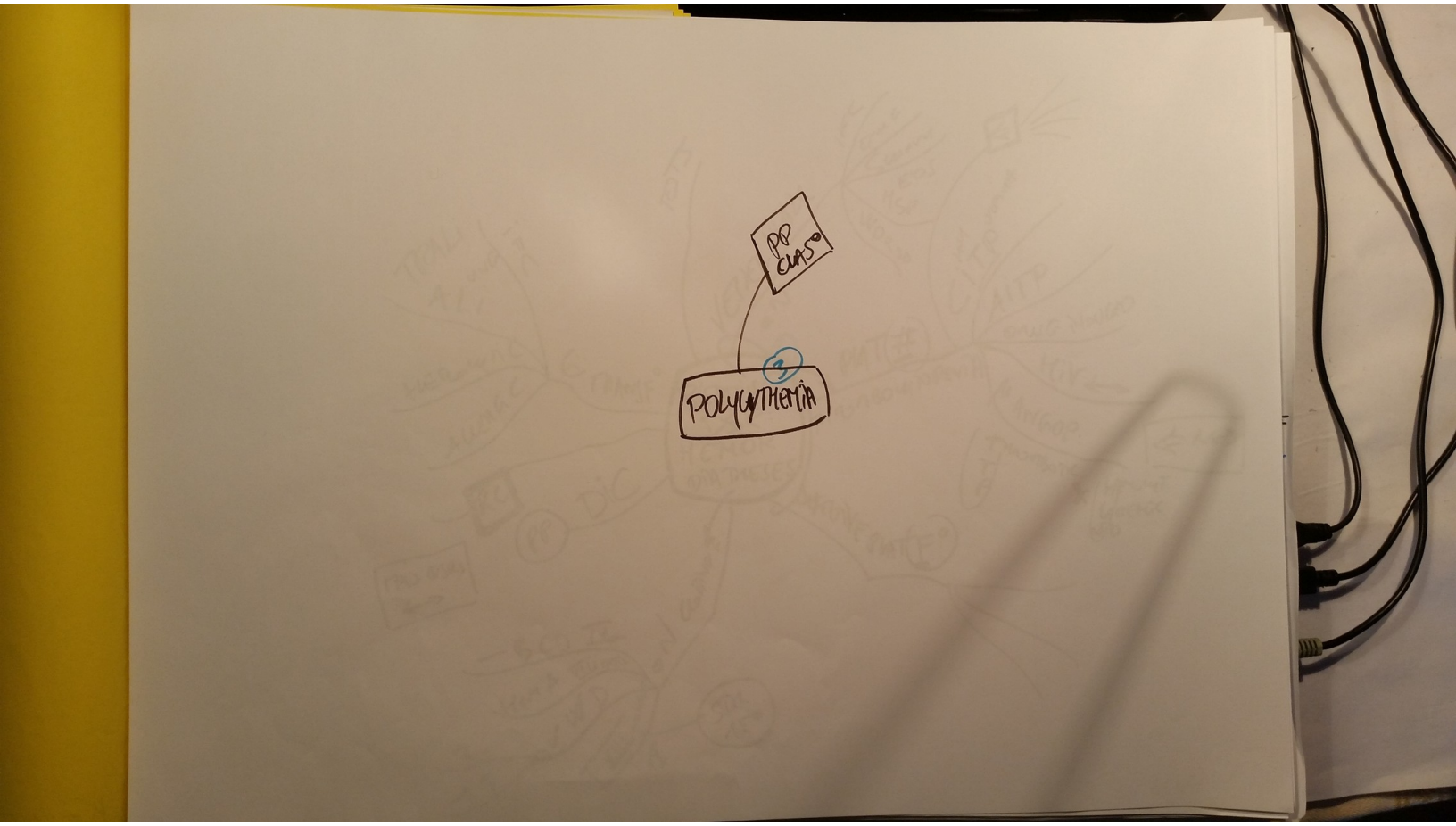


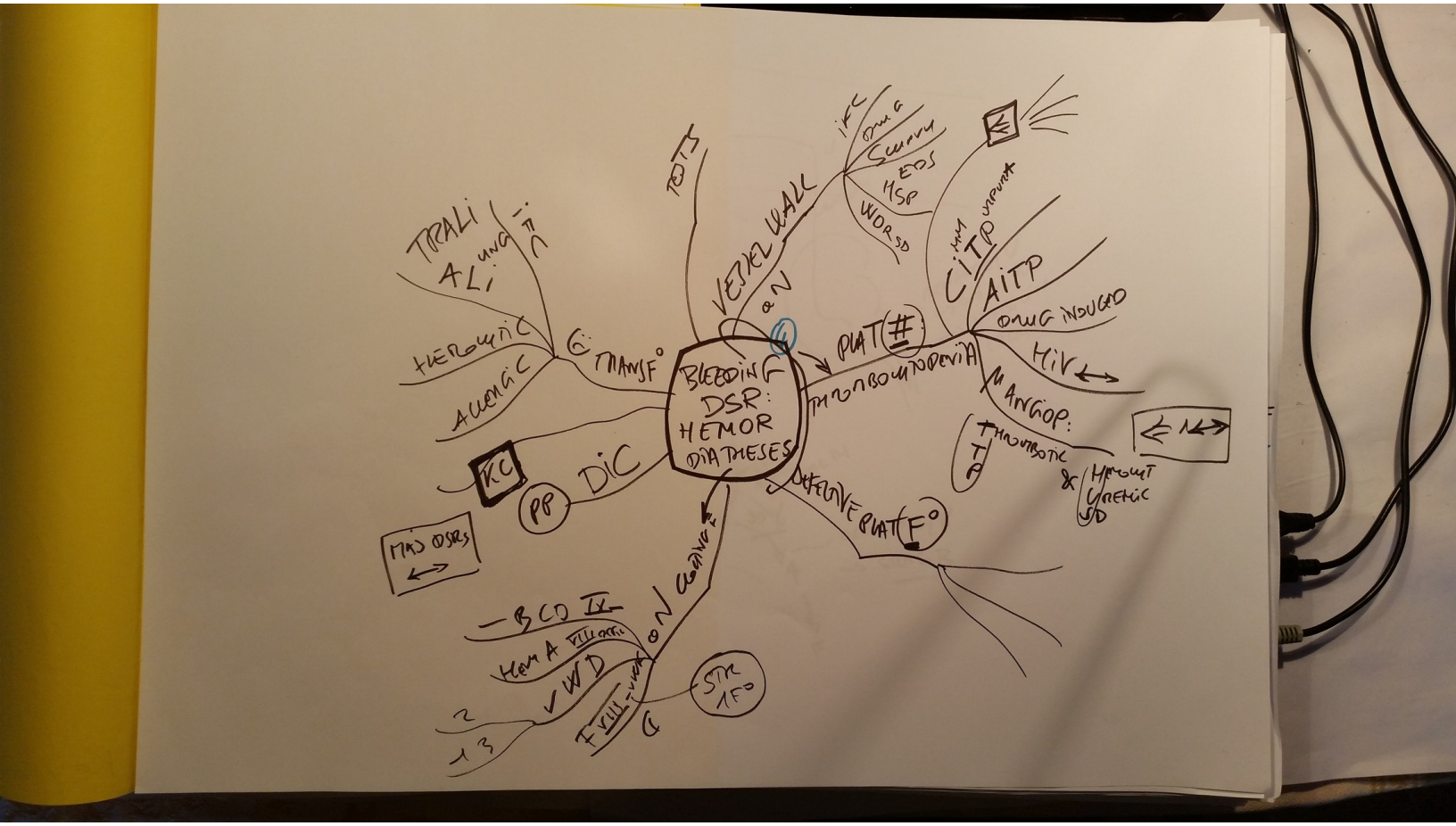

RBC & BLEEDING DISORDERS
HEMOR
DIATHESES
CLOTTING F
HEMB
IX
HEM A
VIII
VON WILLE BRAND
F VIII-vWF COMPLEX
FUNC° PLAT
NB
THROMBOCYTOPENIA
C ITP
A
DRUG
HIV
THROMBOTIC ANGIOPATHIES
PURPURA / HUS
DIC
ACUTE LUNG INJ
HEMOLYTIC
ANERGIC
COMPLICATED TRANSFUSION
ALSO ↓PLATS
27 PP
26 SAE
10 ASSOCIATED
3 SAE
VES W
① ↓PLAT F/U INVESTIGATIONS
② EVERYTHING ELSE
POLYCYTHEMIA
8 PP CLAS°
ANEMIAS
ADULT REF RANGE T3
CLAS° T-1
A
C
Bd LOSS
HEMOLYTIC
ENZ DEF G6PDH
HS
SICKLE
THALAS
SDs
PNH
IMMUNO
TRAUMA
T3 CLAS°
F14
F15 MAF
T2 BM
F16
T3 F1/P
T5 F
F13 B12 ABS°
F19 NF
ERYTHROPOIESIS
MEGALOB
FOLATE
IRON
T3 DIST°
F20 b6
CD
F21 MET
F22 NEG
APLASTIC
APLAS
PURE RC
MARROW FAIL
OTH FOAMI
24 PP
THE APLASTIC
23 chronic
2T BIOPSY
F8 P
F9 SPLEEN
F10 AUTO INFAM LT
T3 CLIN
T3 X RAY
F11 B GLOBIN
F11 MAJ
F6
F7 PP
F5 NOLE
F3 PP
F4 MANNOSE SMEAR
F6 POSITIVE
ROLE SMEL F2

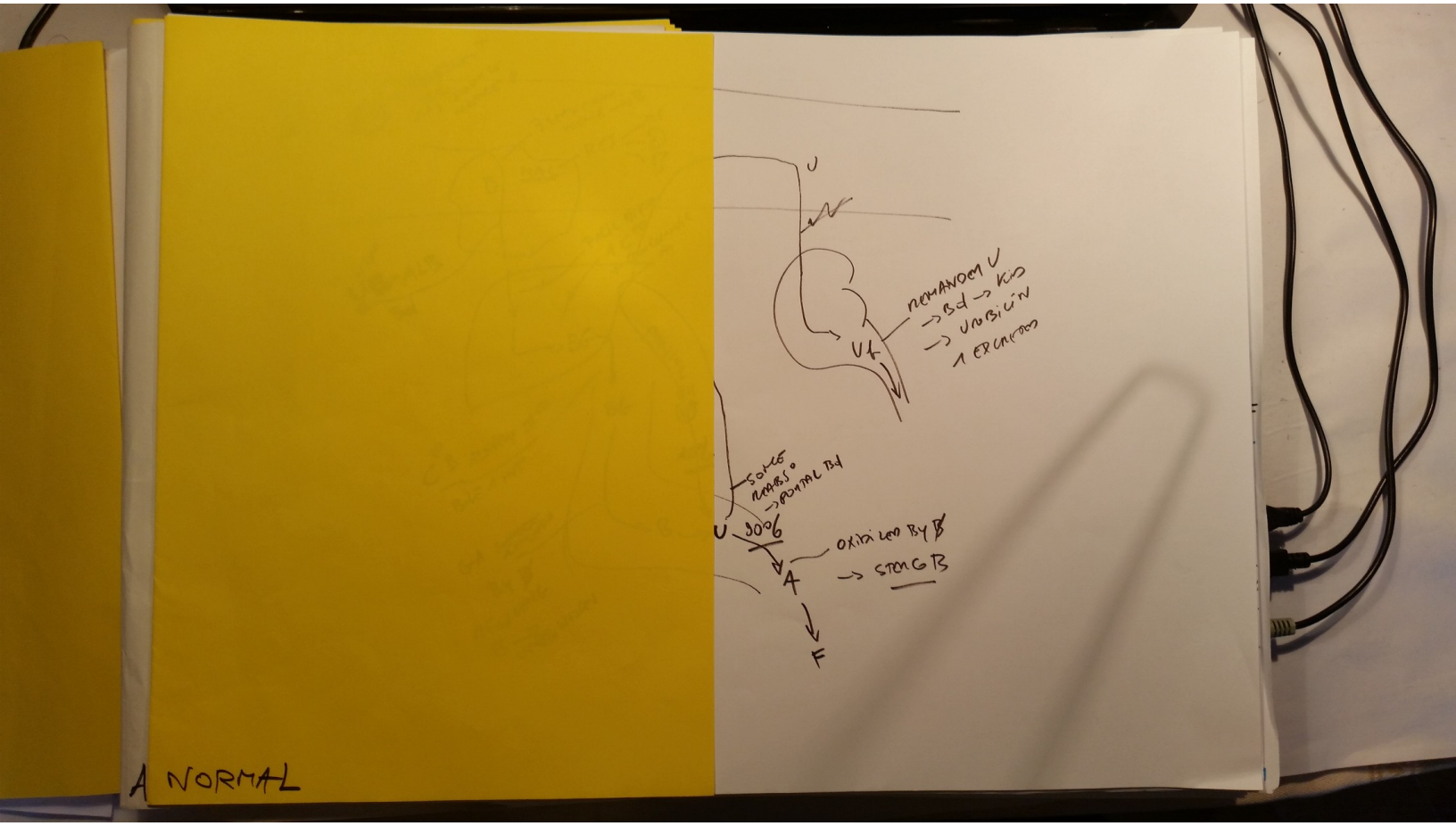

ORMAL
A KEY GNCEPTS


NORMAL

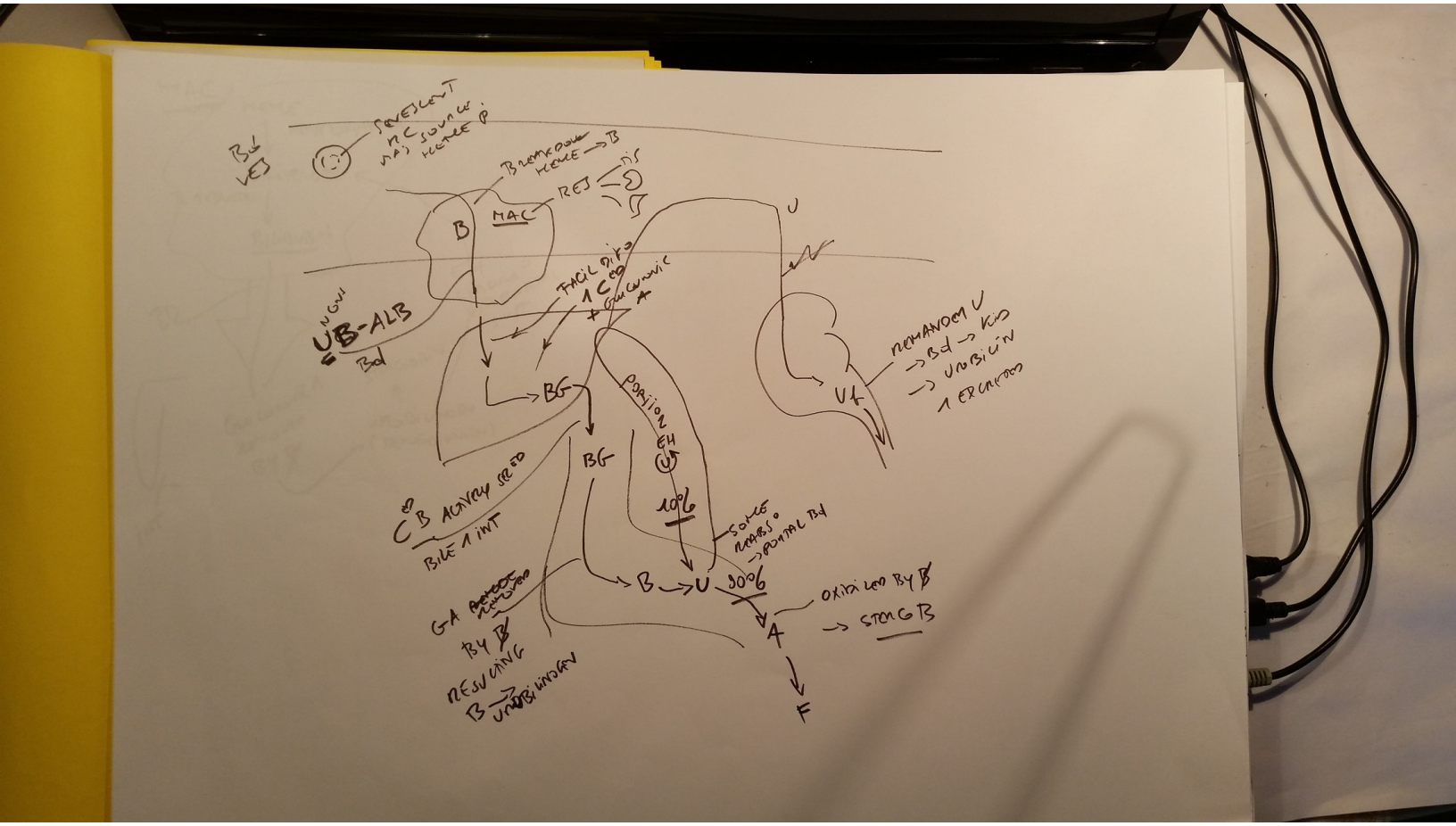

ANEMIAS
KC
NORMAL
CRF
MYELOPHTHISIS
MARROW FAILURE
APLASTIC
ERYT
CD
BIOPSY
PP
PURE RC APLASIA
PBS
MEGALOB
FOLATE DEFIC
VIT B12 DEFIC : PA
MICROCYTIC
IRON
BISTURB
BALSS
HEMOLYTIC
HS
G-6PDH DEFIC
SICKLED
THALASSDs
TRAUMA
IMMUNO-
CLAS
FLOW CYTOMETRY
SPLEEN
HISPATHIES
XRAY
H=HEREDO
A=ACQUIRED

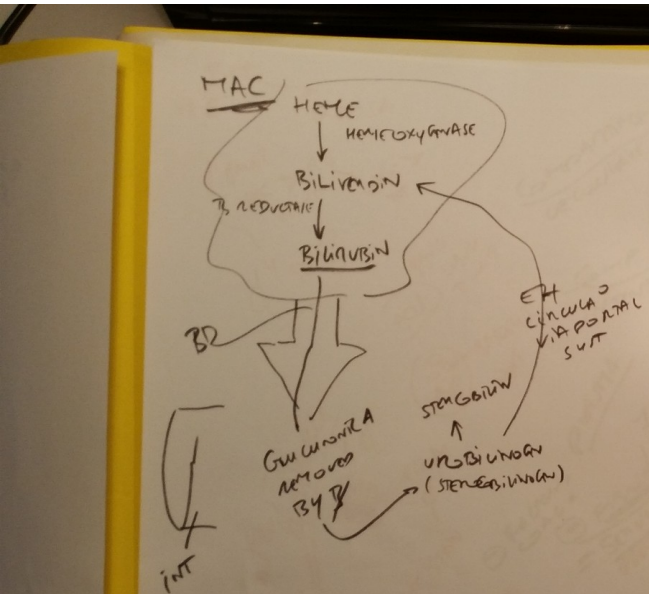

PP
CLASS
POLYCYTHEMIA

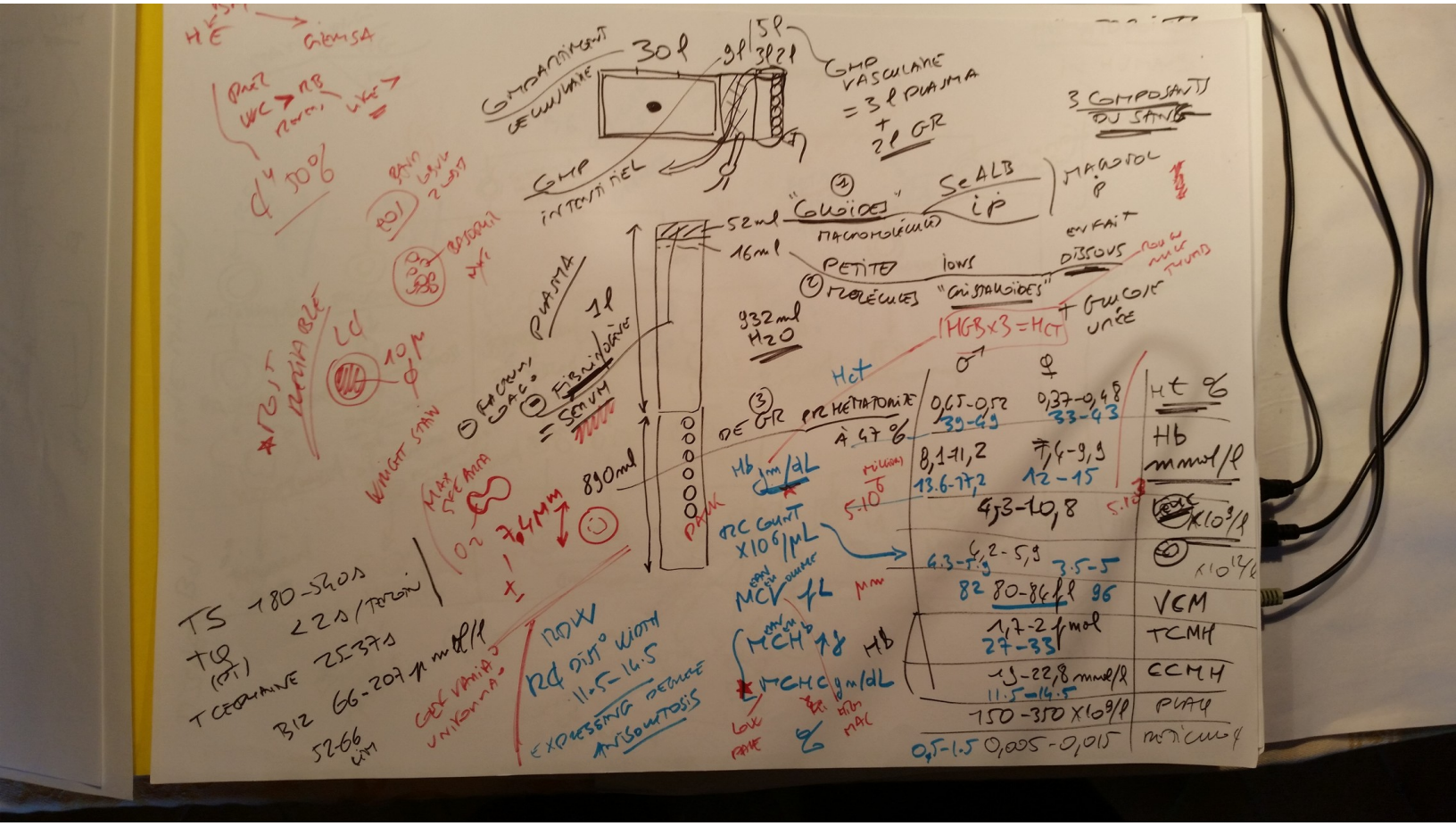

TRALI
ALI
THERAPIC
ALLERGIC
TRANSF°
TESTS
VESSEL WALL
ON
IFC
SEVERE
MSP
WORSD
CITP
AITP
DRUG INDUCED
HIV
PLAT(#)
THROMBOCYTOPENIA
ANGIOP:
THROMBOTIC
HEMORRHAGIC
BLEEDING DSR: HEMOR DIATHESES
DIC
PP
FC
MIS OSRS
EXTENSIVE PLAT(F°)
CLOTTING
BCD IV
HEMA
VWD
STR 1F°
2
13

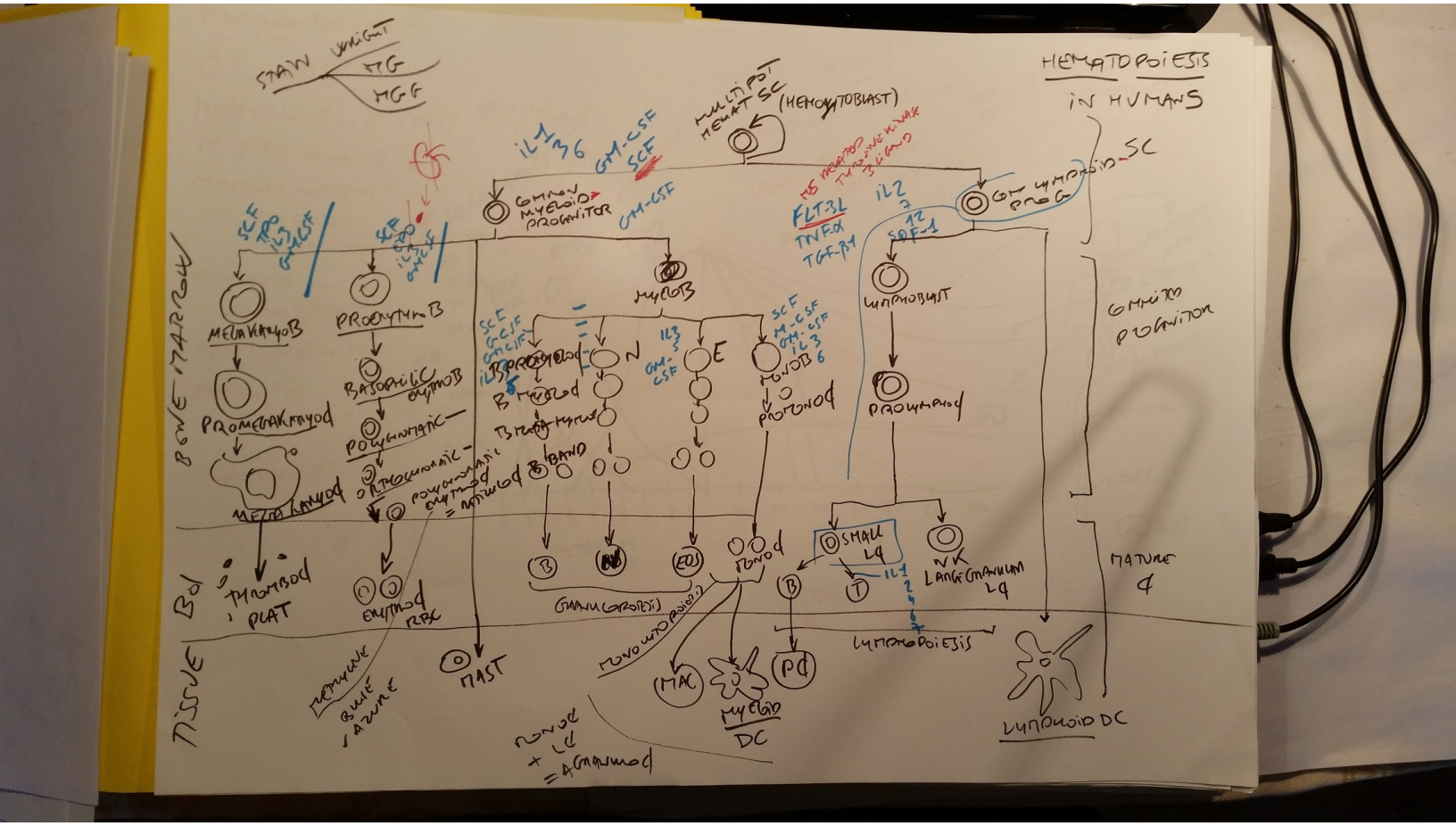

U
MECHANISM U
↓ Sol → Kus
→ UROBILIN
↑ ERYTHROID
Ut
SOME
NORMAL Bd
U
90%
A
OXIDIZED BY B
→ STRONG B
F

A NORMAL


B
MAC
REJ
U
BG
BG
Ut
B → U
30%
A
F


MAC
HEME
HEME OXYGENASE
BILIVERDIN
REDUCTASE
BILIRUBIN
BR
EH
CIRCULA
VIA PORTAL
SYST
STERCOBILIN
UROBILINOGEN
(STERCOBILINOGEN)
INT


3 COMPOSANTS DU SANG
GMP VASCULAIRE
= 3 l PLASMA + 2 l GR
GMP INTERSTITIEL
"CRISTALLOÏDES"
SeALB
iP
MACROMOLÉCULES
PETITES MOLÉCULES
ions
PLASMA
Hct
HGB x 3 = Hct
PRÉHÉMATOCRITE
À 47 %
890 ml
PARIS
TS 180-320 s
TP (PT) < 2 s / Témoin
TCK/PTT 25-37 s
B12 66-207 ng/l
5266 UI/l
RDW
RD 11.5-16.5
EXPRESSING REFUGE
ANISOCYTOSIS
Hb
MCV
MCH
MCHC
PLAQ
0,5-1,5
0,005-0,015


HEMATOPOIESIS
IN HUMANS
BONE MARROW
BLOOD
TISSUE
MATURE
MAST
MAC
DC
LYMPHOID DC
LYMPHOPOIESIS
GRANULOPOIESIS
MONOCYTOPOIESIS
ERYTHROCYTE
PLATELET
NEUTROPHIL
EOSINOPHIL
BASOPHILIC ERYTHROB
PROERYTHROB
METAMYELOCYTE
PROMYELOCYTE
MYELOCYTE
PROMONOCYTE
PROLYMPHOCYTE
LYMPHOBLAST
SMALL LY
NK
LANGERHANS LY
GM-CSF
SCF
IL3
IL6
FLT3L
TNFα
TGF-β1
IL7
SDF-1
IL2
IL15

MARROW FEATURES

♂ Y → 50%

MEGAKARYO ♂ → AT LEAST 1-2/hpf

M: E RATIO → 3:1

MYELOID MATURATION

→ 1/3 BANDS OR MORE

ERYTHROID —

→ NUC/CYT

· HYPO/ Ø Y → STAIN %

· STAIN Fe

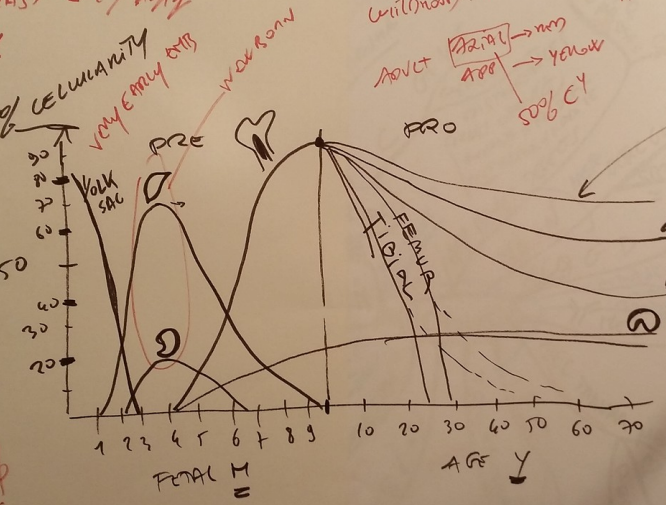
IF HEMOSIDERIN

→ PRESENT

"RORIGN ♂"

LYMPH ♂

GLAND ♂



WHERE?

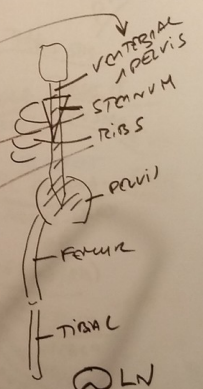
HEMATOP SITE

CHILDHOOD: AXIAL & APPEND

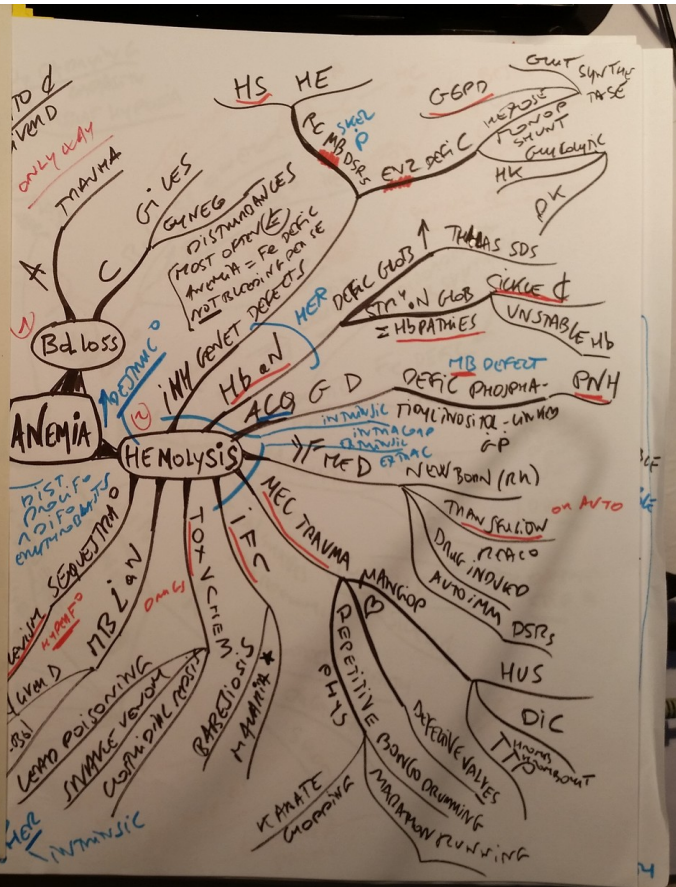
ADULT AXIAL → RED

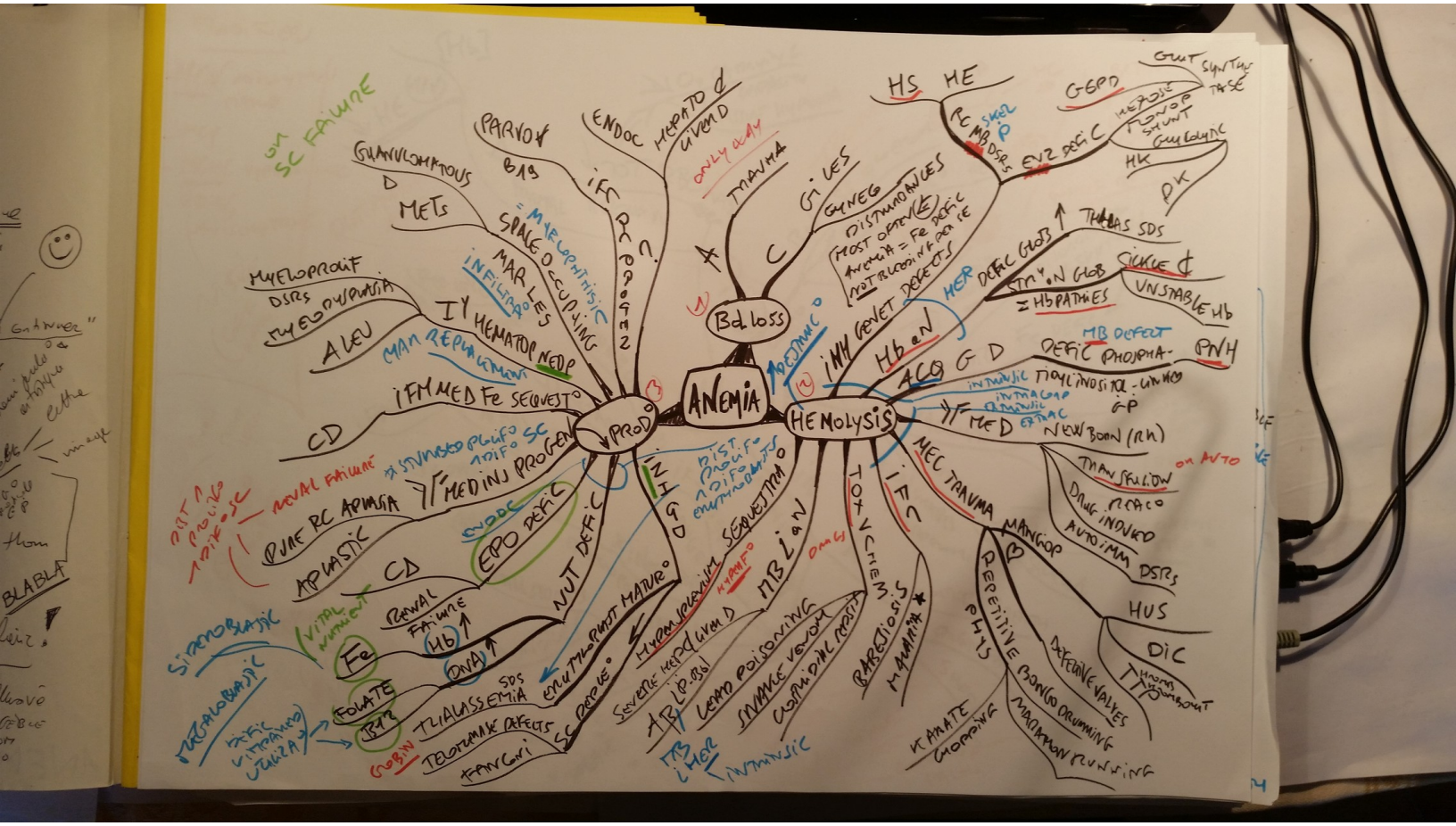
APPEND → YELLOW

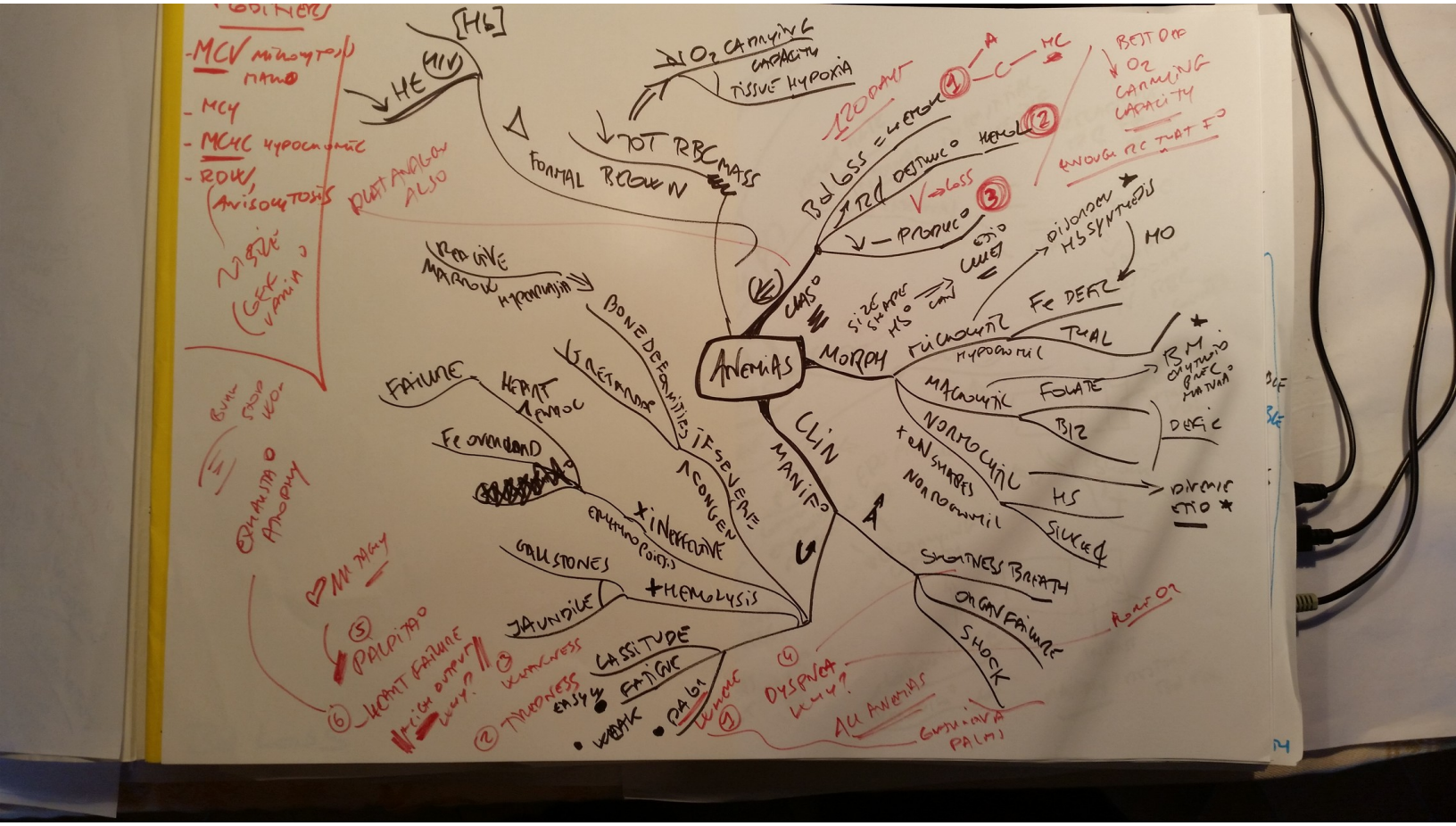
50% ♂Y



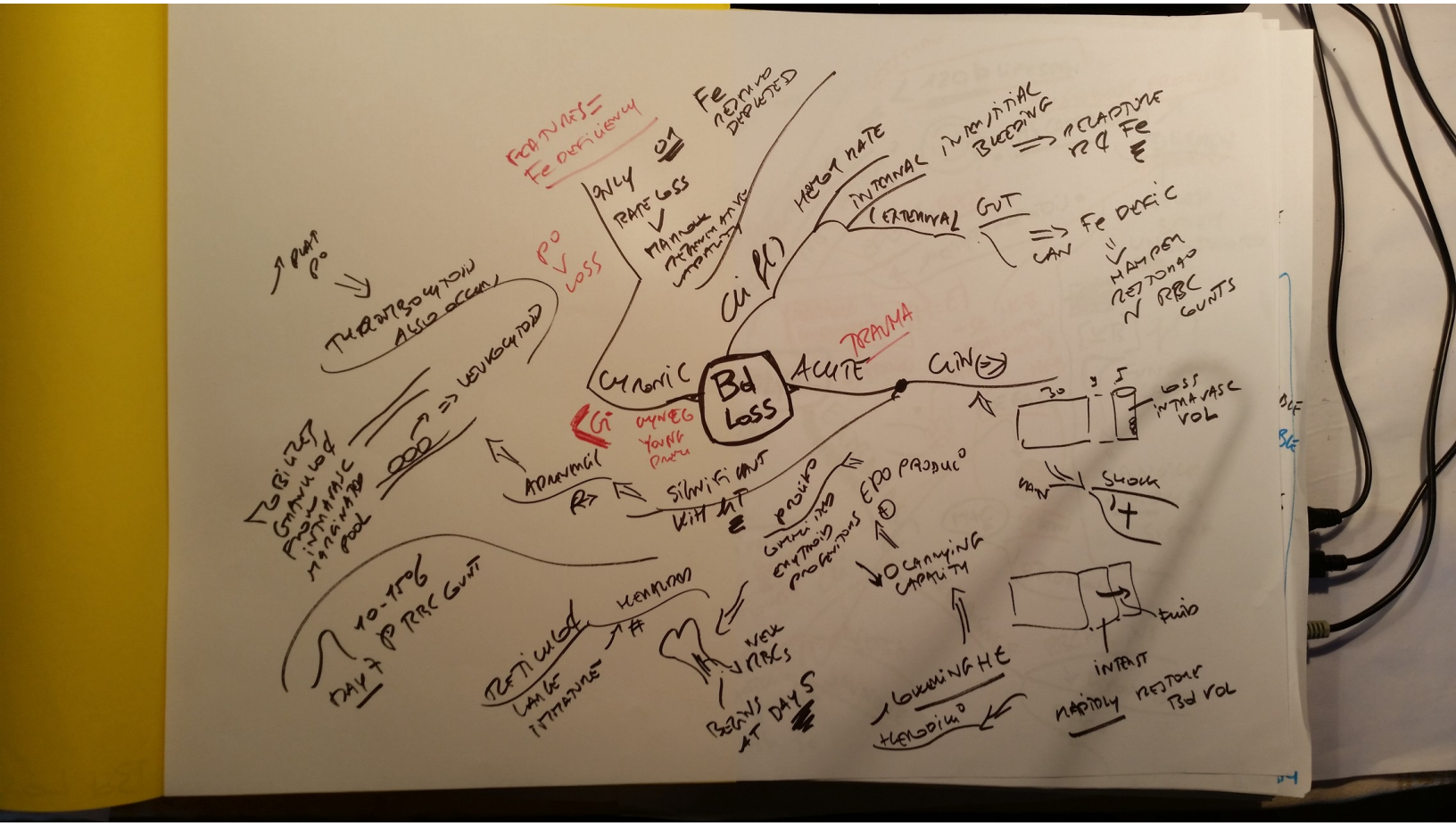
ANEMIAS

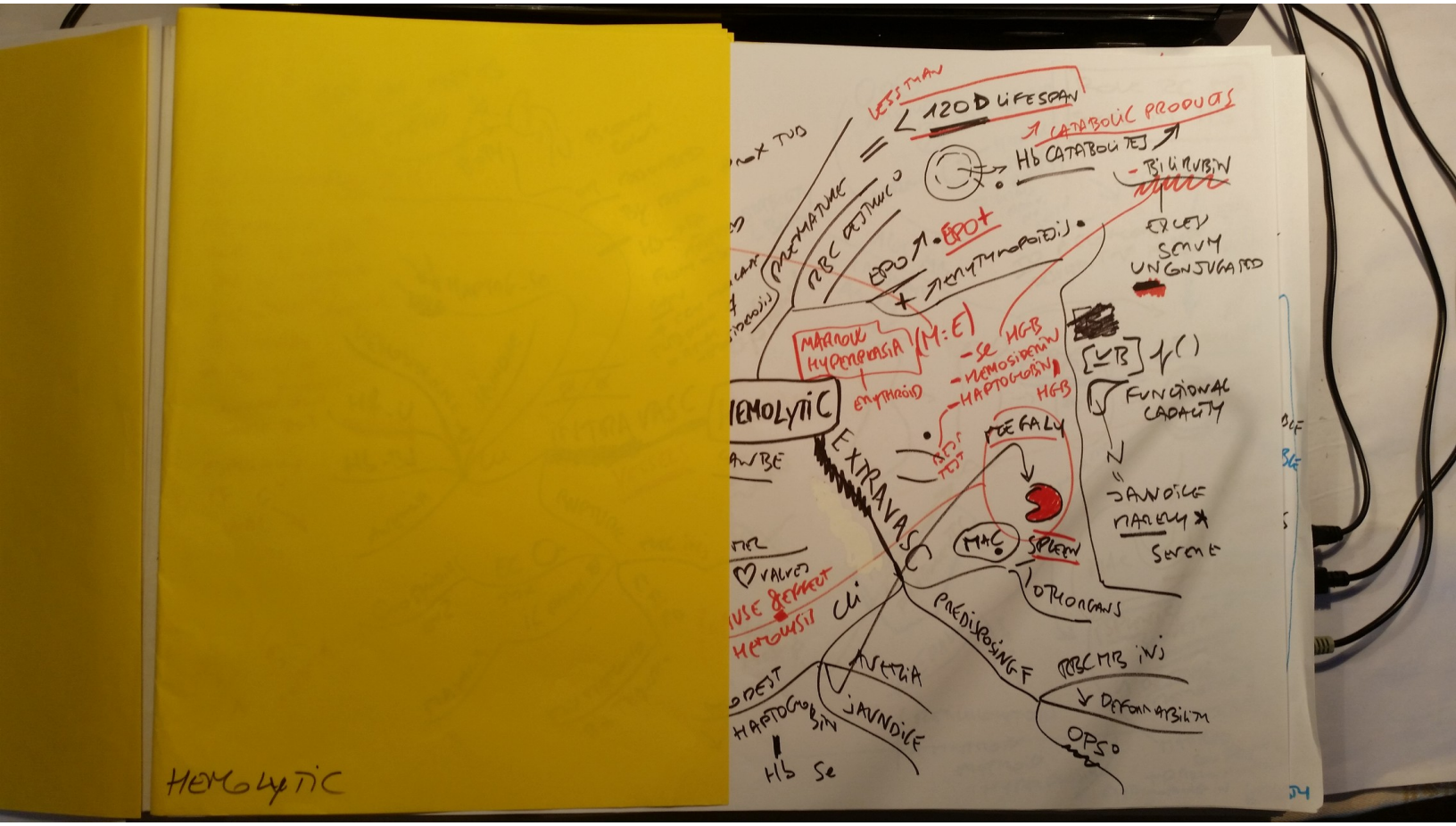

ANEMIA
HEMOLYSIS
Bd loss
HS HE
GSPD
GLUT
SYNTHASE
TRANSF
HK
PK
TRAUMA
GIVES
GYNEG
DISMORPHIC
MOST OFTEN
ANEMIA = Fe DEFIC
NOT BLOOD VESSEL DEFECTS
MEMBR DSRS
ENZ DEFIC
HEREDITARY SPHEROCYTOSIS
HEREDITARY ELLIPTOCYTOSIS
HEREDITARY STOMATOCYTOSIS
PYRUVATE KINASE DEFIC
GLUCOSE PHOSPHATE ISOMERASE DEFIC
THALASS SDS
SICKLE
UNSTABLE Hb
HAEM
Hb aN
GENET DEFECTS
DEFIC GLOB
STRUCTURAL GLOB ABN
= Hb PATHIES
ACQ
MB DEFECT
DEFIC PHOSPHATIDYLINOSITOL-LINKED GP
PNH
INTRAVASC
INTRACORP
CHRONIC
EXTRAC
MED
NEWBORN (HN)
TRANSFUSION
DRUG INDUCED
AUTOIMM DSRS
MECH TRAUMA
MARCHIAFAVA MICHELI SYNDROME
PAROXYSMAL NOCTURNAL HAEMOGLOBINURIA
PHYS
REPETITIVE BANGING DRUMMING
DEFECTIVE VALVES
HUS
DIC
THROMBOTIC THROMBOCYTOPENIC PURPURA
VITAMIN DEFICIENCY
MALABSORPTION RUNNING
TOXICHEMICAL
BABESIOSIS
MALARIA
INFECT
INTRINSIC
EXTRINSIC
MBL aN
SEQUESTRATION
LEAD POISONING
SNAKE VENOM
CLOSTRIDIAL TOXIN
ONLY ACUTE
ACUTE
CHRONIC
ON AUTO
DRUG
HYPERFO

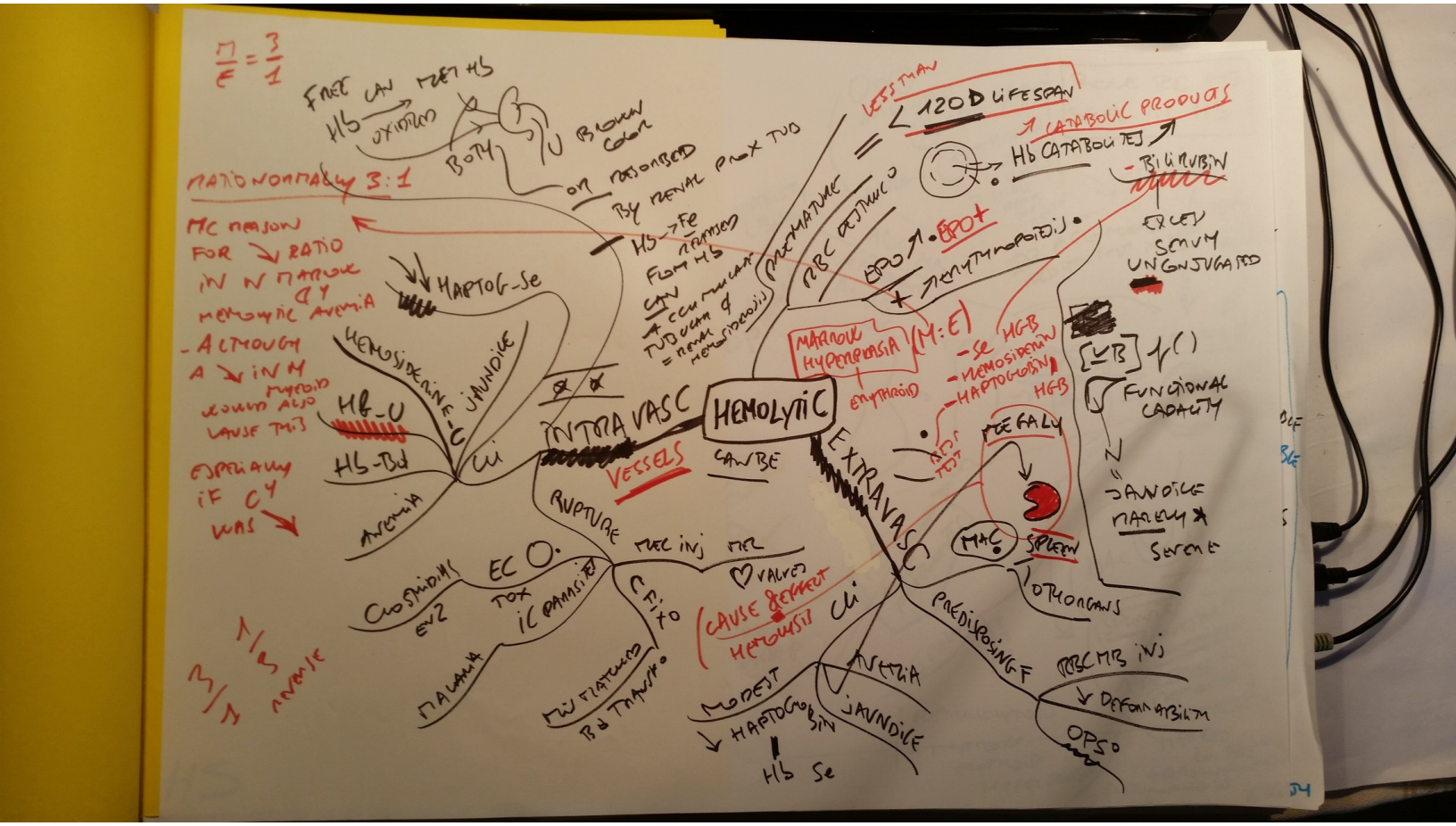

ANEMIA
Bd loss
↓PROD
HEMOLYSIS
↓INH GD
↑ DESTRUCT
HS
HE
G6PD
PK
HK
PARVO B19
ENDOC
HEPATO d
CIRRH D
TRAUMA
CML
GYNEC
MYELOPROLIF DSRS
MYELODYSPLASIA
ALEU
MARROW INFILTRAT°
MYELOPHTHISIC
SPLAC SEQUEST°
IY
HEMATOP NEDP
MAN REPLACEMENT
IFM MED
Fe SEQUEST°
CD
APLASTIC
PURE RC APLASIA
MEDINJ PROGEN
SYNDROMIC PLUrIFo SC
NEONAT FAILURE
ENDOC
EPO DEFIC
CD
RENAL FAILURE
NUT DEFIC
Fe
FOLATE
B12
Hb
DNA
SIDEROBLASTIC
MEGALOBLASTIC
VITAL MOMENT
THALASSEMIA
SDS
TELOMERIC DEFECTS
FANCONI
ENUCLEAT° MATURE°
SC DEPLE°
GLOBIN
HYPERPROLIFERATIVE
SEVERE HEMOLYSIS
ABO
LEAD POISONING
SIDERO BLASTIC
MBL iaN
HYPERFo
DIMERS
TOXICHEM
BASOPHILIC MYELOCYTE
IFC
MEC TRAUMA
MARCHIAFAVA
PAROXYSMAL NOCTURNAL HEMOGLOBINURIA
PNH
REPETITIVE BONKO DRUMMING
DEFERENCE VALVES
MARATHON RUNNING
HUS
DIC
THROMBOCYTOPENIA
TTP
SCHIZOCYTES
HELMET CELLS
MICROANGIOPATHIC HEMOLYTIC ANEMIA
CHOPPING
MECHANICAL
PROSTHETIC VALVE
CARDIAC
ENDOTHELIAL
DISTURBANCES
DISTINGUISHABLES
MOST OFTEN (IE)
ANEMIA = Fe DEFIC
NOT BLEEDING BC Fe
DEFECTS
HER
HbaN
DEFIC GLOB
THALAS SDS
STRUCTURAL GLOB
SICKLE
UNSTABLE Hb
=HbPATHIES
MB DEFECT
DEFIC PHOSPHA-
TIDYLINOSITOL - LINKED
GP
INTRINSIC
EXTRINSIC
NEWBORN (RH)
TRANSFUSION
DRUG-INDUCED
AUTOIMM DSRS
MAINGOT
ON AUTO
GLUT SYNTHASE
HEXOSE MONO SHUNT
GLUCOLYTIC
PK
GENET DEFECTS
IMM
ACQ
G D
MED
IFM
RC MB DSRS
ENZ DEFIC
SPHER P
ELLIPTO
OVAL
STOMA
GYNEG
DISTINGUISHABLES
MOST OFTEN (IE)
ANEMIA = Fe DEFIC
NOT BLEEDING BC Fe
DEFECTS
ONLY ACUTE
TRAUMA
ENDOC
HEPATO d
CIRRH D
PARVO
B19
GRANULOMATOUS
D
METS
SPLAC SEQUEST°
MYELOPHTHISIC
INFILTRAT°
MARROW
IY
HEMATOP NEDP
MAN REPLACEMENT
IFM MED
Fe SEQUEST°
CD
SYNDROMIC PLUrIFo SC
NEONAT FAILURE
APLASTIC
PURE RC APLASIA
MEDINJ PROGEN
ENDOC
EPO DEFIC
CD
RENAL FAILURE
NUT DEFIC
VITAL MOMENT
Fe
FOLATE
B12
Hb
DNA
SIDEROBLASTIC
MEGALOBLASTIC
THALASSEMIA
SDS
TELOMERIC DEFECTS
FANCONI
ENUCLEAT° MATURE°
SC DEPLE°
GLOBIN
HYPERPROLIFERATIVE
SEVERE HEMOLYSIS
ABO
LEAD POISONING
SIDERO BLASTIC
MBL iaN
HYPERFo
DIMERS
TOXICHEM
BASOPHILIC MYELOCYTE
IFC
MEC TRAUMA
MARCHIAFAVA
PAROXYSMAL NOCTURNAL HEMOGLOBINURIA
PNH
REPETITIVE BONKO DRUMMING
DEFERENCE VALVES
MARATHON RUNNING
HUS
DIC
THROMBOCYTOPENIA
TTP
SCHIZOCYTES
HELMET CELLS
MICROANGIOPATHIC HEMOLYTIC ANEMIA
CHOPPING
MECHANICAL
PROSTHETIC VALVE
CARDIAC
ENDOTHELIAL
DISTURBANCES
DISTINGUISHABLES
MOST OFTEN (IE)
ANEMIA = Fe DEFIC
NOT BLEEDING BC Fe
DEFECTS
HER
HbaN
DEFIC GLOB
THALAS SDS
STRUCTURAL GLOB
SICKLE
UNSTABLE Hb
=HbPATHIES
MB DEFECT
DEFIC PHOSPHA-
TIDYLINOSITOL - LINKED
GP
INTRINSIC
EXTRINSIC
NEWBORN (RH)
TRANSFUSION
DRUG-INDUCED
AUTOIMM DSRS
MAINGOT
ON AUTO
GLUT SYNTHASE
HEXOSE MONO SHUNT
GLUCOLYTIC
PK
GENET DEFECTS
IMM
ACQ
G D
MED
IFM
RC MB DSRS
ENZ DEFIC
SPHER P
ELLIPTO
OVAL
STOMA
GYNEG
DISTINGUISHABLES
MOST OFTEN (IE)
ANEMIA = Fe DEFIC
NOT BLEEDING BC Fe
DEFECTS
ONLY ACUTE
TRAUMA
ENDOC
HEPATO d
CIRRH D
PARVO
B19
GRANULOMATOUS
D
METS
SPLAC SEQUEST°
MYELOPHTHISIC
INFILTRAT°
MARROW
IY
HEMATOP NEDP
MAN REPLACEMENT
IFM MED
Fe SEQUEST°
CD
SYNDROMIC PLUrIFo SC
NEONAT FAILURE
APLASTIC
PURE RC APLASIA
MEDINJ PROGEN
ENDOC
EPO DEFIC
CD
RENAL FAILURE
NUT DEFIC
VITAL MOMENT
Fe
FOLATE
B12
Hb
DNA
SIDEROBLASTIC
MEGALOBLASTIC
THALASSEMIA
SDS
TELOMERIC DEFECTS
FANCONI
ENUCLEAT° MATURE°
SC DEPLE°
GLOBIN
HYPERPROLIFERATIVE
SEVERE HEMOLYSIS
ABO
LEAD POISONING
SIDERO BLASTIC
MBL iaN
HYPERFo
DIMERS
TOXICHEM
BASOPHILIC MYELOCYTE
IFC
MEC TRAUMA
MARCHIAFAVA
PAROXYSMAL NOCTURNAL HEMOGLOBINURIA
PNH
REPETITIVE BONKO DRUMMING
DEFERENCE VALVES
MARATHON RUNNING
HUS
DIC
THROMBOCYTOPENIA
TTP
SCHIZOCYTES
HELMET CELLS
MICROANGIOPATHIC HEMOLYTIC ANEMIA
CHOPPING
MECHANICAL
PROSTHETIC VALVE
CARDIAC
ENDOTHELIAL
DISTURBANCES

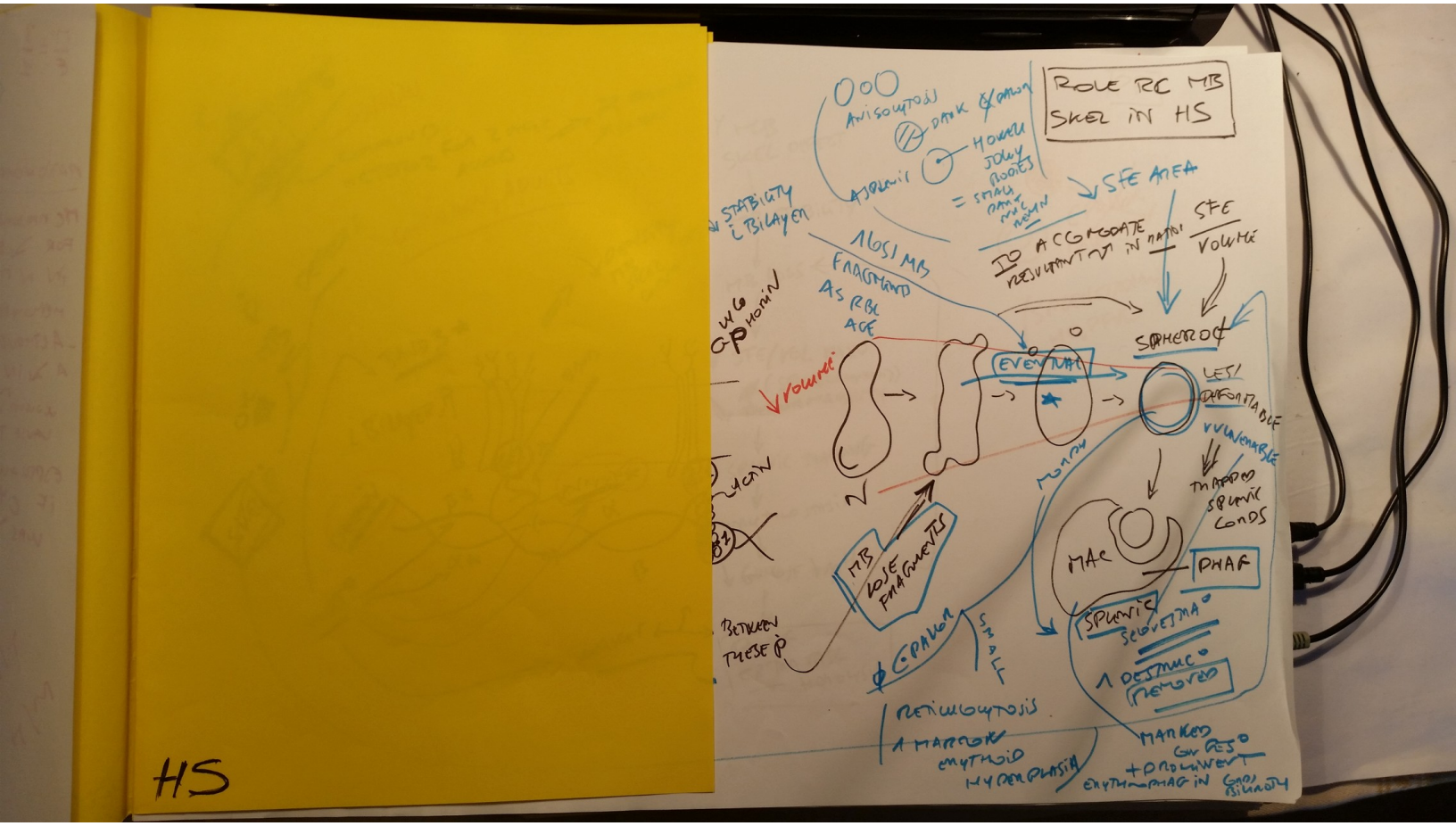

ANEMIAS
[Hb]
HCT
RBC MASS
O2 CARRYING CAPACITY
TISSUE HYPOXIA
FORMAL RECKON
BLOOD LOSS = ACUTE
RBC DESTRUCTION
RBC PRODUCTION
MORPH
MACROCYTIC
FOLATE
B12
NORMOCYTIC
HS
MICROCYTIC
IRON STORES
FERRITIN
HYPOCHROMIC
TIBC
Fe DEFICIENCY
BONE DEFORMITIES
IF SEVERE
ACONGEN
INEFFECTIVE ERYTHROPOIESIS
HEMOLYSIS
GALLSTONES
JAUNDICE
CLIN MANIFS
SHORTNESS BREATH
ORGAN FAILURE
SHOCK
DYSPNEA
ALL ANEMIAS
PALLOR
FATIGUE
WEAKNESS
TIREDNESS
PALPITATIONS
HEART FAILURE
FAILURE
HEART MURMUR
Fe OVERLOAD
HEMOCHROMATOSIS
ERYTHROPOIESIS
BONE MARROW HYPERPLASIA
PLATELETS ALSO
MCV
MCH
MCHC HYPOCHROMIC
RDW, ANISOCYTOSIS
SIZE SHAPE HS
DIAGNOSIS HS SYMPTOMS
HO
RBM
ALCOHOL
DEFICIT
DYSERYTHROPOIESIS
ALCOHOL

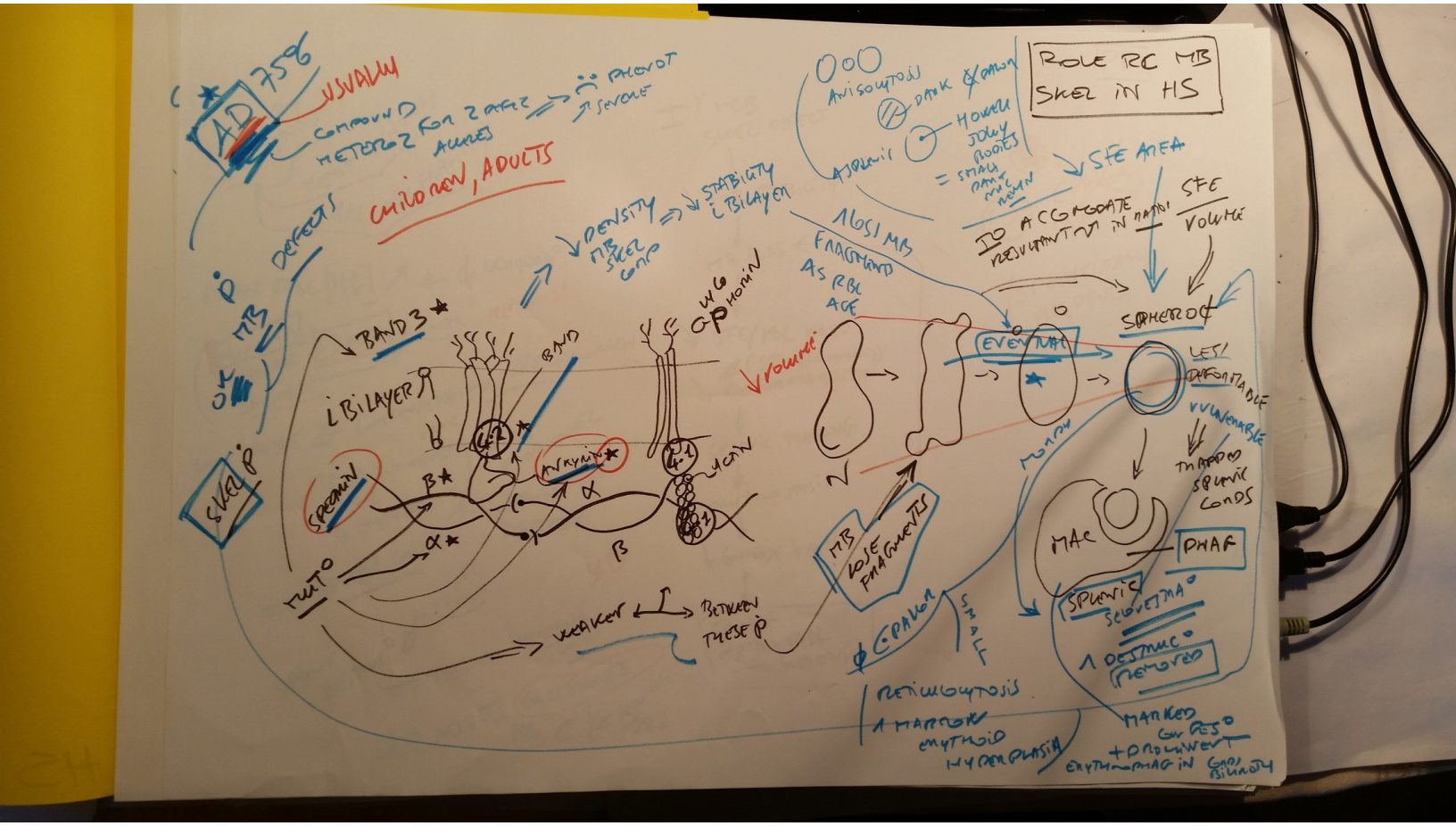
Bd Loss
HEMORRHAGE
INTERNAL
EXTERNAL
GUT
CAN
Fe DEFIC
ACUTE
TRAUMA
GAIN
LOSS INTRAVASC VOL
EPO PRODUC
SHOCK
CARRYING CAPACITY
fluid
LOWERING HE
HEMODIL°
RAPIDLY
RESTORE Bd VOL

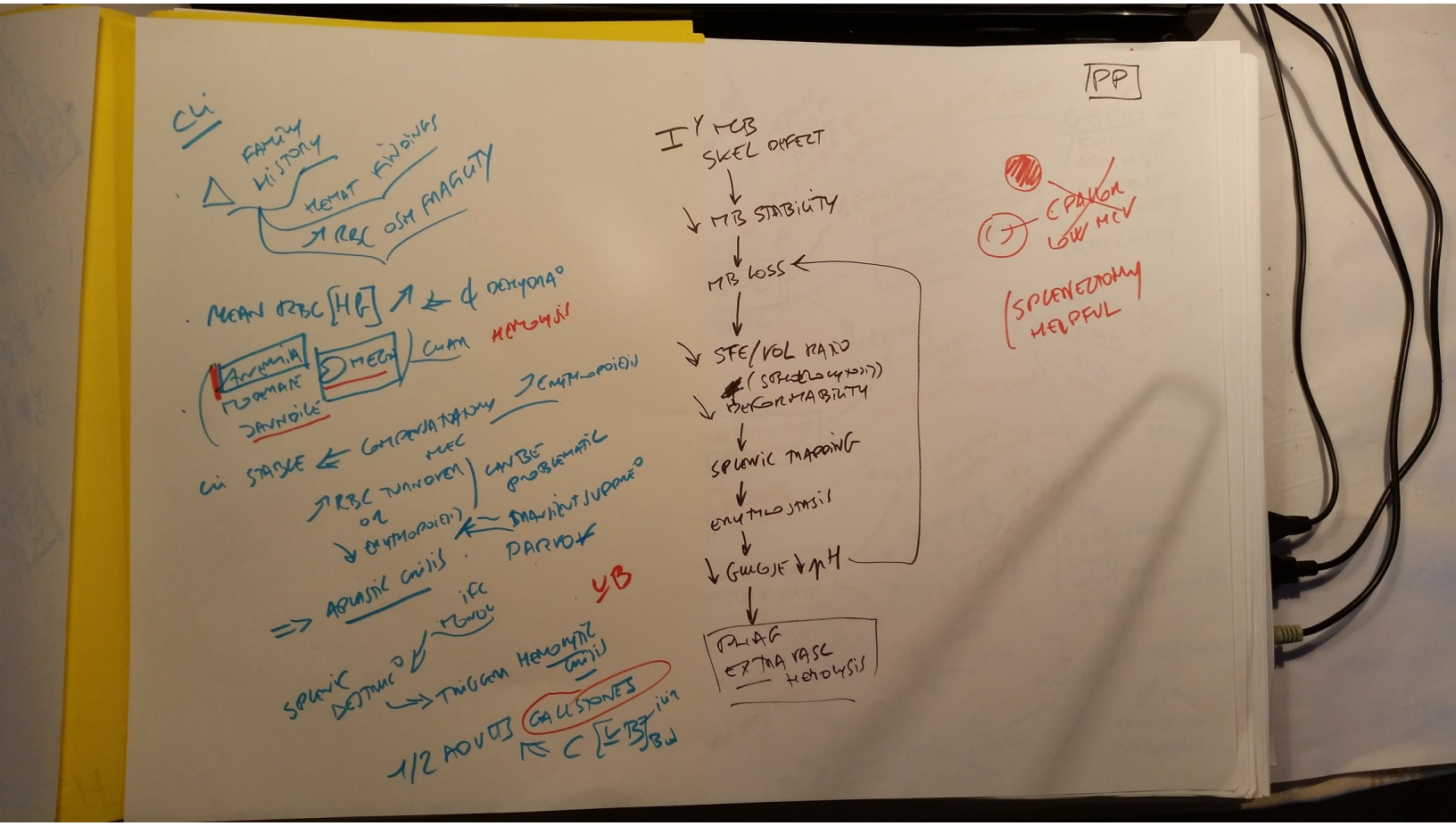

Bd Loss
CHRONIC
ACUTE
TRAUMA
CLIN(=)
Fe DEFICIENCY
Fe DEPLETED
ANEMIA
RATE LOSS
MANUAL
INTERMITTENT
CHRONIC
INTERNAL
(EXTERNAL
GUT
INITIAL BLEEDING
Fe
Fe DEFIC
HAMPER
RBC COUNTS
PUMP
PO
PO LOSS
=> LEUKOCYTOSIS
Gi
UNMET
YOUNG
ADAPTIVE
SIGNIFICANT
EPO PRODUCTION
SHOCK
FLUID
INFUSE
RAPIDLY
RESTORE
Bd VOL
LOSS
INTRAVASC
VOL
10-14D
RETICULOCYTOSIS
LARGE
INITIATING
WEAK
RBCs
BEGINS AT DAYS
LOWERING HE
HEMODILUTE
CARRYING
CAPACITY


HEMOLYTIC
< 120D LIFESPAN
CATABOLIC PRODUCTS
Hb CATABOLITES
BILIRUBIN
EXCEED SERUM UNCONJUGATED
EPO
ERYTHROPOIESIS
MARROW HYPERPLASIA (M:E)
ERYTHROID
-Se HGB
-HEMOSIDERIN
-HAPTOGLOBIN
HGB
HEMOLYTIC
EXTRAVASC
MEGALY
MAC
SPLEEN
FUNCTIONAL CAPACITY
JAUNDICE
MARKED
SERUM
ORTHOPEDICS
PREDISPOSING F
ANEMIA
JAUNDICE
HAPTOGLOBIN
Hb Se
DEFORMABILITY
OPS

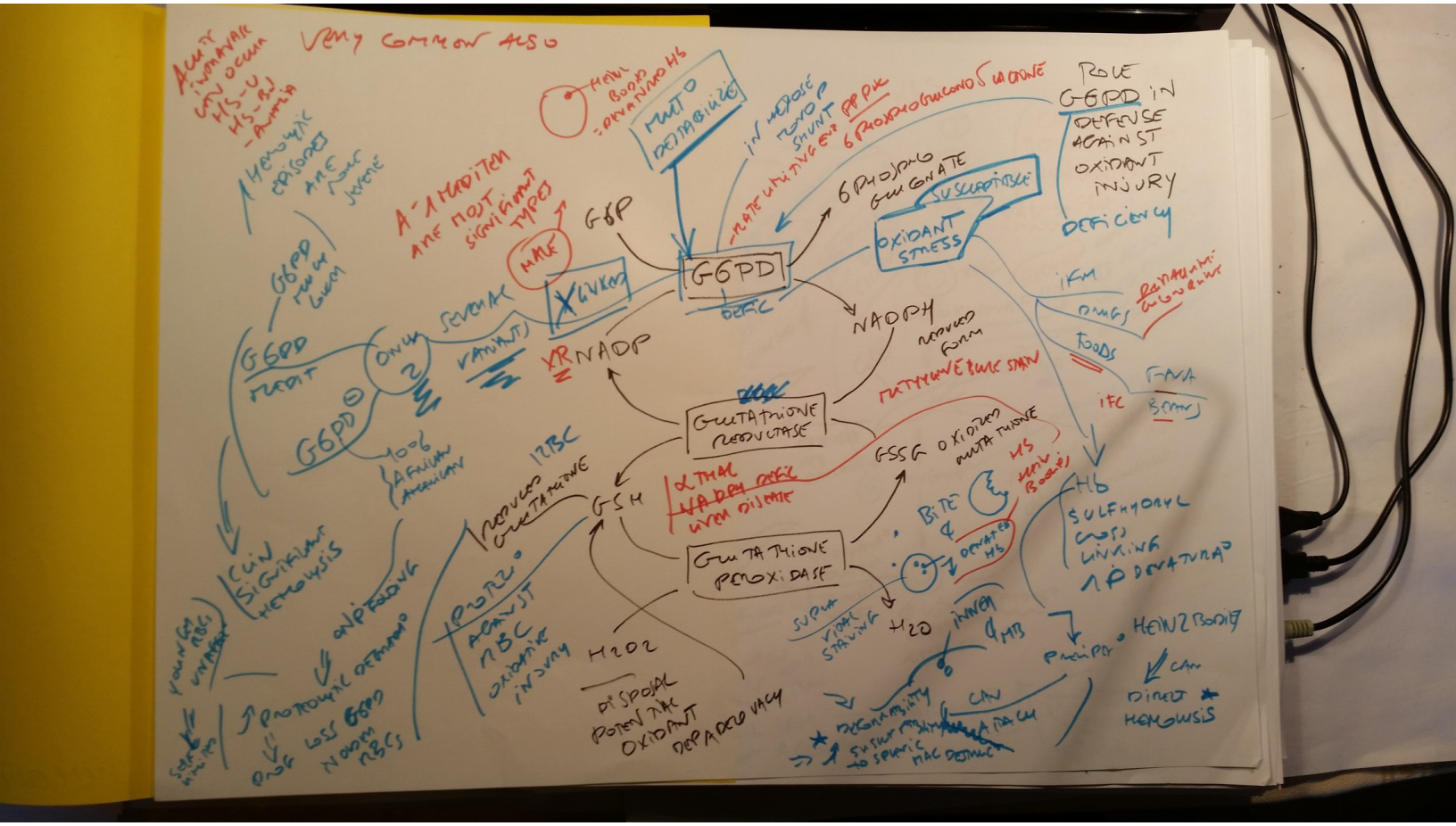

HEMOLYTIC
INTRAVASC
EXTRAVASC
VESSELS
CAUSE
RUPTURE
CLOSTRIDIUM
ECOLI
TOX
IC
CITO
MALARIA
CLI
MODEST
HAPTOGLOBIN
HB SE
ANEMIA
JAUNDICE
PREDISPOSING F
RBC MB INJ
DEFORMABILITY
OPSO
MAC
SPLEEN
MEGALY
FUNCTIONAL CAPACITY
SERUM
ORTHOCANS
MARROW HYPERPLASIA
ERYTHROID
(M:E)
-SE HGB
-HEMOSIDERIN
-HAPTOGLOBIN
HGB
EPO
EPO↑
ERYTHROPOIESIS
RBC DEFICIT
PREMATURE
LESS THAN
120D LIFESPAN
CATABOLIC PRODUCTS
HB CATABOLITES
-BILIRUBIN
EXCESS
SERUM
UNCONJUGATED
[UB]
HAPTOG-SE
HB→FE
TRANSFER
FROM HB
CAN
ACCUMULATE
TUBULES OF
RENAL
HEMOSIDEROSIS
BROKEN
DOWN
OR ABSORBED
BY RENAL PROX TUB
FREE CAN NOT HB
HB
OXIDIZE
BOTH
RATIO NORMALLY 3:1
MC REASON
FOR ↘ RATIO
IN N MARROW
IN
HEMOLYTIC ANEMIA
-ALTHOUGH
A ↘ IN M
MYELOID
ALSO
CAUSE THIS
ESPECIALLY
IF CY
WAS
HB-U
HB-BU
HEMOSIDERINE-C
JAUNDICE
ANEMIA
CLI
RUPTURE
EXTRINS INJ
VALVES
CAUSE DEFECT
HEMOLYSIS
CLI
CITO
M/F
M/F
ANEMIC

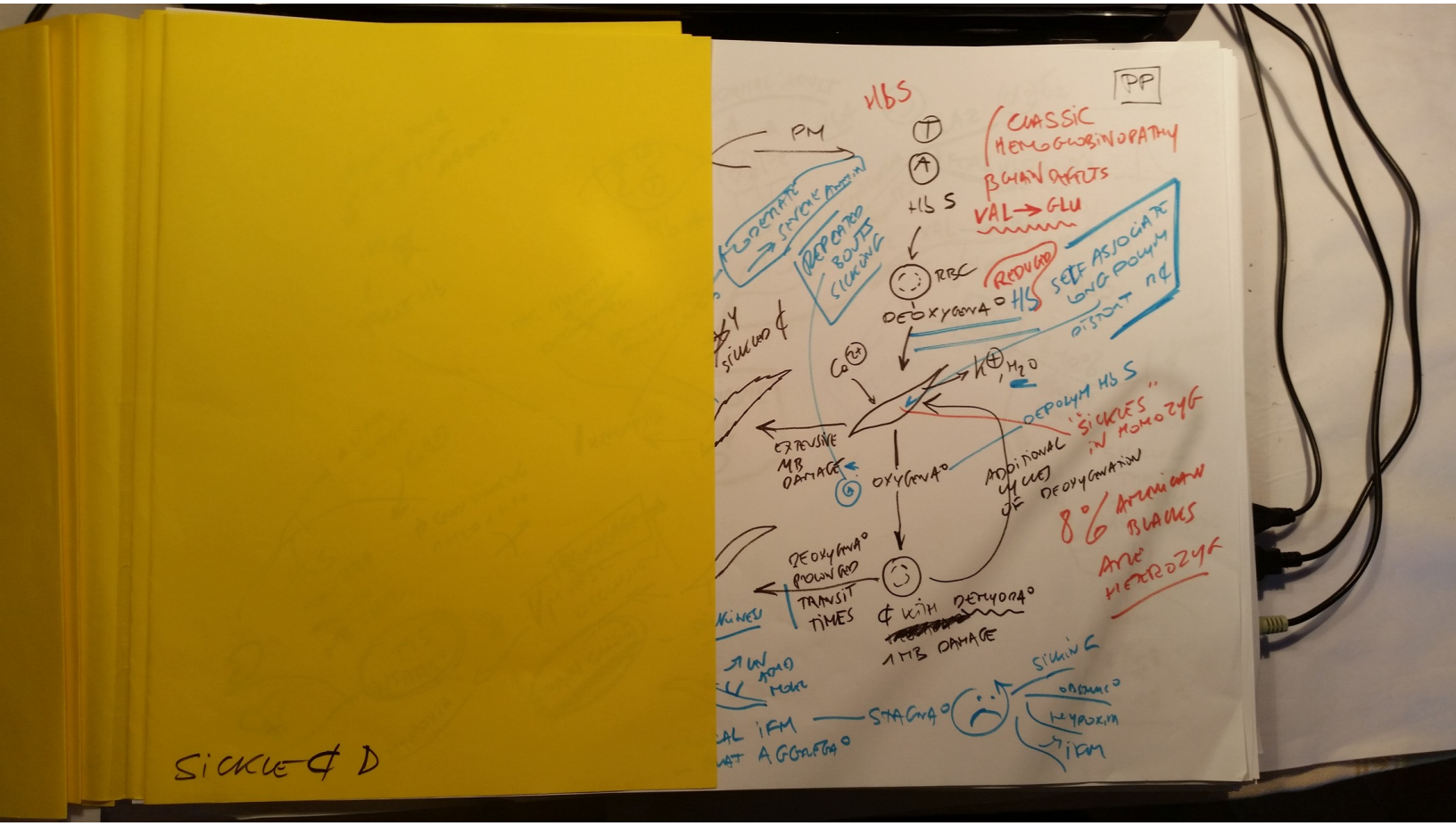

HS
ROLE RC MB SKEL IN HS
ANISOCYTOSIS
DARK
HOWELL JOLLY BODIES
= SMALL
SFE AREA
SFE VOLUME
STABILITY
BILAYER
MOSTLY FRAGMENTED AS RBC AGE
EVENTUAL
SPHEROCYTE
LESS DEFORMABLE
VULNERABLE
MACROPHAGE
SPLENIC CONDS
MAC
PHAF
SPLENIC SEQUESTRATION
DEFINITE REMOVED
MB LOSE FRAGMENTS
SMALL
RETICULOCYTOSIS
MARROW ERYTHROID HYPERPLASIA
MARKED
+ PROGRESSIVE

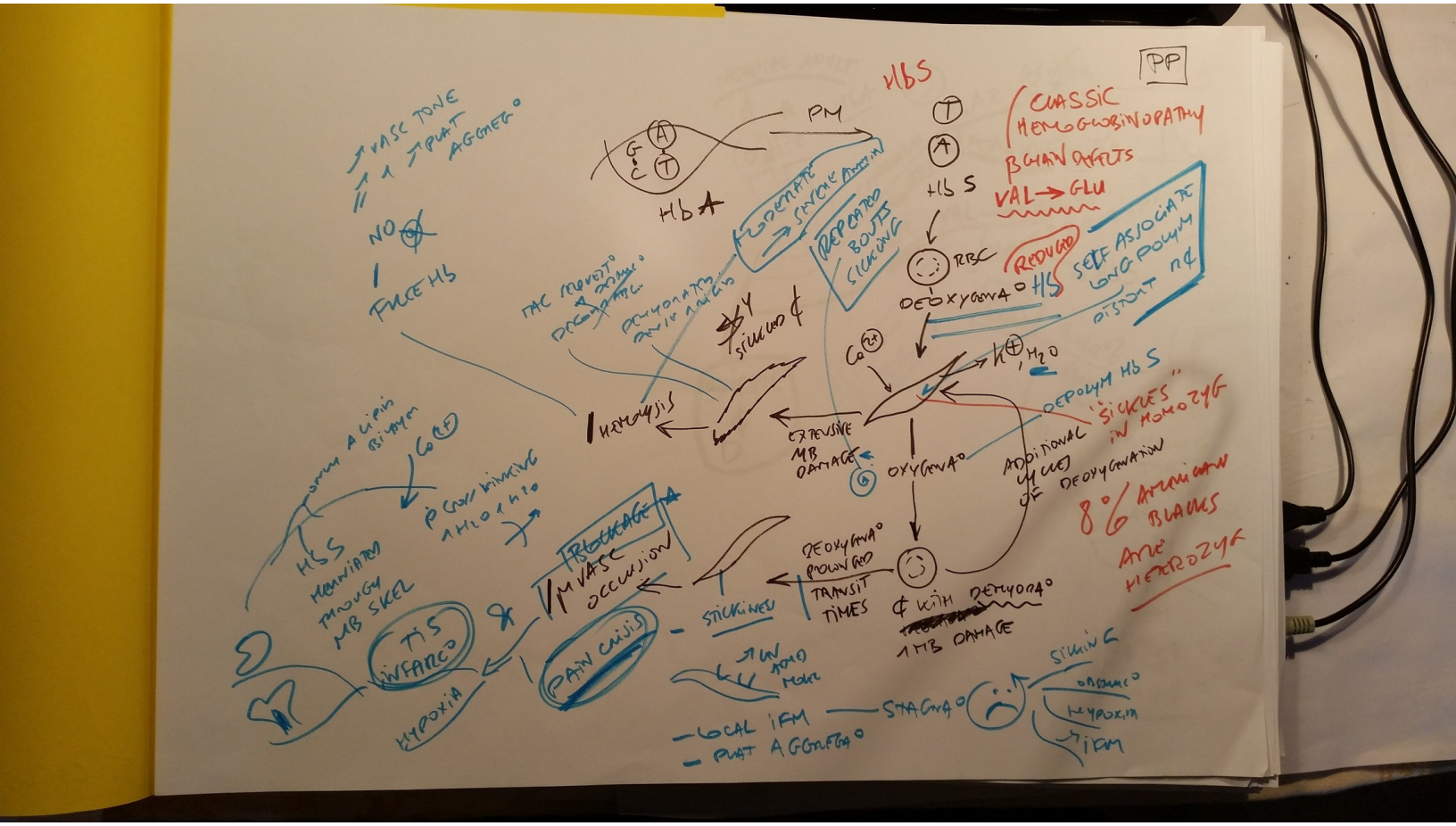

AD 756
USUALLY
CHILDREN, ADULTS
DEFECTS
SKELETON
BAND 3
ANKYRIN
SPECTRIN
ACTIN
BAND
LIPID BILAYER
DENSITY
STABILITY
ROLE OF MB SKEL IN HS
ANISOCYTOSIS
DARK
HOWELL JOLLY BODIES
SPHEROCYTE
EVENTUAL
LESS DEFORMABLE
VULNERABLE
MACROPHAGE
SPLENIC CORDS
MAC
PHAG
SPLENIC SEQUESTRATION
DESTRUCTION REMOVED
RETICULOCYTOSIS
MARROW ERYTHROID HYPERPLASIA
MARKED GR POS
ERYTHROPHAGIA
SMALL
VOLUME
SFE AREA
SFE VOLUME

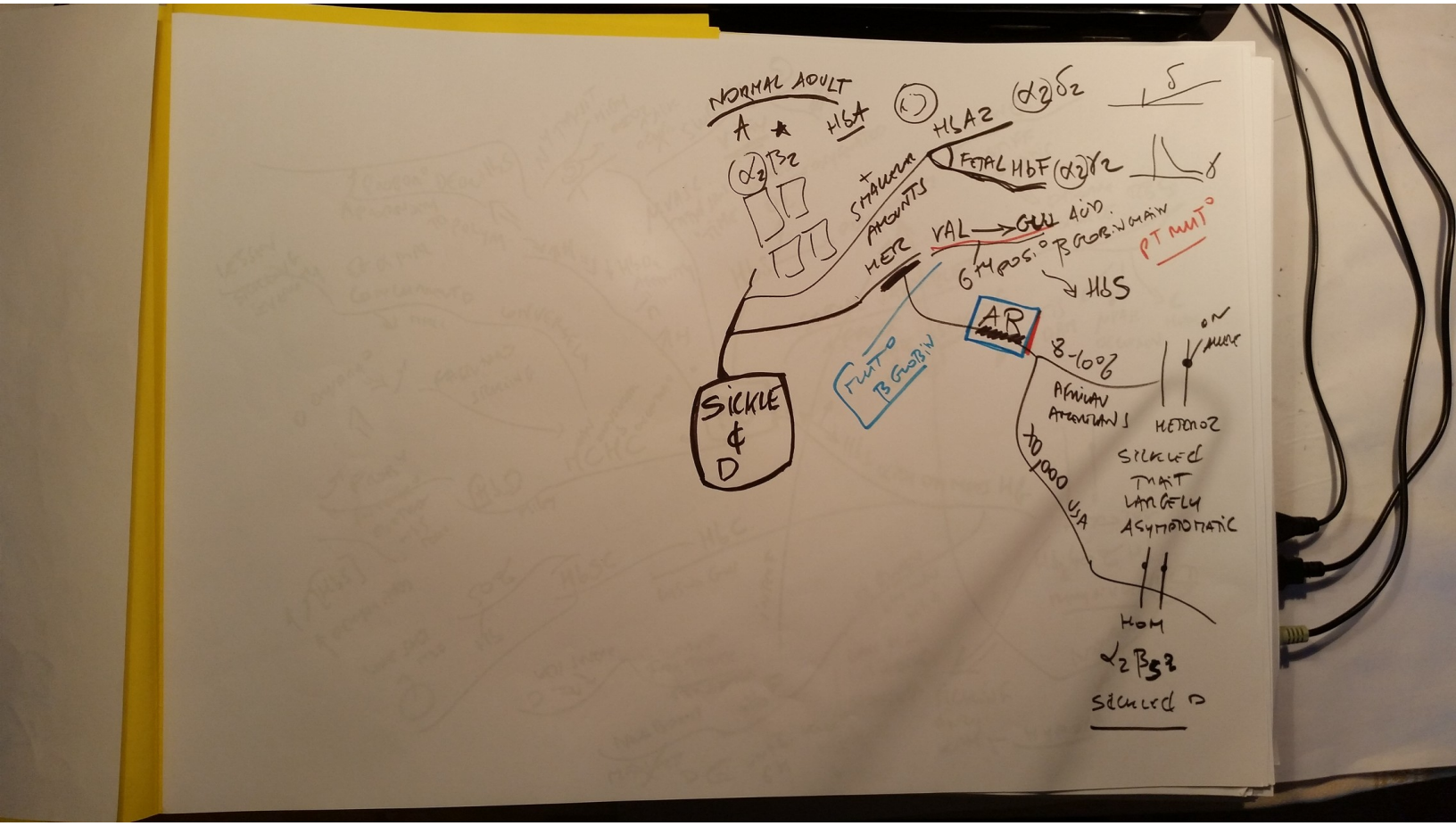

Cli
FAMILY HISTORY
HEMAT FINDINGS
↑ RBC OSM FRAGILITY
MEAN RBC [Hb] ↑ ← ↓ DEHYDRA°
ANEMIA
MICRO
CHRON
HEMOLYSIS
NORMAL
DIMINISHED
ERYTHROPOIESIS
Cli STABLE ← COMPENSATORY
↑ RBC TURNOVER
MCC
CAN BE PROBLEMATIC
OR
↓ ERYTHROPOIESIS
← DIMINISHED SUPPRO°
PARVO ↓
=> APLASTIC CRISIS
SPLENIC DESTRUC°
↑ CC BILIRUBIN
→ TRIGGER HEMOLYTIC CRISIS
1/2 ADULTS
GALLSTONES
< C [↑ BILIRUBIN
IV MCB
SKEL EFFECT
↓ MB STABILITY
↓ MB LOSS
↓ SFE/VOL RATIO
(SPHEROCYTOSIS)
↓ DEFORMABILITY
↓ SPLENIC TRAPPING
↓ ERYTHROSTASIS
↓ GLUCOSE ↓/↑
PLAG
EXTRAVASC
HEMOLYSIS
IPP
(+) CPAXON
LOW MCV
SPLENECTOMY
HELPFUL

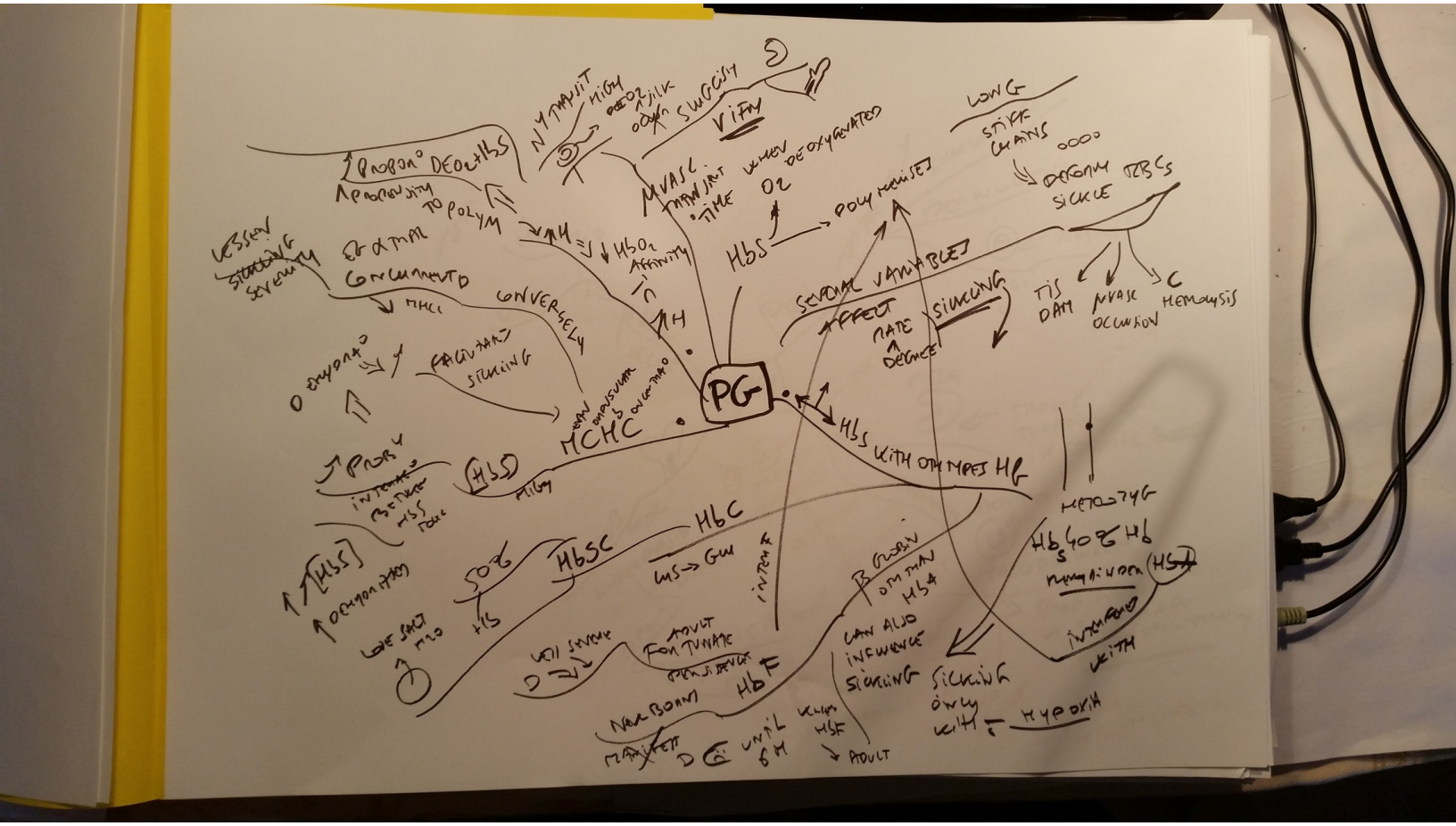
ROLE
G6PD IN
DEFENSE
AGAINST
OXIDANT
INJURY
DEFICIENCY
6 PHOSPHO
GLUCONATE
SUSCEPTIBLE
OXIDANT
STRESS
NADPH
FAVISM
DRUGS
FOODS
INFC
GSSG OXIDIZED
GLUTATHIONE
HS
HEINZ BODIES
SULFHYDRYL
CROSS
LINKING
DENATURED
H2O
DIRECT
HEMOLYSIS
HEMOLYTIC REDUCTANTS
G6PD
DEFIC

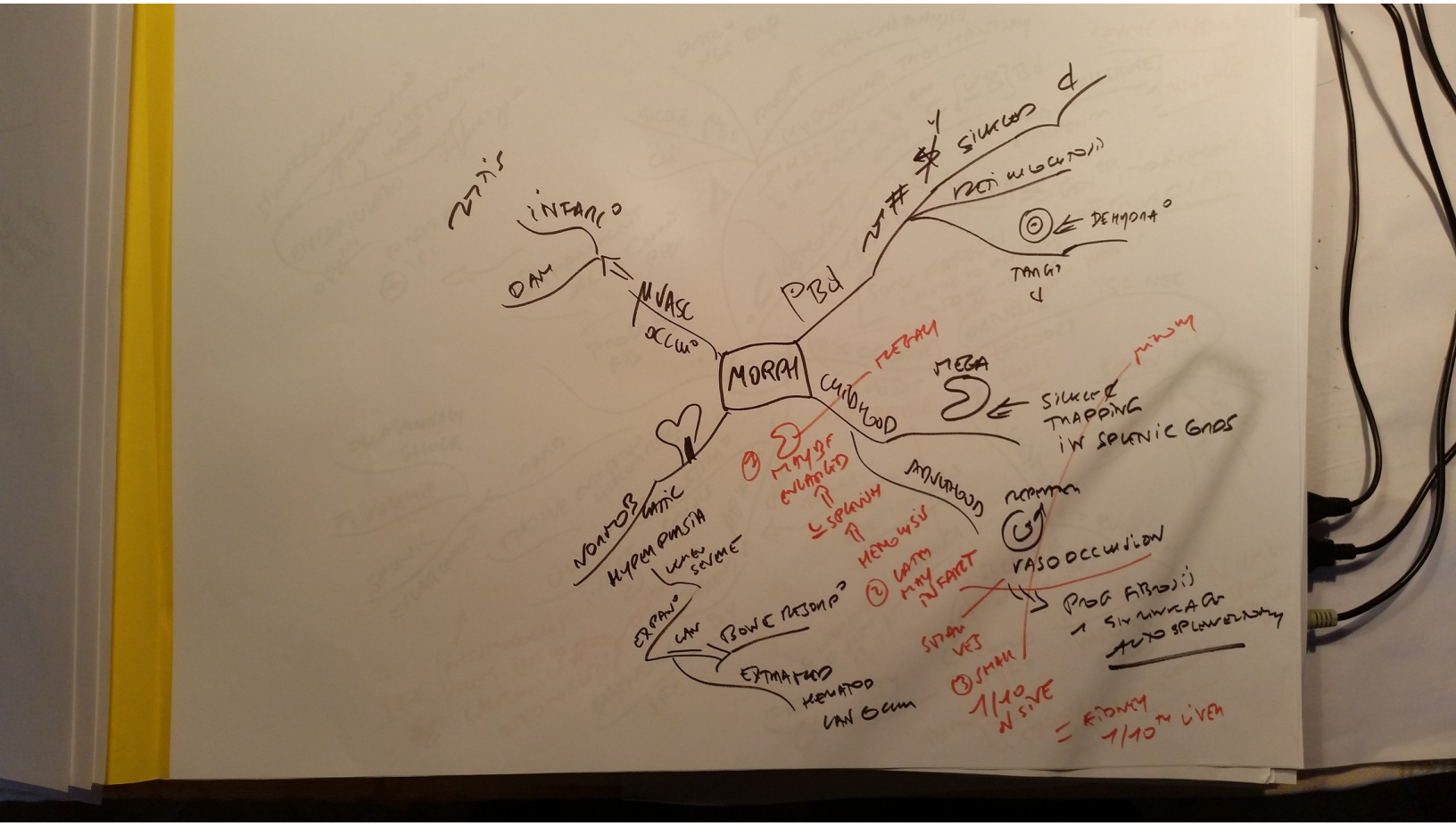

VERY COMMON ALSO
ROLE G6PD IN DEFENSE AGAINST OXIDANT INJURY
DEFICIENCY
G6PD
G6P
6PHOSPHOGLUCONATE
OXIDANT STRESS
NADPH
NADPH FORM
XR NADP
GLUTATHIONE REDUCTASE
GLUTATHIONE PEROXIDASE
GSH
GSSG OXIDIZED GLUTATHIONE
H2O2
H2O
HEINZ BODIES
HEMOLYSIS
DRUGS
FOODS
FAVA BEANS
INFECTION
A-1 MEDITERRANEAN MOST SIGNIFICANT TYPES
SEVERE VARIANTS
100% AFRICAN AMERICANS
CLIN SIGNIFICANT HEMOLYSIS
PROTECTS AGAINST RBC OXIDATIVE INJURY
DISPOSAL POTENTIAL OXIDANT DEPLETION
METHYLENE BLUE STAIN

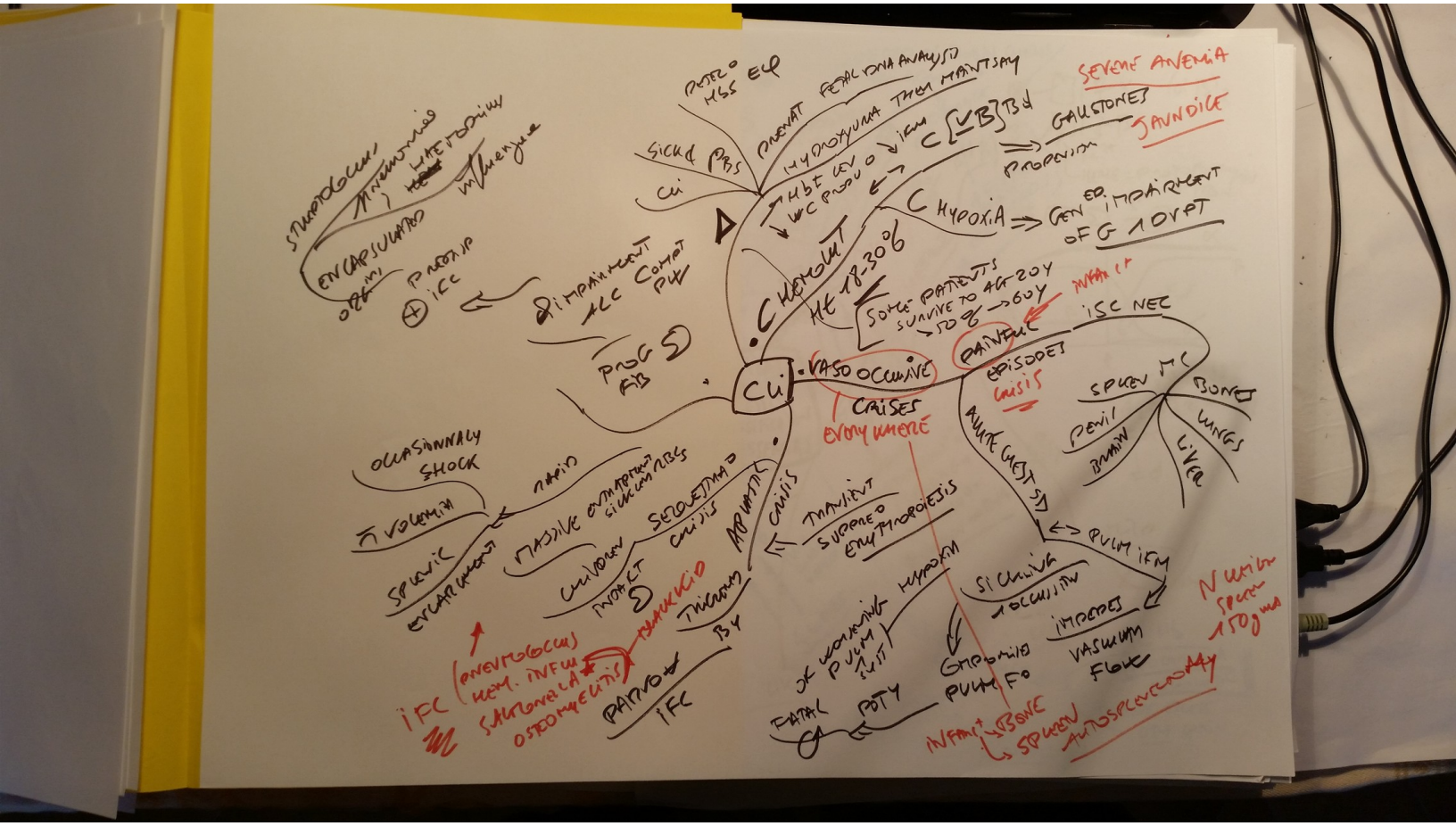

PP
HbS
PM
T
A
HbS
CLASSIC HEMOGLOBINOPATHY
β CHAIN DEFECTS
VAL → GLU
RBC
DEOXYGENATED HbS
REDUCED
SELF ASSOCIATE LONG POLYMER
DISTORT RBC
Ca++
H+, H2O
DEPOLYM HbS
"SICKLES" IN HOMOZYG
EXTENSIVE MB DAMAGE
OXYGENATED
ADDITIONAL LYSIS OF DEOXYGENATION
8% AFRICAN AMER BLACKS ARE HETEROZYG
DEOXYGENATED PROLONGED TRANSIT TIMES
↑ MB DAMAGE
STASIS
HYPOXIA
↓IFM
SICKLE Ø D

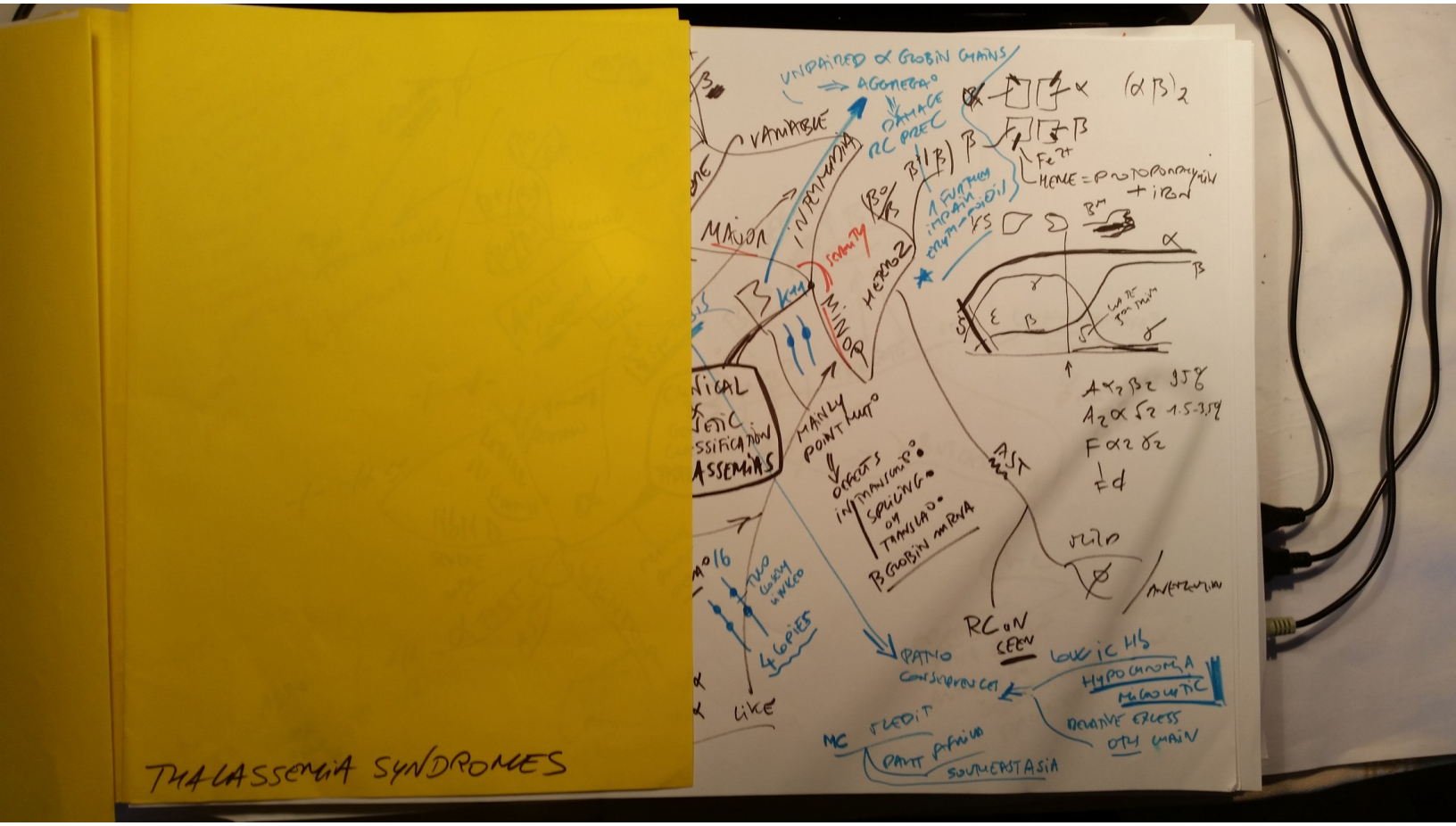

PP
HbS
PM
HbA
HbS
CLASSIC HEMOGLOBINOPATHY
BCHAIN DEFECTS
VAL → GLU
VASC TONE
PLAT AGGREG°
NO
FALCE HB
SELF ASSOCIATE LONG POLYM
DEOXYGEN°
REVERSED
SICKLING
HEMOLYSIS
EXPOSURE MB DAMAGE
OXYGEN°
DEPOLYM HbS
"SICKLES" IN HOMOZYG
8% AFRICAN BLACKS ARE HETEROZYG
ADDITIONAL LYSED
DEOXYGENATION
VASC OCCLUSION
STICKINESS
DEOXYGEN° PROLONGED TRANSIT TIMES
DAMAGE
TISS INFARC°
HYPOXIA
PAIN CRISIS
LOCAL INFM
PLAT AGGREG°
STASIS
SICKLING
INFM

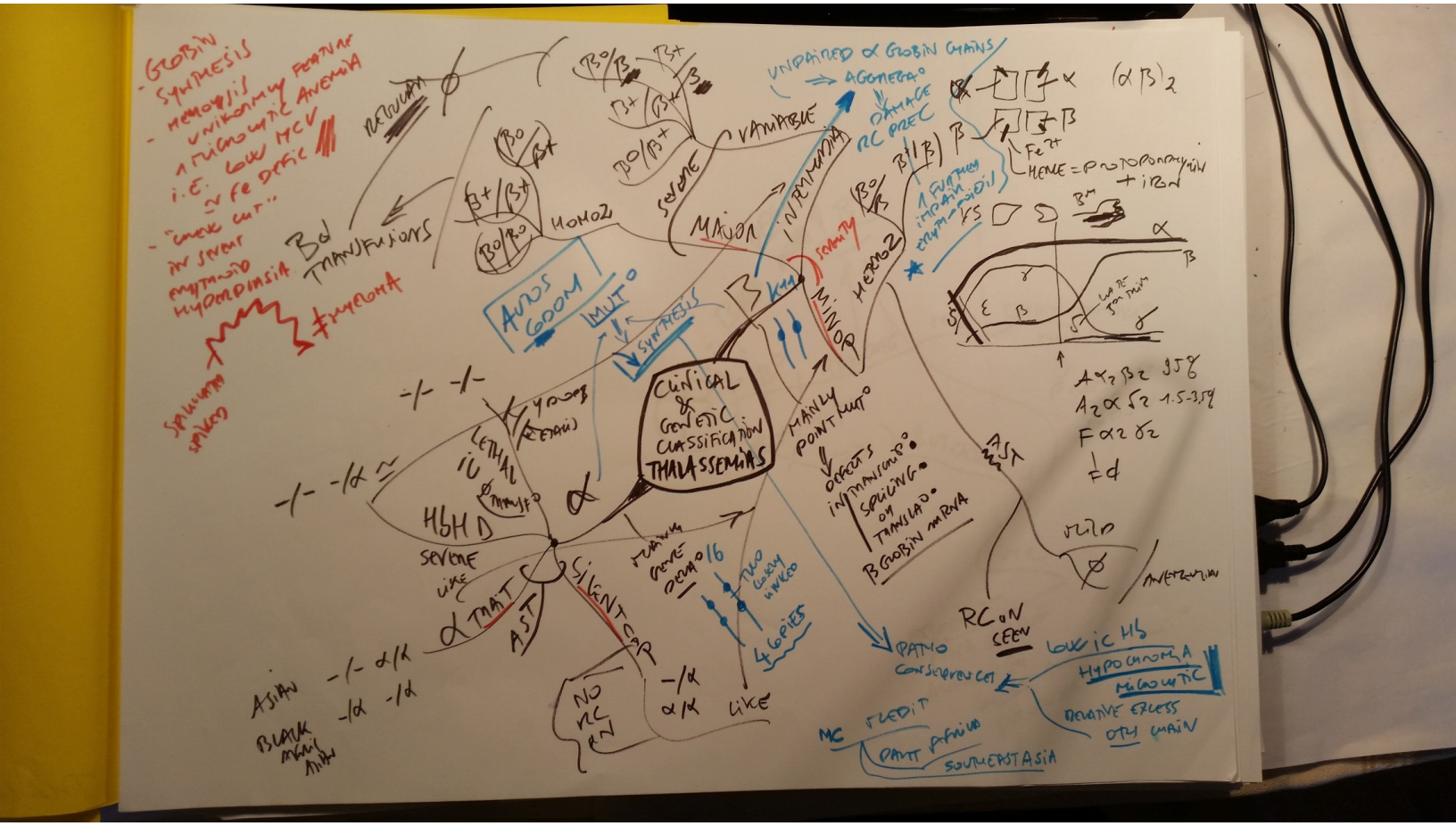

NORMAL ADULT
A
HbA
HbA2
FETAL HbF
SMALLER AMOUNTS
HETEROZ
VAL → GLU
6TH POS. β GLOBIN CHAIN
PT MUT°
HbS
AR
8-10%
SICKLE C D
MUTº β GLOBIN
AFRICAN AMERICANS
HETEROZ
SICKLED TRAIT
LARGELY ASYMPTOMATIC
1/10,000 USA
HOM
SICKLED D

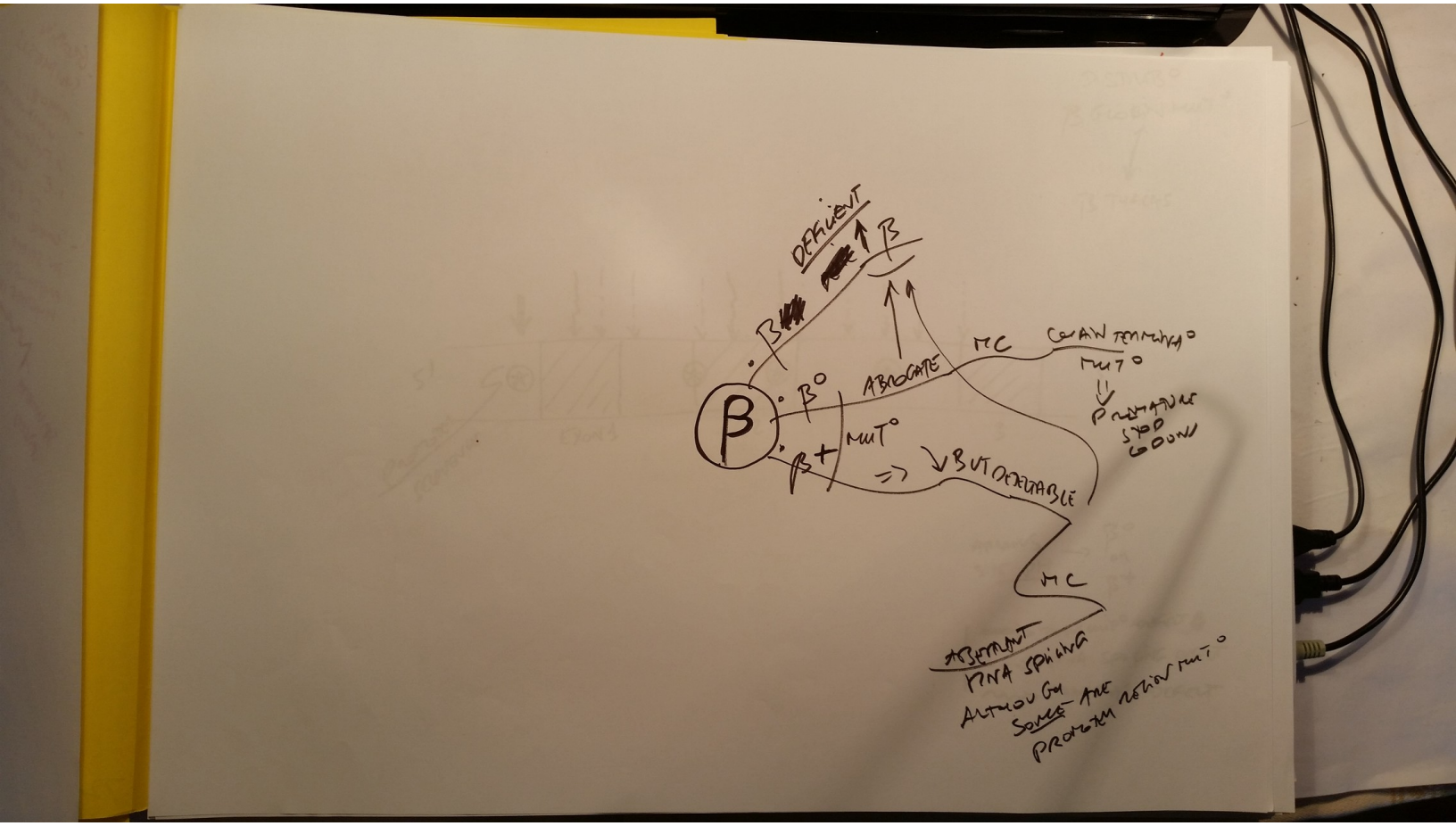

PG
HbS
HbC
HbF
MCHC
SICKLING
VASO-OCCLUSION
HEMOLYSIS
POLYMERIZES
DEOXYGENATED
HbS WITH OTHER TYPES Hb
HbS & Hb
HYDROXYUREA
SICKLING ONLY WITH HYPOXIA
CAN ALSO INFLUENCE SICKLING
ADULT
FETAL
NEWBORN
SEVERAL VARIABLES
AFFECT
RATE
DECREASE
LONG
STIFF CHAINS
DEFORMED SICKLE RBCs
TISSUE DAMAGE
VASO-OCCLUSION
HEMOLYSIS
CONVERSELY
INCREASE
HbS → GEL
HbS → POLYMERIZES
HbS → DEOXYGENATED
HbS → HbC
HbS → HbF
HbS → HbS
HbS → HbS
HbS → HbS


MORPH
PBL
MEGA
VASOOCCLUSION
SPLENIC
HEPATIC
RENAL
1/10 SPLEEN
= KIDNEY 1/10 LIVER

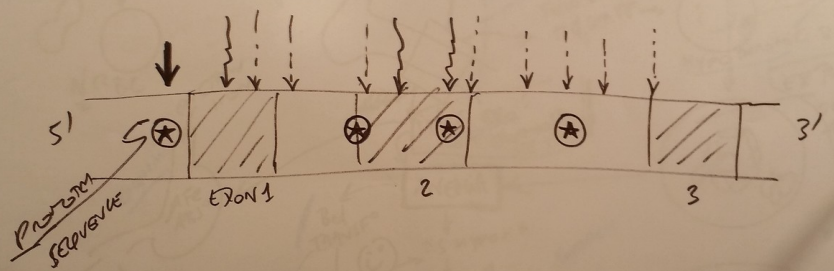

SEVERE ANEMIA
JAUNDICE
GALLSTONES
CHOLECYST
HE 18-30%
SOME PATIENTS SURVIVE TO 40-50Y → 60Y
PAINFUL
ISC NEC
CRISES
ERYTHROMELE
SPLEEN
BONE
LUNGS
LIVER
BRAIN
PENIS
ACUTE CHEST SY
PULM HTN
IFC
PAPPO
PATENT FORAMEN OVALE
HYDROXYUREA
HYPOXIA
GEN. IMPAIRMENT OF G
PROPHYLAXIS
ENCAPSULATED
INFECTIONS
OCCASIONALLY
SHOCK
SPLENIC
ENLARGEMENT
MASSIVE
SEQUESTRATION
CRISIS
INFARCTS
SPLEEN
BONE
AUTOSPLENECTOMY


THALASSEMIA SYNDROMES
UNPAIRED α GLOBIN CHAINS
AGGREGATE
DAMAGE RC PREC
VARIABLE
MAJOR
INTERMEDIA
MINOR
HBH
HBPH2
HEME = PROTOPORPHYRIN + IRON
MAINLY POINT MUT°
EFFECTS IN TRANSCRIPT° SPLICING° OF TRANSLAT° BGLOBIN mRNA
RC ON SEEN
RATIO CONSERVED
LOGIC HB
HYPOCHROMIA MICROCYTIC
REDUCE EXCESS OTH CHAIN
MC REDIT
PART DEFICIT
SOMEPASTASIA
like
4 COPIES
TWO COPIES WANTED


GLOBIN SYNTHESIS
HEMOLYSIS
UNIFORMLY FEATURE
↑ RETICULOCYTE ANEMIA
i.e. LOW MCV
↓ Fe DEFIC
"CHECK CUT"
IN SEVERE
ANEMIA
HYPOPLASIA
RETICULA
B0/B0
B+/B+
B0/B+
MONO2
SEVERE
VARIABLE
MAJOR
INTERMEDIA
UNPAIRED α GLOBIN CHAINS
AGGREGATE
DAMAGE
RC PREC
(αβ)2
Fe2+
HENCE = PHOTOPORPHYRIN + IRON
B0/B0
B+/B+
FAMILY
MINOR
HEMO2
AUTOSOMAL
MULTIPLE
SYNTHESIS
Clinical & Genetic Classification THALASSEMIAS
-/- -/-
-/- -/α
LETHAL
HBH
SEVERE LIKE
α THAL
SILENT CARRIER
AST
ASIAN -/- α/α
BLACK -/α -/α
NO RC ANEMIA
-/α α/α LIKE
MAINLY POINT MUTATIONS
AFFECTS INITIATION SPLICING OR TRANSLATION OF β GLOBIN mRNA
FUSION GENE DELETION 16
TWO GENES LINKED
4 COPIES
RC ↓N SEEN
RATIO CONSERVED
LOW IC Hb
HYPOCHROMIA
MICROCYTIC
RELATIVE EXCESS OTH CHAIN
MC
FLEDIT
PAPPENHEIMER
SIDEROPENIA
INTERMEDIA
A γ2 β2 95%
A2 α2 δ2 1.5-3.5%
F α2 γ2
↓ α
β
γ
δ
ε

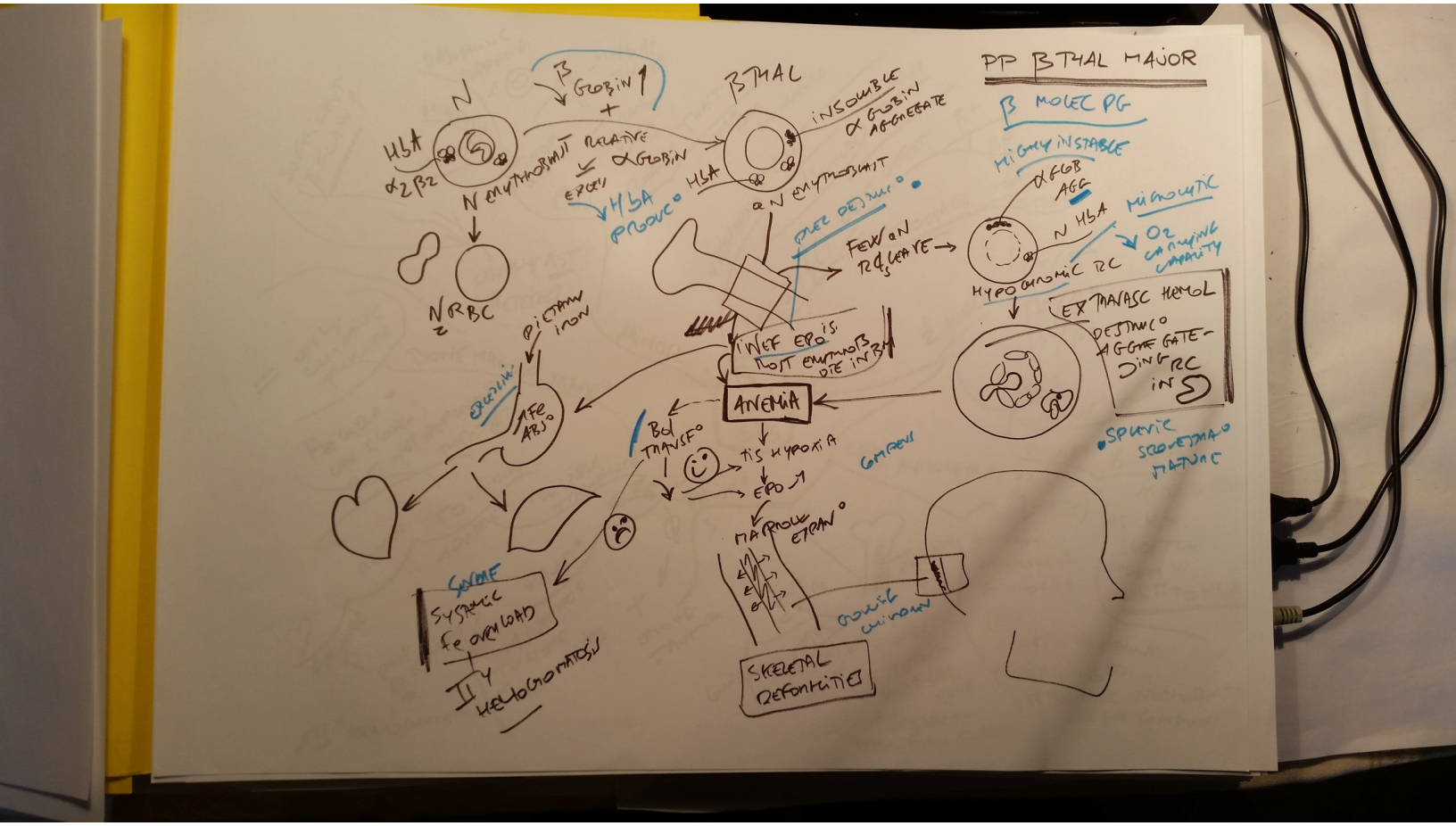

DEFICIENT
β
β°
β+
ABSCAPE
MUT°
MC
MUT°
⇒ UBIQUITINABLE
MC
PNA SPLICING
ALTHOUGH
SOME
PROTEIN

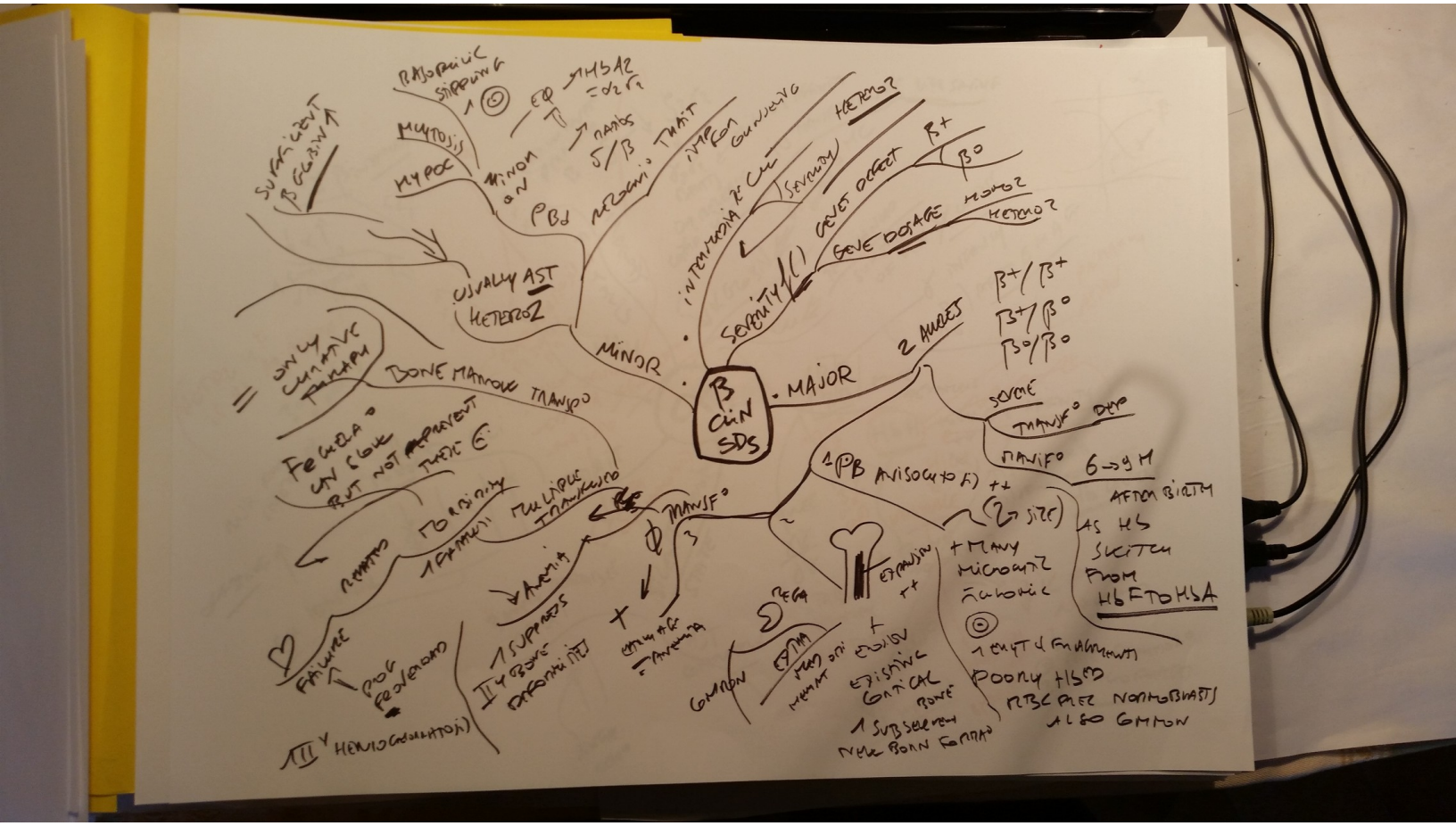
DISTURBO
β GLOBIN MUT°
↕
β THALAS

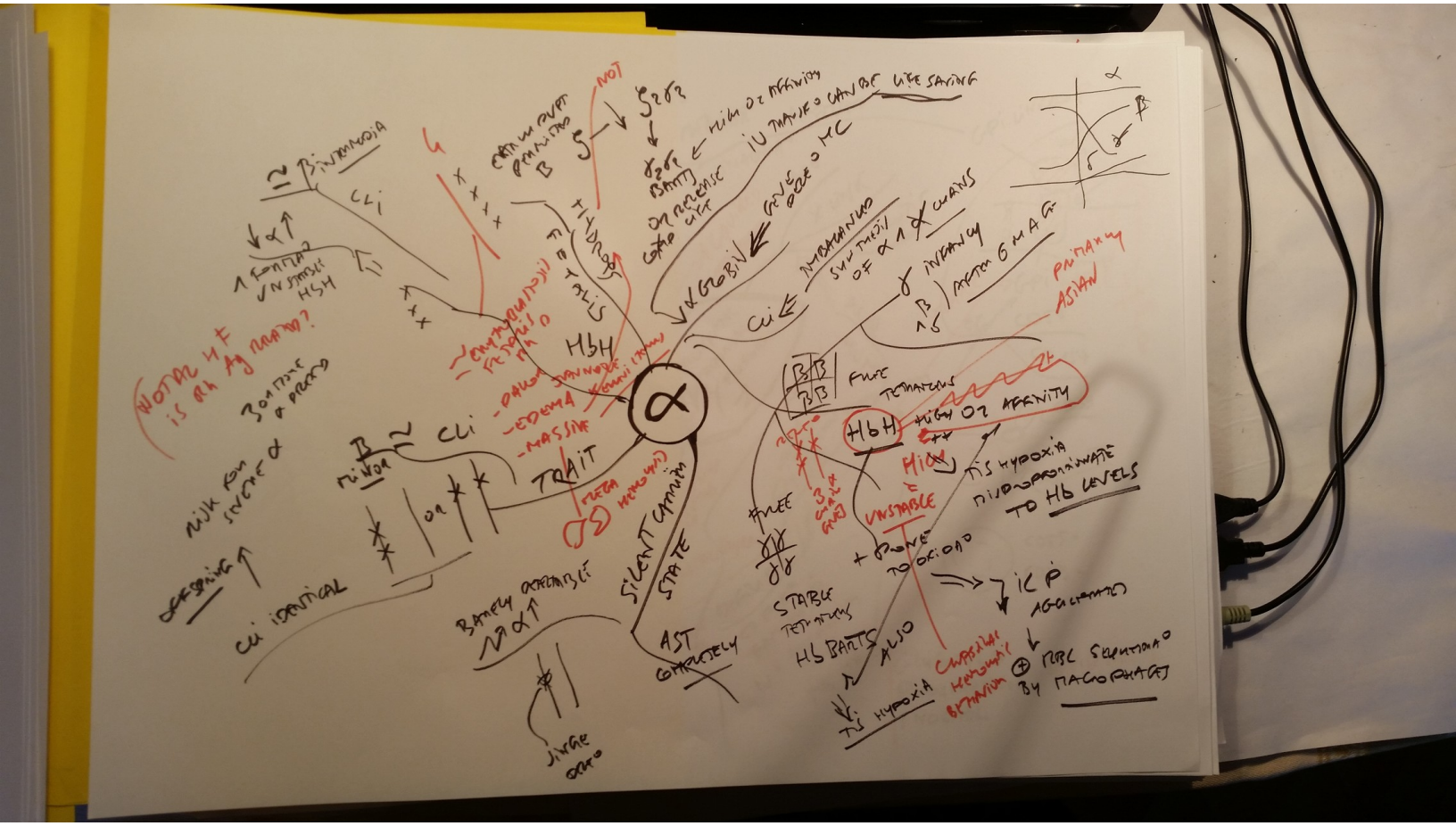


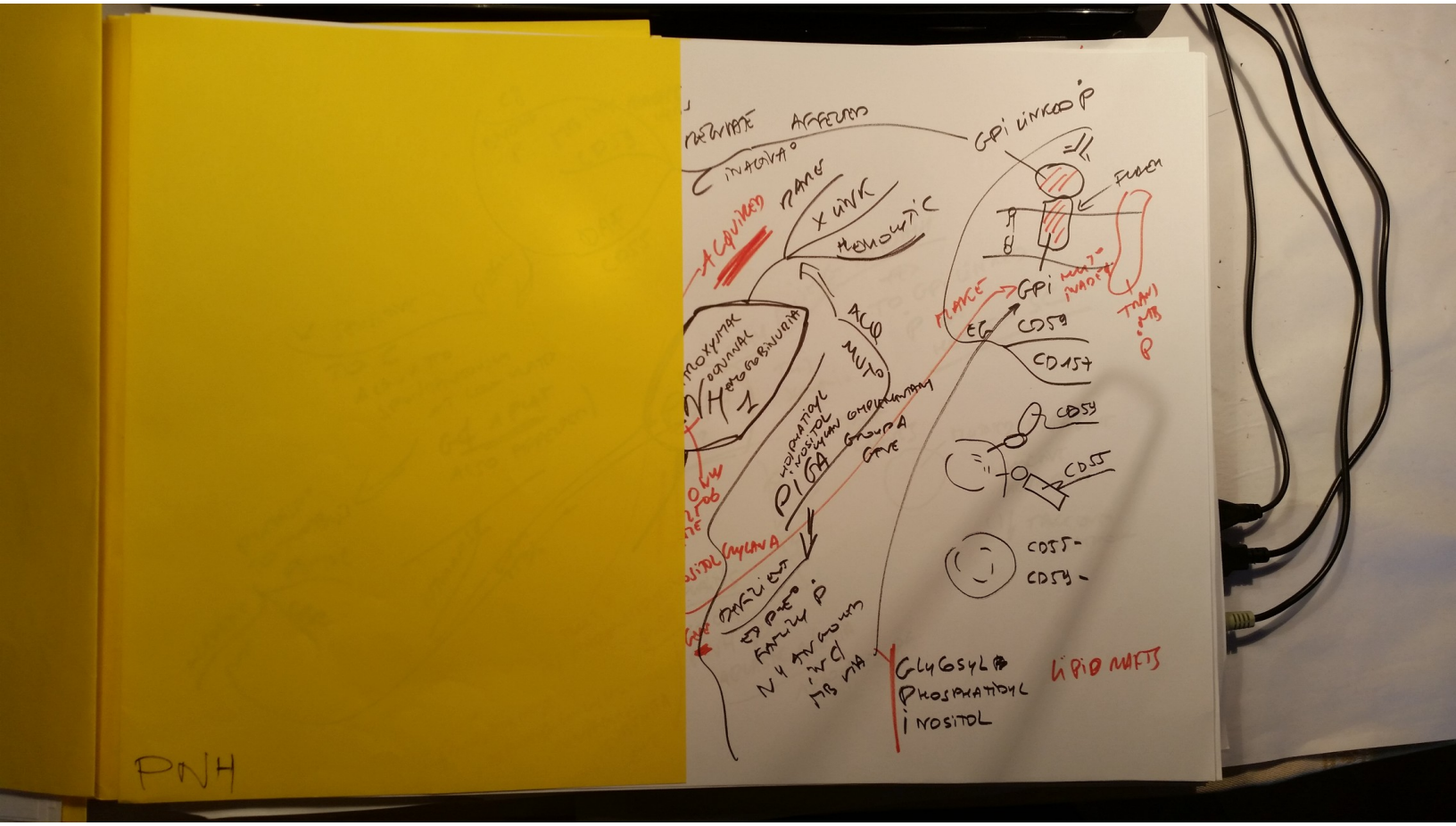
ANEMIES SIAE PM → β° or β+

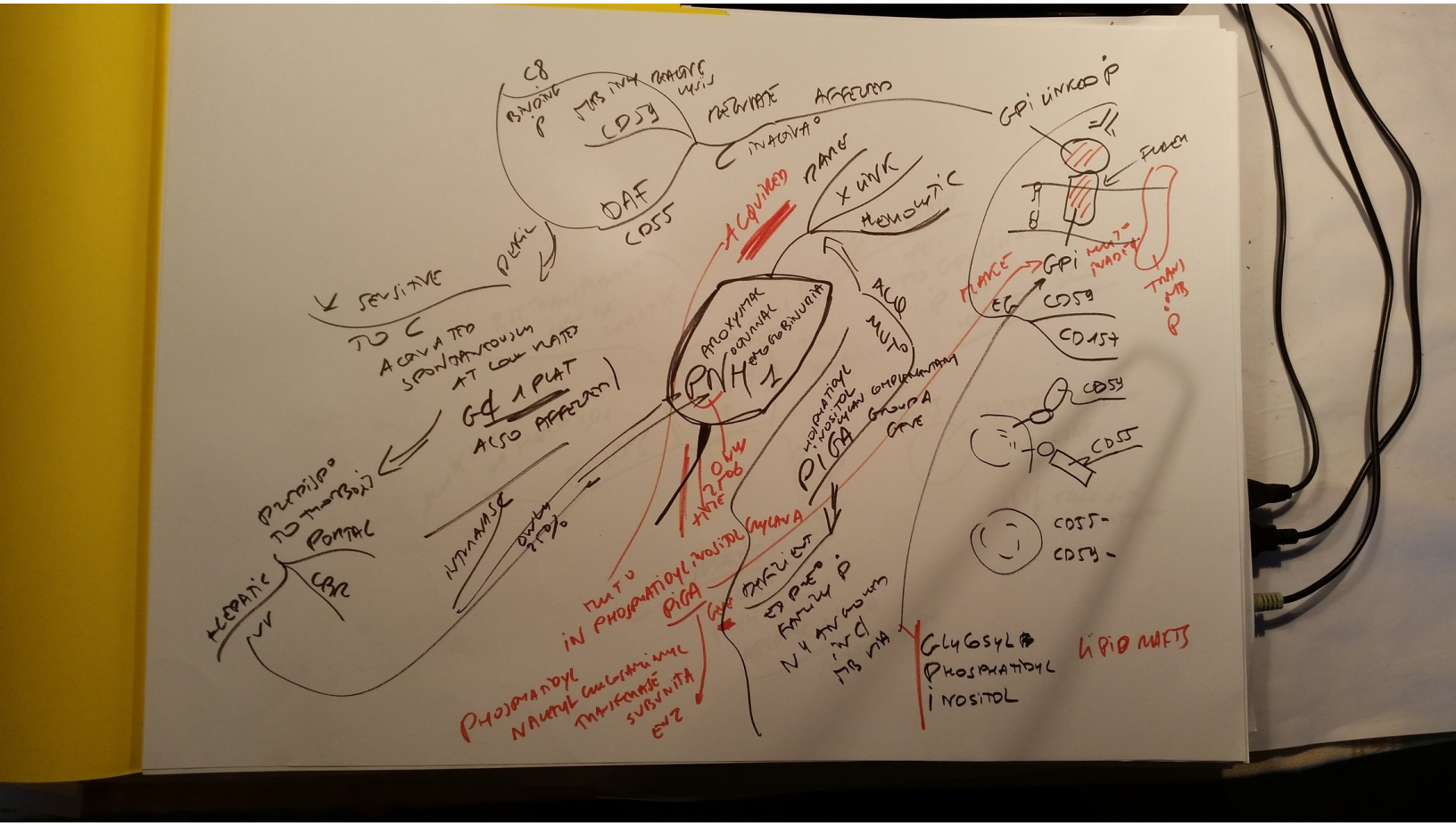
→ TRANSCRIPO DEFECT
--→ RNA SPLICING DEFECT
~→ TRANSLA° DEFECT

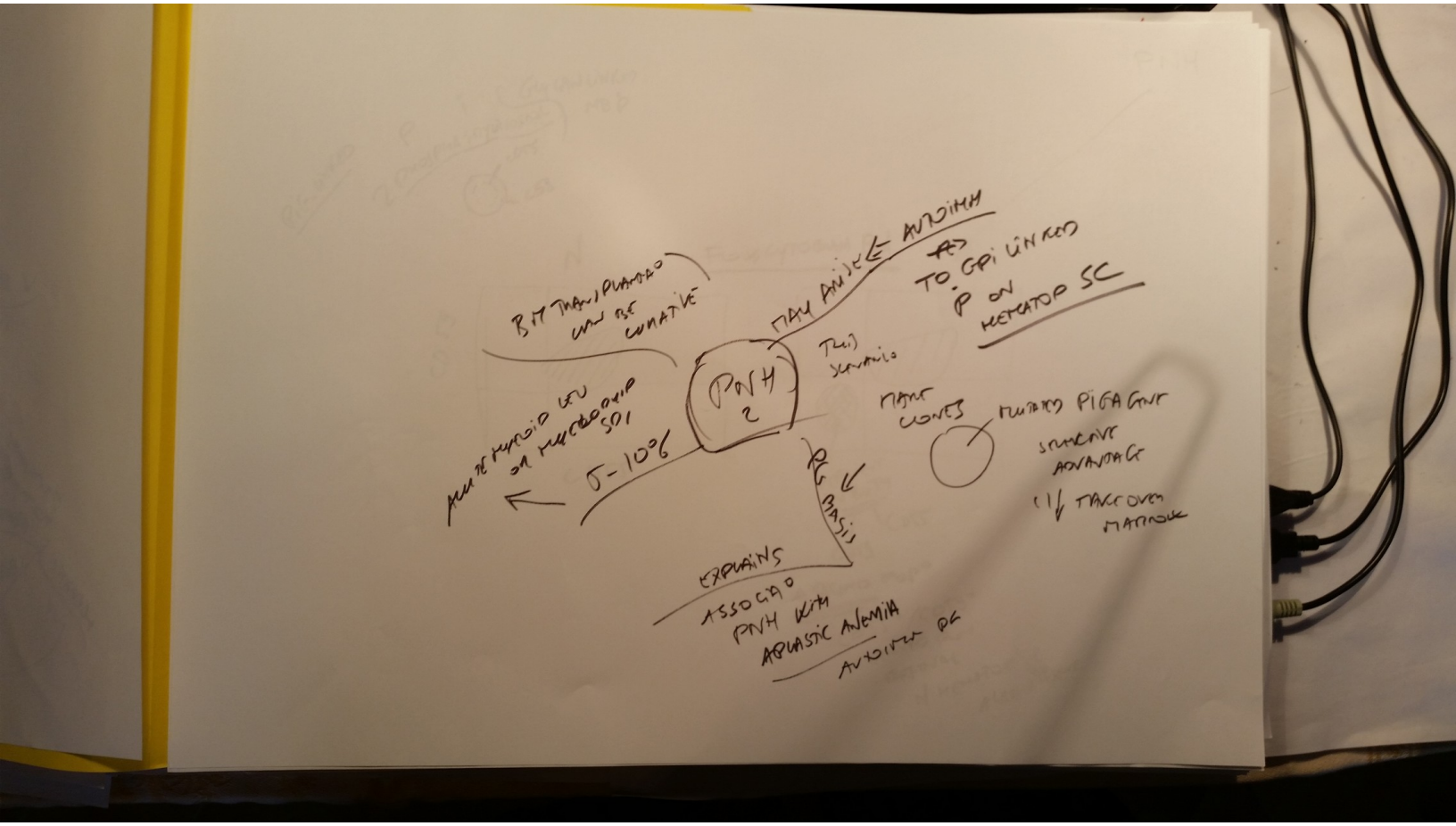

PP BTHAL MAJOR
N
BTHAL
HbA
α2β2
N ERYTHROPOIET
N RBC
β GLOBIN
+
RELATIVE
α GLOBIN
EPO↑
HbA PROD°
INSOLUBLE
α GLOBIN
AGGREGATE
α N ERYTHROPOIET°
FEW αN
RELEASE
INEF EPO is
NOT ERYTHROID IN BM
ANEMIA
TISS HYPOXIA
EPO↑
MARROW EXPAN°
SKELETAL
DEFORMITIES
CRANIAL
CHANGES
PLASMA
IRON
Fe ABS°
Bd TRANSF°
SYSTEMIC
Fe OVERLOAD
HEMOCHROMATOSIS
β MOLEC PG
HIGHLY INSTABLE
αGGB
AGG
N HbA
HYPOCHROMIC RC
MICROCYTIC
O2 CARRYING
CAPACITY
EXTRAVASC HEMOL
DEFINITIVE
AGGREGATE-
DING RC
IN
SPLENIC
SEQUESTRATION

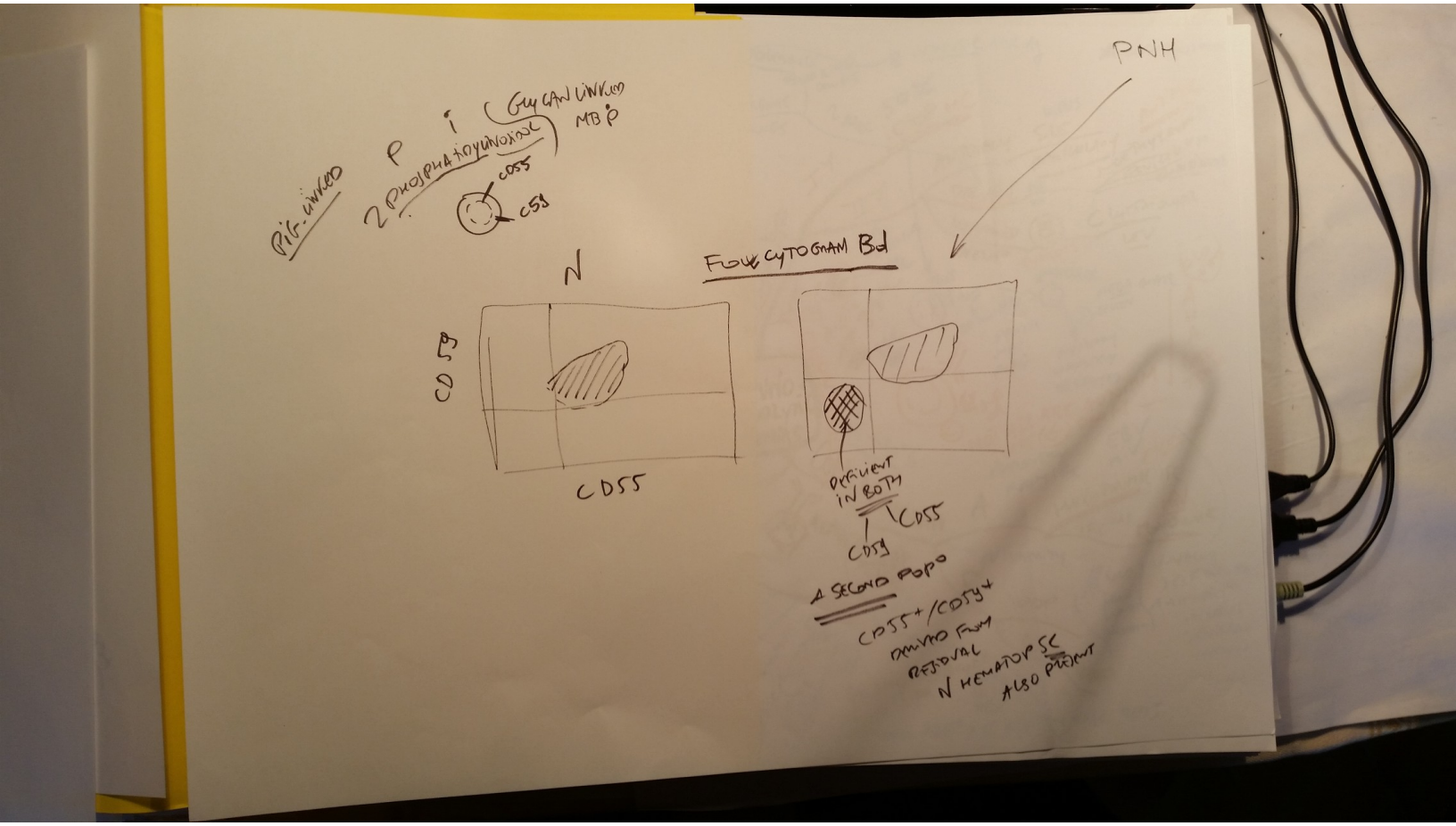

β CLIN SDS
MINOR
MAJOR
2 ALLELES
β+/β+
β+/β°
β°/β°
SEVERE
MANIF° DIAG
MANIF° 6→9 M
AFTER BIRTH
AS HbS SWITCH FROM HbF TO HbA
↑PB ANISOCYTOSIS ++
(↑ SIZE)
+ MANY MICROCYTIC ERYTHROCYTES
↑ FRAGILITY
POORLY FILLED PERIPHERAL NORMOBLASTS ALSO GRANULOCYTES
EXPANSION ++
↑ SUBSEQUENT BONE FRACTURES
↓ GROWTH
MULTIPLE TRANSFUSIONS
↑ SPLENOMEGALY
↑ HAEMOLYSIS
↑ IRON OVERLOAD
↓ HAEMOGLOBIN
FAILURE
PROG RESISTANCE
↑↑ HEMOCHROMATOSIS
ONLY CURATIVE THERAPY
BONE MARROW TRANSPO
FERRITIN ↑ BUT NOT APPARENT TOXIC ↑
↑ IRON STORAGE
↑ CAPACITY
↓ ANEMIA
↑ ERYTHROPOIESIS
↑ HbA2 >3.5%
↑ HbF
MACROCYTIC SHIFTING
MYELOSIS
MYPOC
MINOR ↓ Hb
PBJ
SURFACE BLEEDING
INTERMEDIA ↑ CLIN SEVERITY
SEVERITY ↑↓ GENE DOSAGE
HOMOZ
HETEROZ
β+
β°
HETEROZ
HOMOZ
CLINICALLY ASYMPT HETEROZ

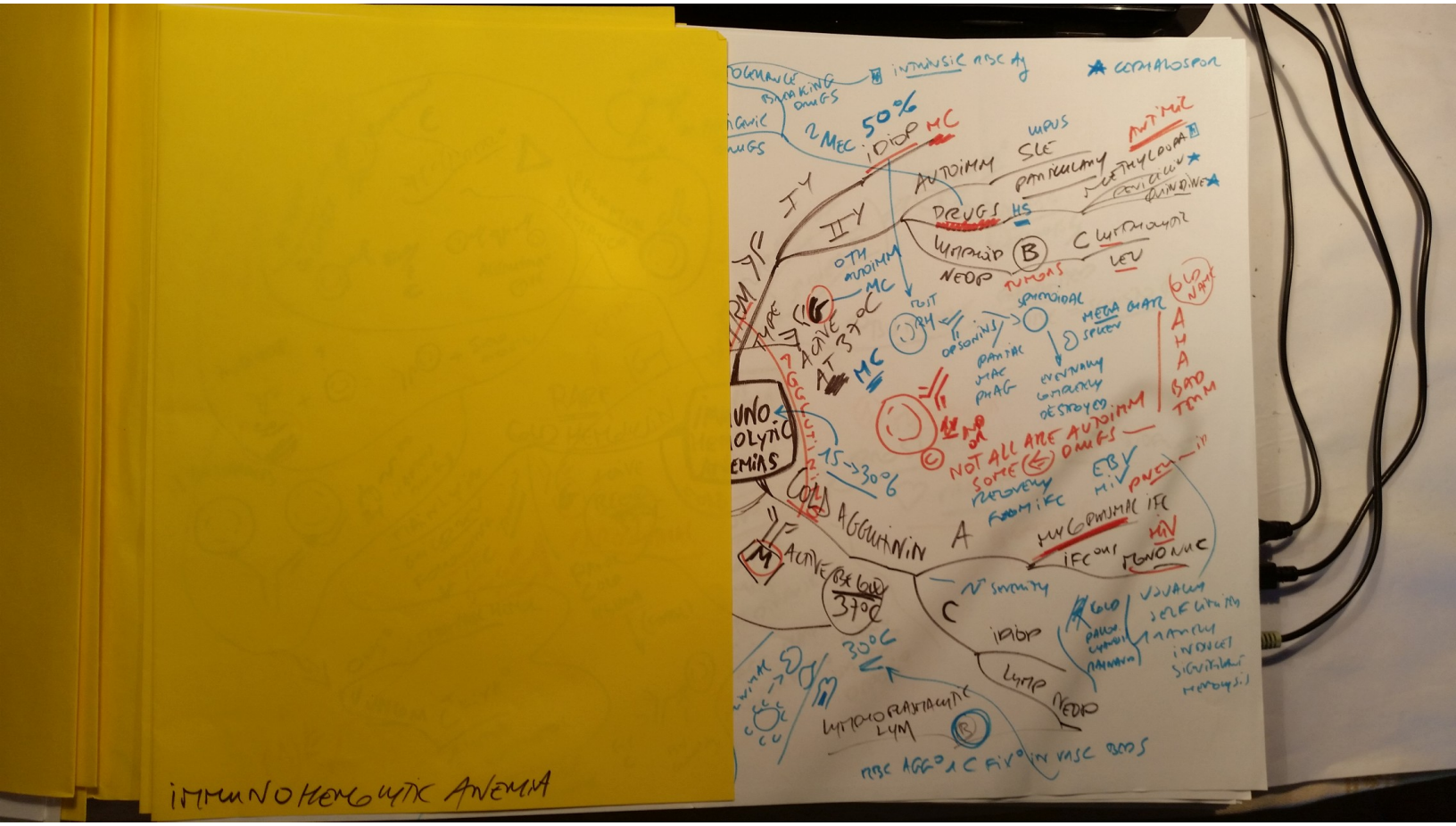

TRAIT
SILENT CARRIER STATE
HbH
UNSTABLE
STABLE
HbBARTS
ALSO
HYPOXIA
ICP
ASIAN

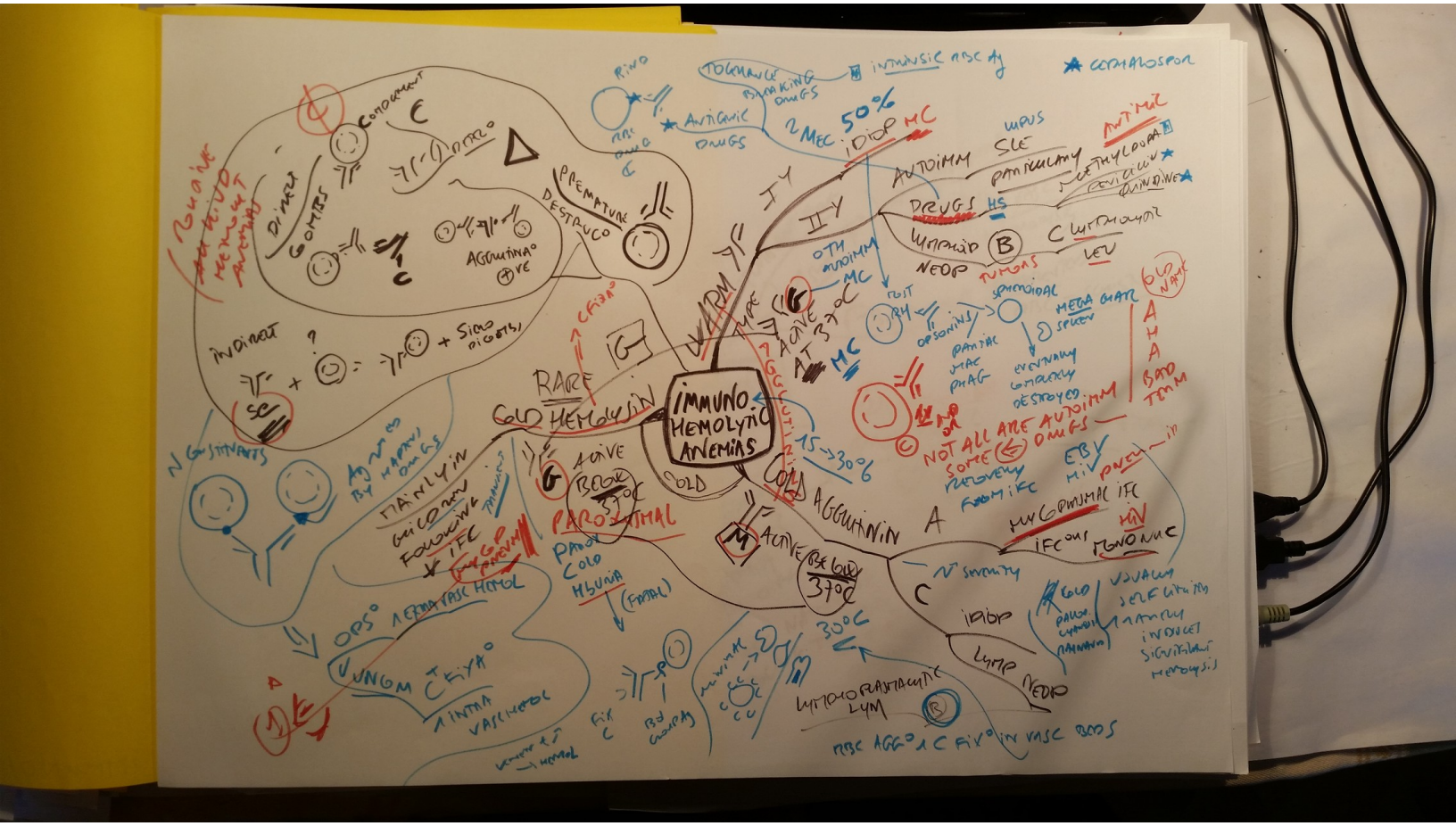

PNH
GPI LINKED P
FLOW
GPI
CD59
CD55
CD55-
CD59-
GLYCOSYL
PHOSPHATIDYL
INOSITOL
LIPID RAFTS

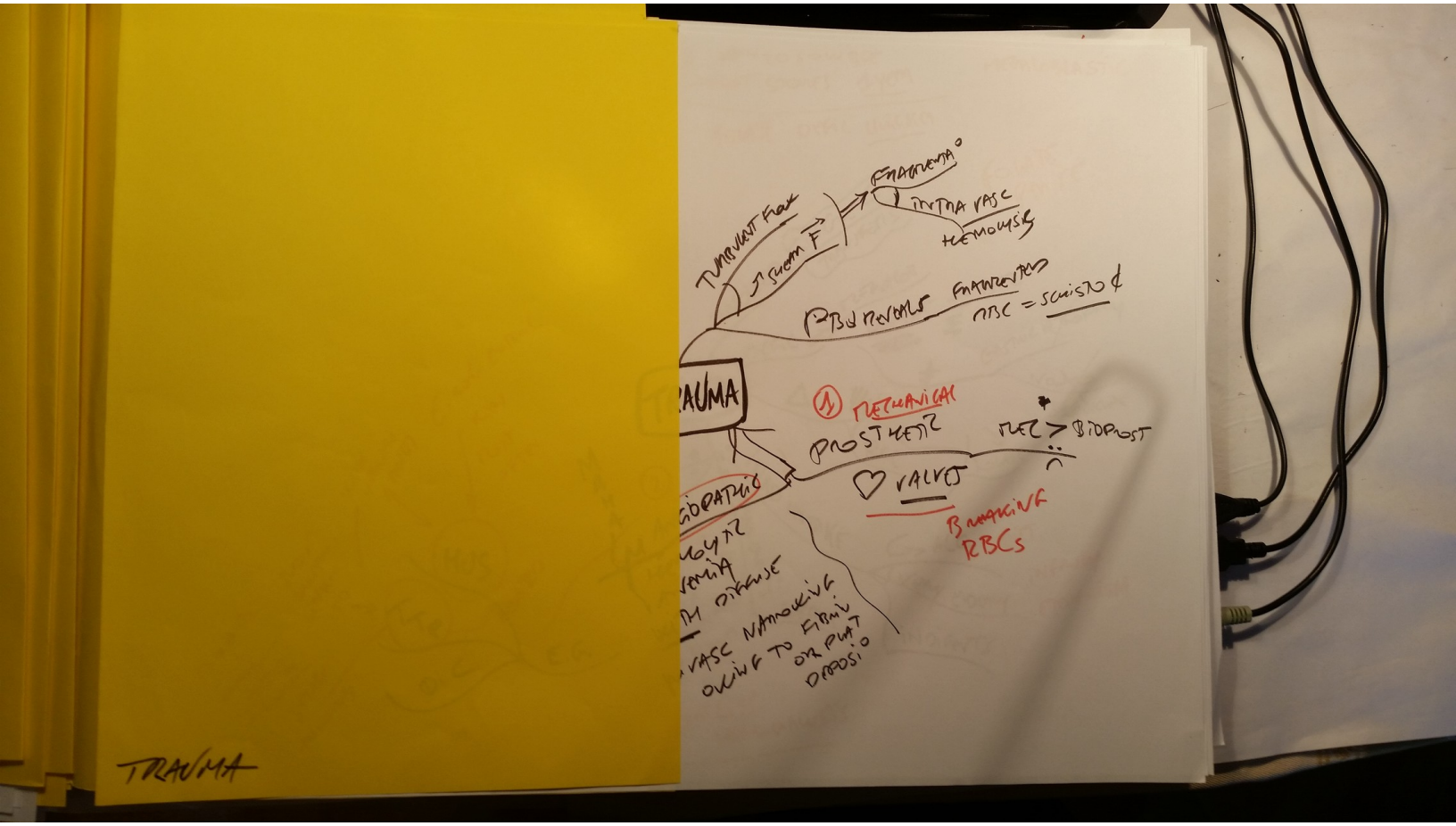

C8
CD59
DAF
CD55
ACQUIRED
RARE
X LINK
HEMOLYTIC
PNH
GPI LINKED P
GPI
CD59
CD157
CD59
CD55
CD55-
CD59-
PIGA
GLYCOSYL PHOSPHATIDYL INOSITOL
LIPID RAFTS

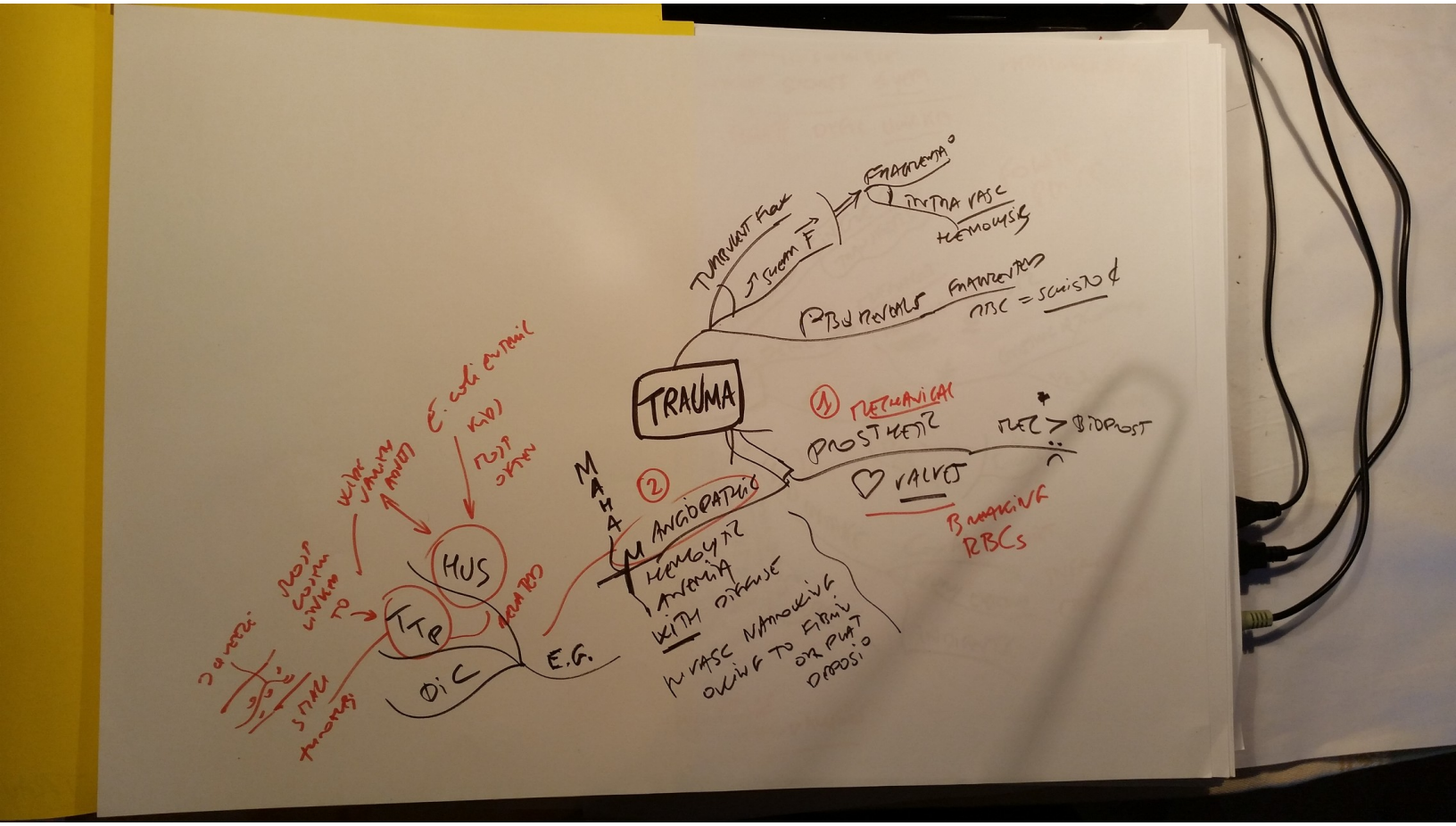

PNH 2
MAY ARISE
AUTOIMM
TO GPI LINKED
P ON NEUTROPH SC
PNH SCENARIO
MAJOR CLONES
PLUSIEURS PIGA CLONE
SELECTIVE ADVANTAGE
TAKEOVER MATURE
PG BASIS
EXPLAINS
ASSOCIATION PNH WITH APLASTIC ANEMIA
AUTOIMM PG

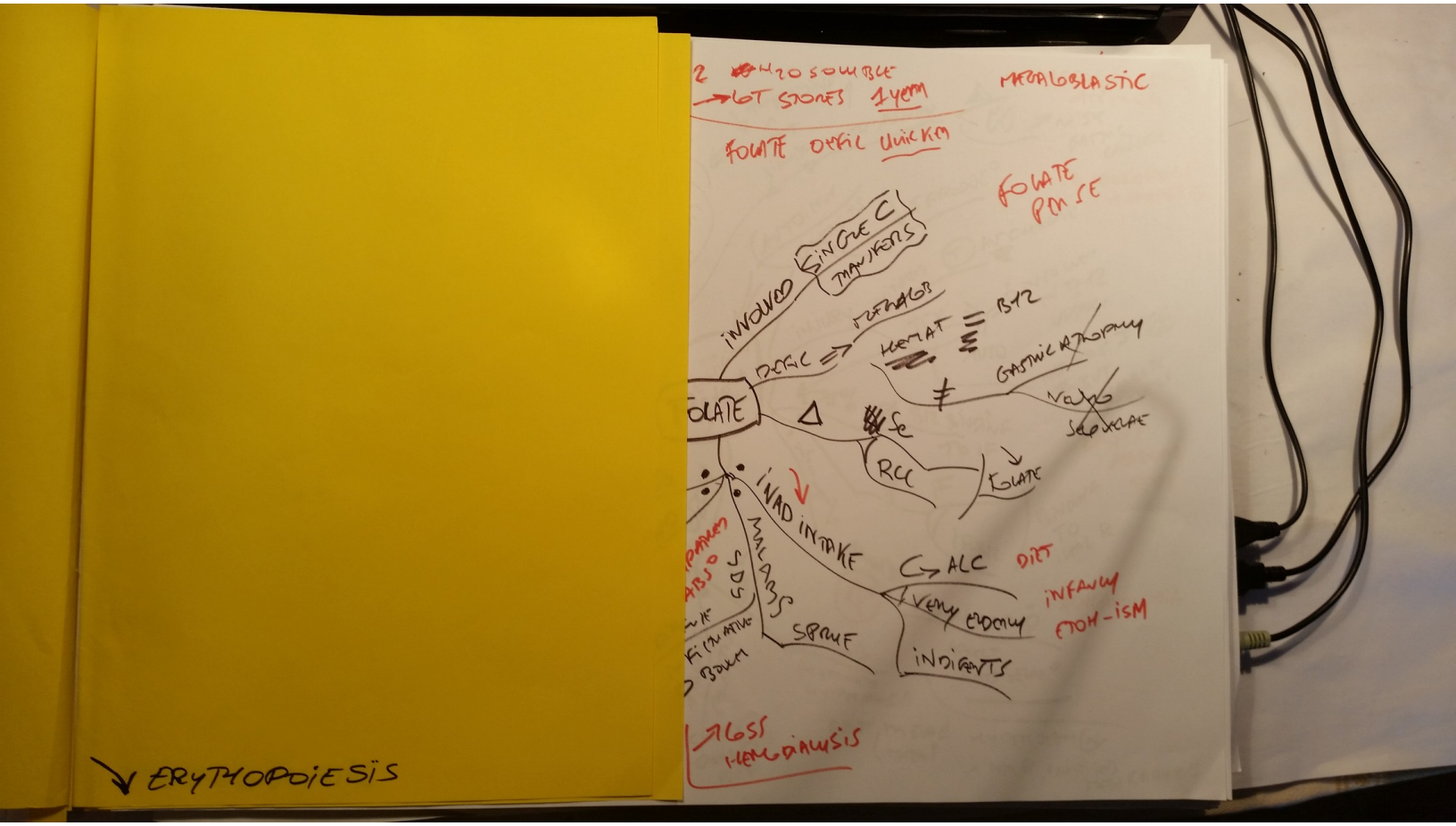

PNH
GPI LINKED
GLYCAN LINKED MB P
2 PHOSPHATIDYLINOSITOL
CD55
CD59
N
FLOW CYTOGRAM Bd
CD59
CD55
DEFICIENT IN BOTH
CD55
CD59
A SECOND POPO
CD55+/CD59+
DRIVEN FROM REMOVAL N HEMATOPOIESIS ALSO PRESENT


IMMUNOHEMOLYTIC ANEMIA
50%
IDIOP
MC
AUTOIMM
SLE
DRUGS
NEOP
TUMORS
LEU
NOT ALL ARE AUTOIMM
AGGLUTININ
IgG
IgM
37°C
30°C
LYMP NEOP

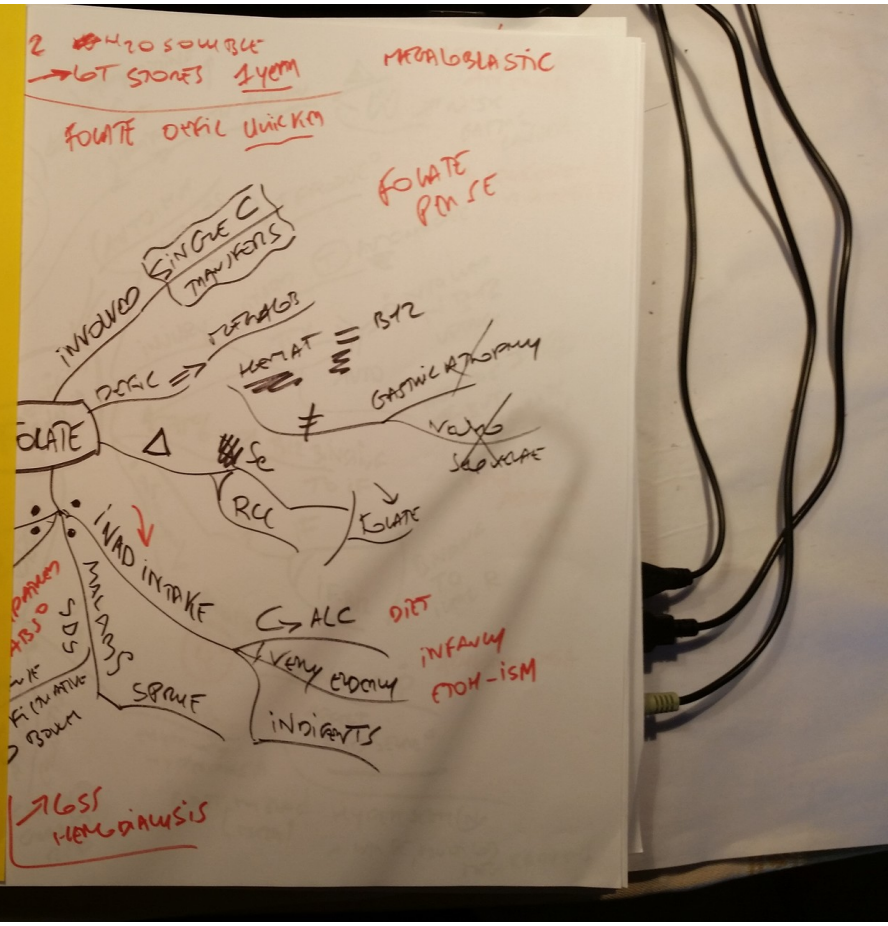

IMMUNO HEMOLYTIC ANEMIAS
WARM
COLD
DIRECT COOMBS
INDIRECT
PREMATURE DESTRUCTION
EXTRAVASC HEMOL
INTRAVASC HEMOL
DRUGS
AUTOIMM
SLE
PARACLONAL
PAROXYSMAL
COLD AGGLUTININ
COLD HEMOLYSIN
IDIOP
MC
50%
2 MEC
37°C
30°C
4°C
LYMPHOPLASMACYTIC LYM
NEOP
TUMORS
LEU
INFECTIONS
EBV
HIV
MYCOPLASMAL IFC
IFCous MONONUC
SPHEROCYTES
SPLENECTOMY
AIHA
BAD TRMT
NOT ALL ARE AUTOIMM
DRUGS
ANTIGENIC DRUGS
IMMUNOGENIC DRUGS
TOLERANCE BREAKING DRUGS
INTRINSIC RBC Ag
CEPHALOSPOR
PENICILLINS
METHYLDOPA
QUINIDINE
HS
RBC AGG↑ C FIX↑ IN VASC BEDS
C FIX↑
IgG
IgM
C3b
C3d
Fab
Fc
Ag
Ab

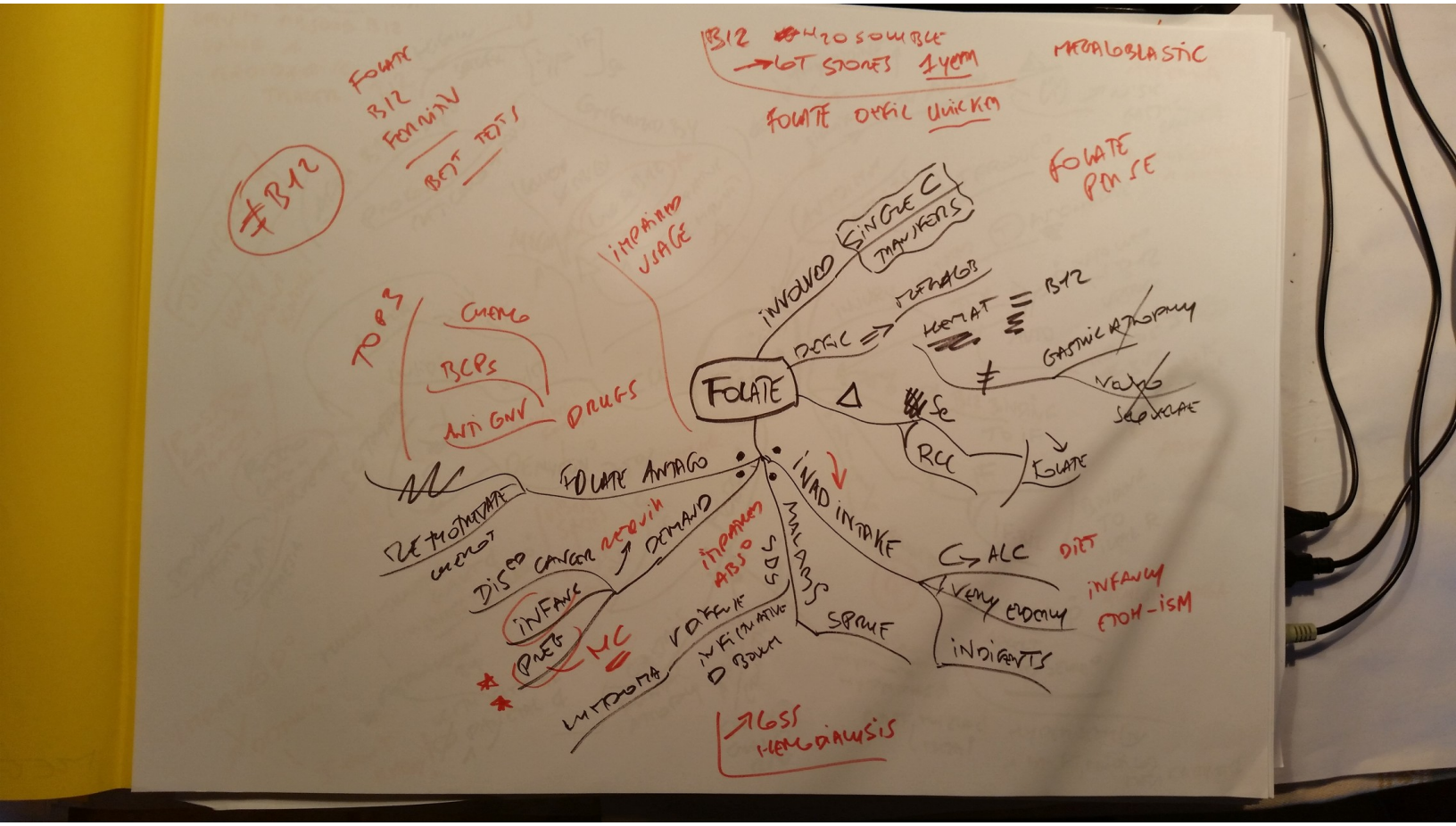

TRAUMA
TURBULENT FLOW
↓ SHEAR F
ANEURYSM
INTIMA TEAR
HAEMOLYSIS
PTFE
ANEURYSMS
TEAR = SCISSION
TRAUMA
MECHANICAL
PROSTHESIS
PTFE > BIOPROST
VALVES
BLEEDING
RBCs
VASC NARROWING
OCCLUDE TO FIBRIL
OR PLAT
DEPOSITION

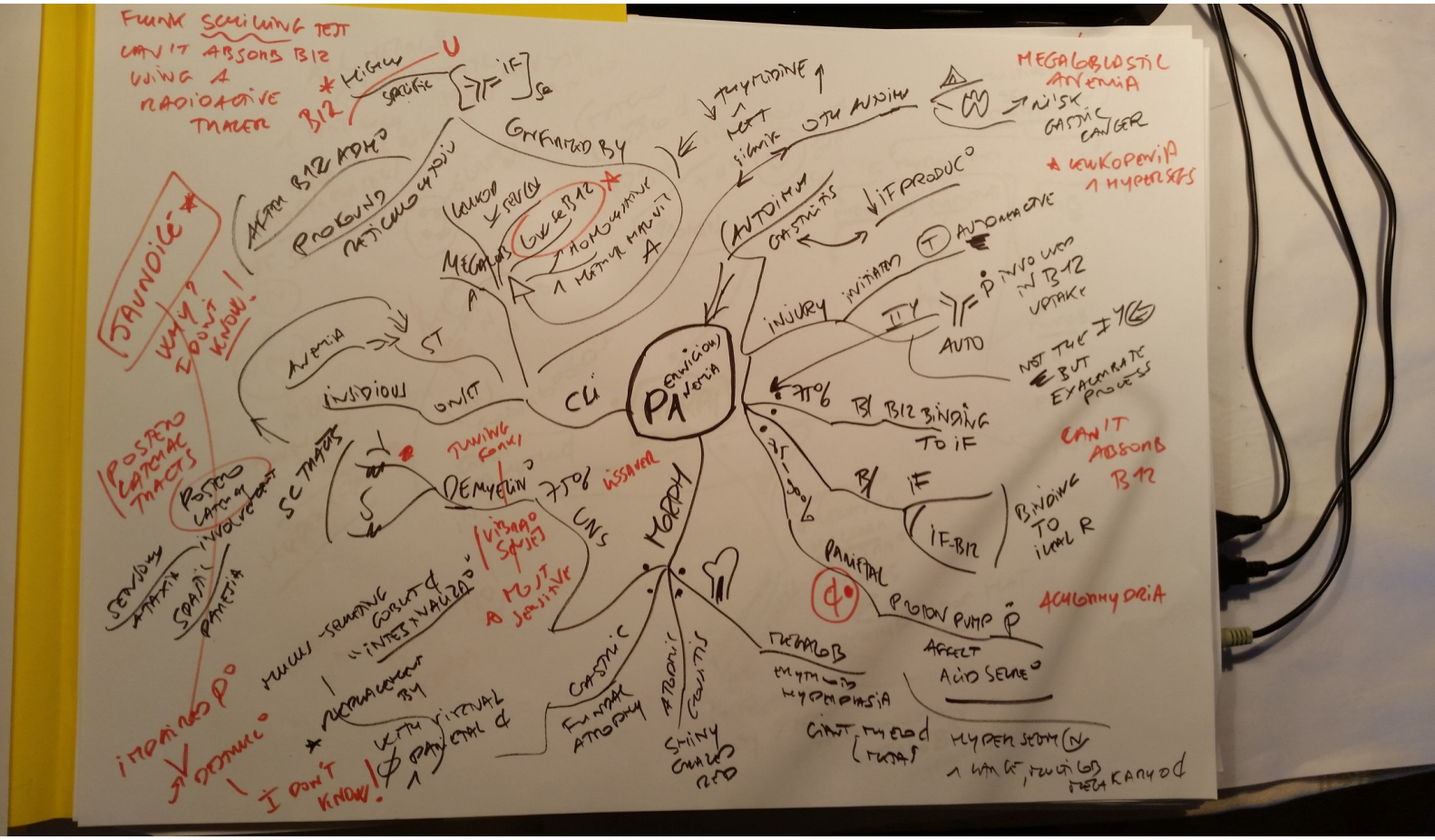

TRAUMA
HUS
TTP
DIC
E.G.
MAHA
ANGIOPATHIC
HEMOLYTIC ANEMIA WITH SCHISTOCYTES
MECHANICAL
PROSTHETIC VALVES
RBCs

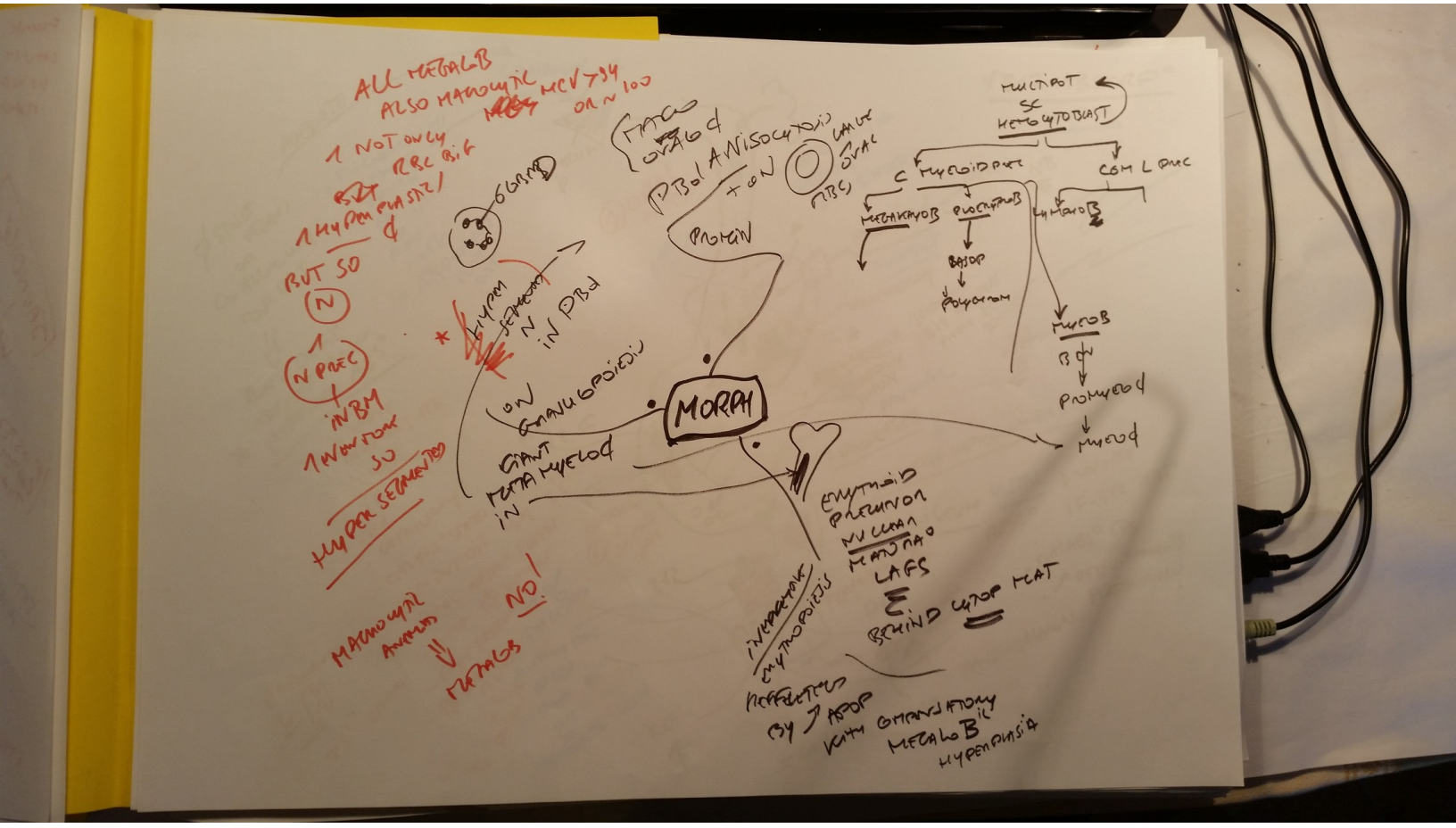

MEGALOBLASTIC
FOLATE DEFIC UNICKM
FOLATE PROSE
INVOLVED
SINGLE C
MANAGERS
DOSIC
HEMAT
B12
GASTRIC ATROPHY
RCC
INAD INTAKE
ALC
DIET
INFANCY
ETOH-ISM
SPRUE
INDIGENTS
SDS
ERYTHOPOIESIS

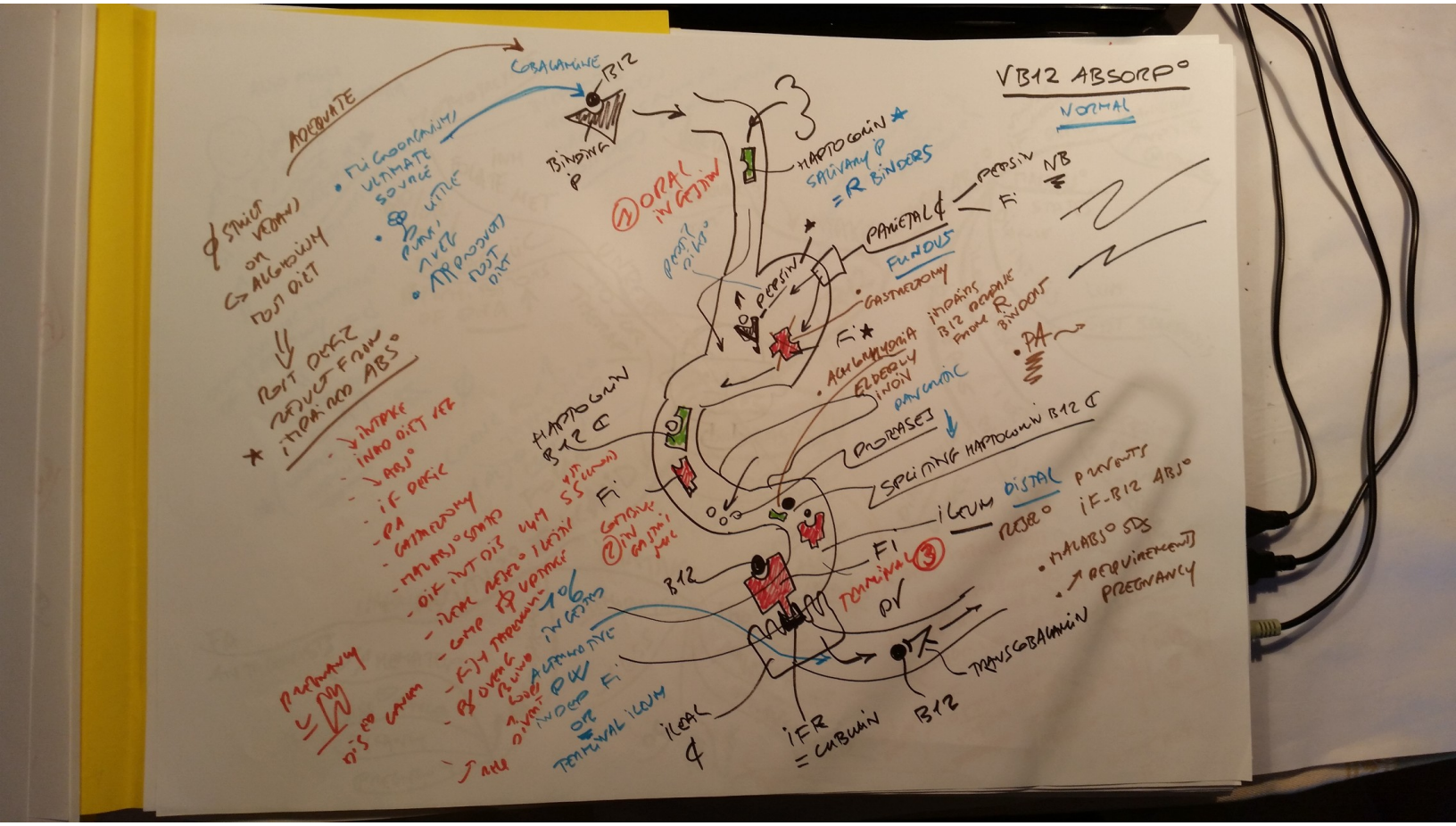
MEGALOBLASTIC

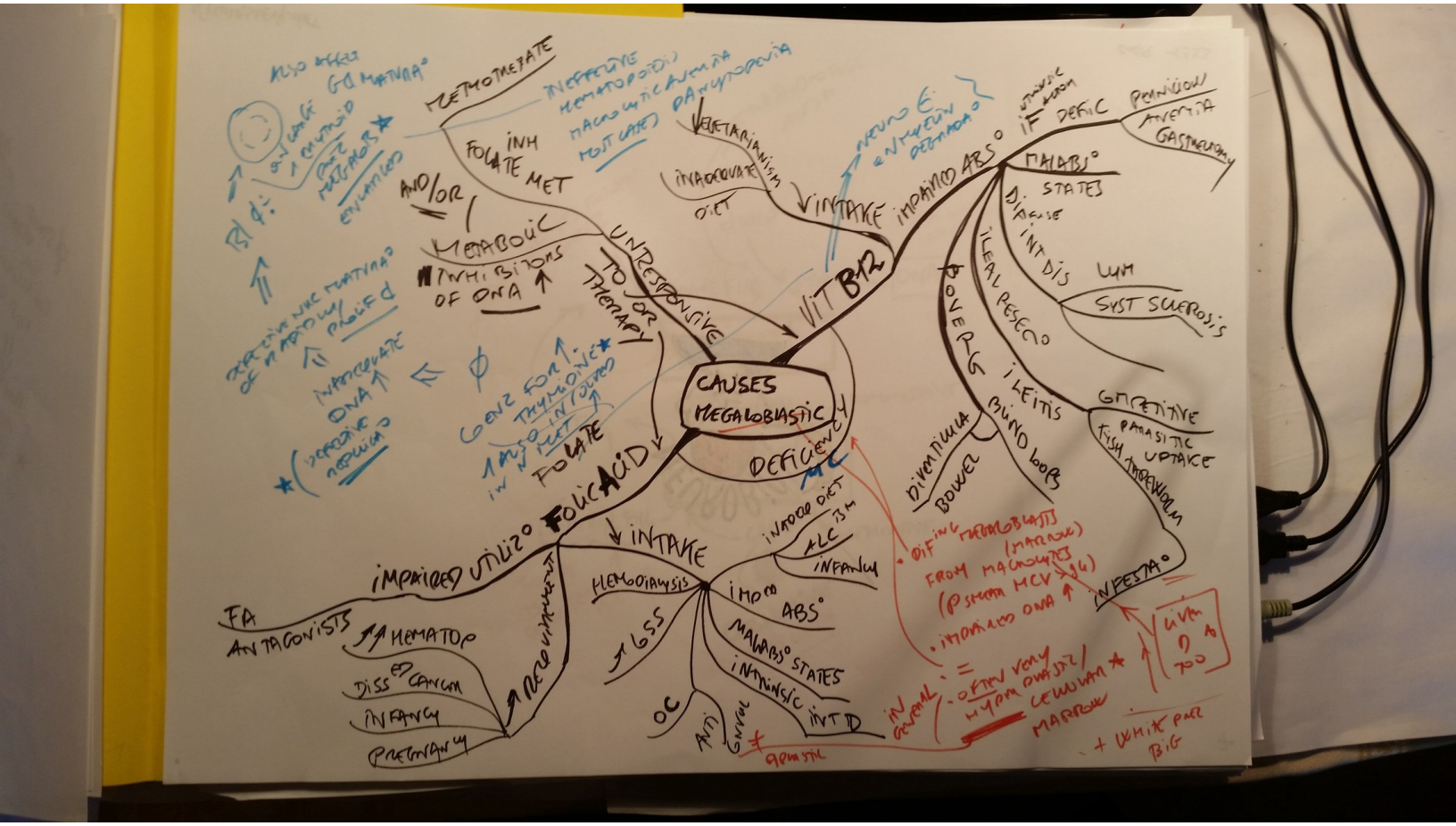


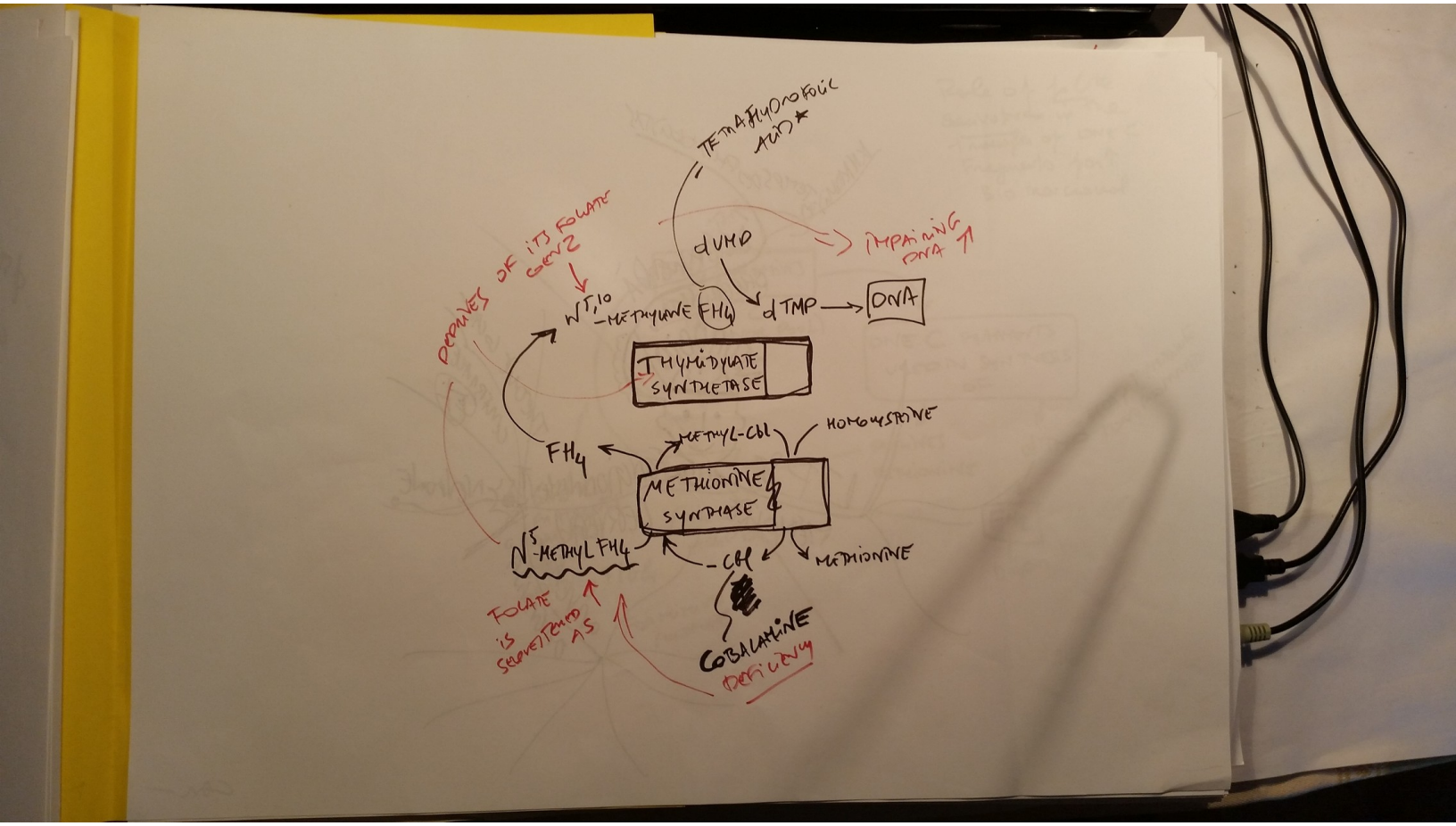

FOLATE
B12
FERRITIN
RBT TEST
#B12
B12 H2O SOLUBLE
→6T STORES 1yrm
FOLATE DEFIC QUICKLY
MEGALOBLASTIC
FOLATE PROFILE
INVOLVED
SINGLE C
MANY GENES
DEFICIENCY
HAEMAT = B12
GASTRIC ATROPHY
FOLATE
RCC
TOPS
CHEMO
TSCPs
ANTI GNV
DRUGS
IMPAIRED USAGE
FOLATE ANTAGO
INAD INTAKE
ALC
DIET
INFANCY
ETOH-ISM
INFANTS
MALABS
SPRUE
SDS
INFECTIVE D
VOMITING
MC
PREG
LYMPHOMA
LOSS
HAEMODIALYSIS

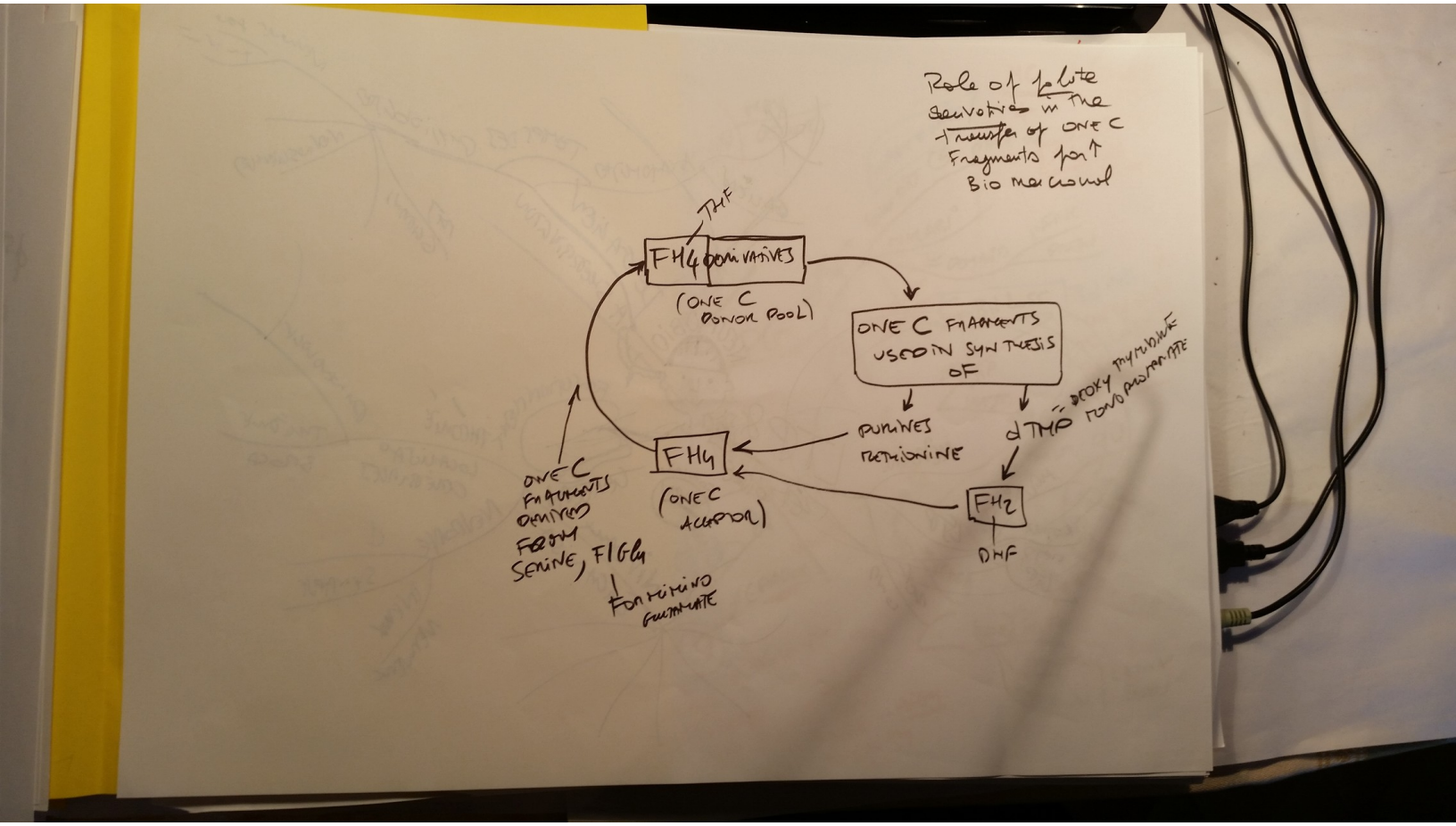

PERNICIOUS ANEMIA
CLI
MEGALOBLASTIC ANEMIA
AUTOIMMUNE GASTRITIS
INJURY
AUTO
BY B12 BINDING TO IF
PARIETAL
PROTON PUMP
ACHLORHYDRIA
MORPH
DEMYELIN
ANEMIA
INSIDIOUS
ONIT
SCLEROSIS
SUBACUTE COMBINED DEGENERATION OF SPINAL CORD
PERIPHERAL NEUROPATHY
OPTIC ATROPHY
GASTRIC ATROPHY
ACHLORHYDRIA
HYPERSEGMENTED NEUTROPHILS
MEGALOBLASTIC ERYTHROPOIESIS
SCHILLING TEST
CAN'T ABSORB B12
RADIOACTIVE
B12
IF
HIGH
SPECIFIC
GENETICALLY
HOMOZYGOUS
MUTATION
ACTIVE B12 ADH
PROBOSCIS
ATHETOSIS
SPASTIC PARESIS
SENSORY ATAXIA
JAUNDICE
WHY?
I DON'T KNOW!
I DON'T KNOW!
PARESTHESIA
PARIETAL CELL
ANTIBODY
PERNICIOUS ANEMIA
NOT THE IF
BUT EXAMINATE PROCESS
CAN'T ABSORB B12
BINDING TO ILEAL R
AFFECT ACID SECRETION
HYPERSEGMENTED NEUTROPHILS
INCREASED RISK GASTRIC CANCER
LEUKOPENIA
THROMBOCYTOPENIA
PANCYTOPENIA
ANEMIA
GLOSSITIS
DIARRHEA
WEIGHT LOSS
FATIGUE
PALLOR
SHORTNESS OF BREATH
TACHYCARDIA
PALPITATIONS
DYSPNEA ON EXERTION
CHEST PAIN
HEADACHE
DIZZINESS
SYNCOPE
CONFUSION
IRRITABILITY
DEPRESSION
PARANOIA
HALLUCINATIONS
DELUSIONS
MEMORY LOSS
DEMENTIA
PSYCHOSIS
SEIZURES
COMA
DEATH

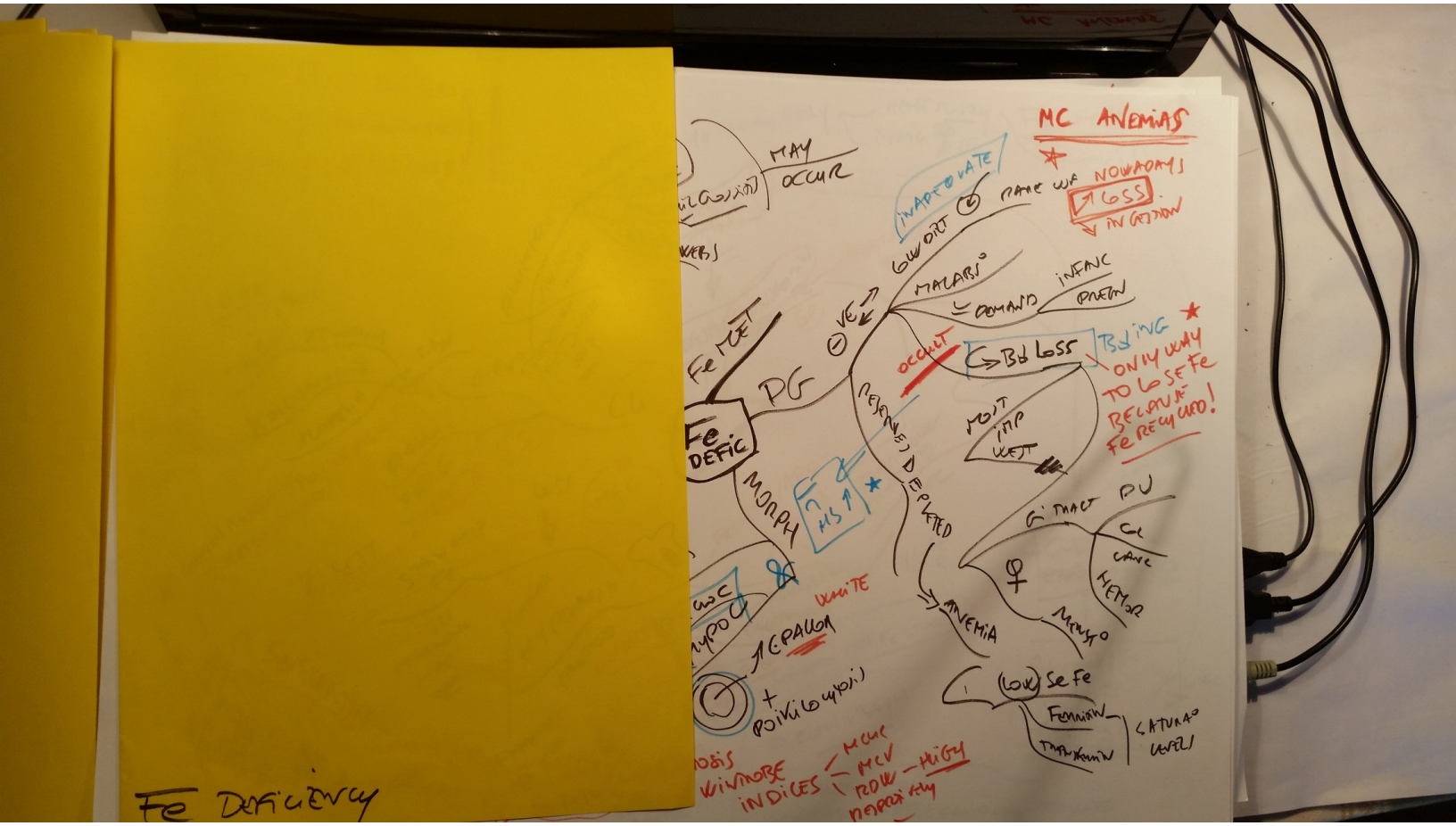

ALL MEGALB
ALSO MACROCYTIC
MCV > 94
OR N 100
↑ NOT ONLY
RBC BIG
BUT ALSO PLATELET
↓ HYPERPLASTIC
BUT SO
N
↑
N PREC
↓
IN BM
↑ NOT FOUR
SO
HYPER SEGMENTED
MACROCYTIC
ANEMIA
NO!
MEGALOS
GRAND
TRACE
OVALOCYTE
POIKILOCYTOSIS
ANISOCYTOSIS
+ ON
LARGE
OVAL
RBC
PROTEIN
ON
HEMATOPOIESIS
MORPH
GIANT
METAMYELOCYTE
IN
MULTIPOT
SC
HEMOCYTOBLAST
C MYELOID PREC
COM L PREC
MEGAKARYOB
PLATELETS
BASOP
POLYCHROM
MYELOB
IS ON
PROMYELOCYTE
MYELOCYTE
ERYTHROID
PRECURSOR
NUCLEAR
MATURATION
LAGS
BEHIND
CYTOP MAT
INEFFECTIVE
ERYTHROPOIESIS
REFLECTED
BY ↑ RDW
WITH OVALOCYTOSIS
MEGALOBLASTIC
HYPERPLASIA

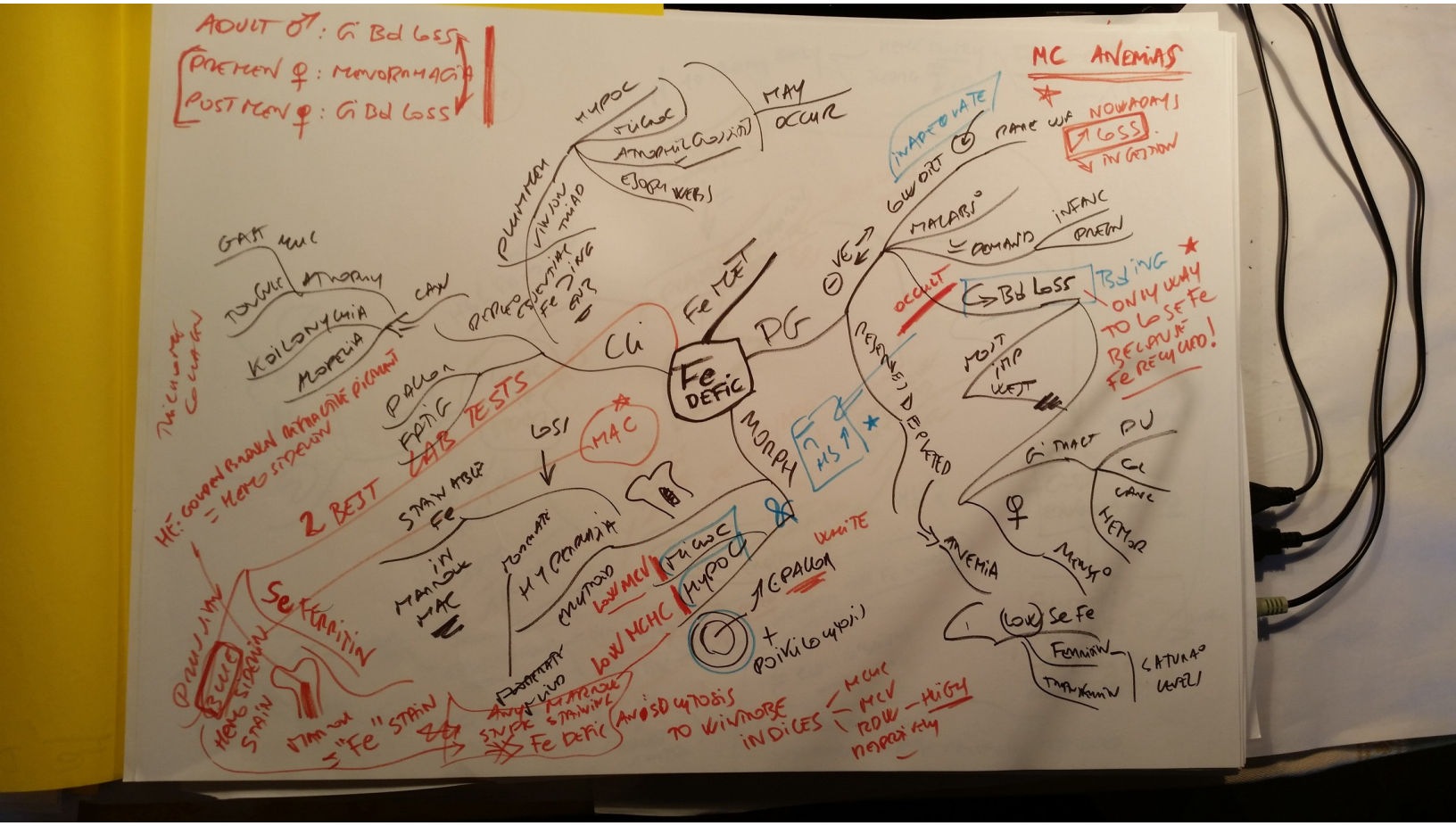

VB12 ABSORP°
NORMAL
ADEQUATE
COBALAMINE B12
BINDING P
HAPTOCORRIN
SALIVARY P
=R BINDERS
PEPSIN
NB
Fi
PARIETAL
FUNDUS
GASTRECTOMY
ACHLORHYDRIA
ELDERLY
PANCREAS
PROPHASE
SPLITTING HAPTOCORRIN B12
PA
ILEUM DISTAL
TERMINAL
PV
TRANSCOBALAMIN
IFR
=CUBULIN
ILEAL
B12
PREGNANCY

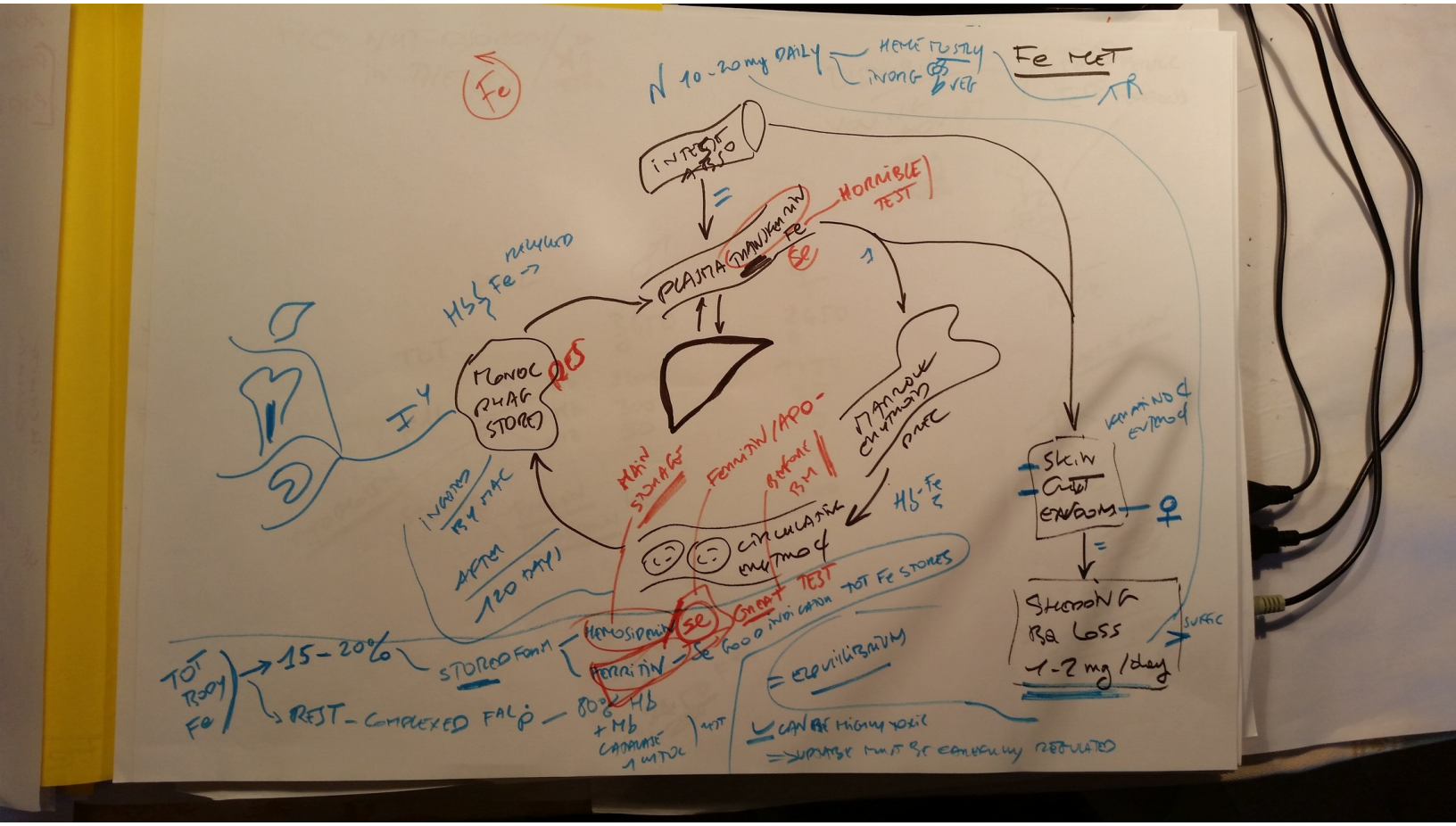

CAUSES
MEGALOBLASTIC
DEFICIENCY
FOLIC ACID
VIT B12
METHOTREXATE
AND/OR
METABOLIC
INHIBITORS OF DNA
FOLATE MET
INH
UNRESPONSIVE TO THERAPY
INTAKE
VEGETARIANISM
INADEQUATE DIET
IMPAIRED ABS°
MALABS° STATES
ILEAL RESECT°
INTRINSIC FACTOR
PERNICIOUS ANAEMIA
GASTRECTOMY
CROHN'S DIS
SYST SCLEROSIS
DIVERTICULA
BOWEL
BLIND LOOP
COMPETITIVE PARASITIC UPTAKE
FISH TAPEWORM
INFESTAT°
IMPAIRED UTILIZ°
FA ANTAGONISTS
HAEMATOP
DISS ED CANCER
INFANCY
PREGNANCY
INCREASED REQUIREMENT
INTAKE
HAEMODIALYSIS
LOSS
INADEQ DIET
ALC
INFANCY
MALABS° STATES
INTRINSIC FACT D
OC
ANTI CONVUL
DRUGS
IN GENERAL
OFTEN VERY HYPERCHROMIC CELLULAR MARROW
LIVER
GOAT MILK
INEFFECTIVE HAEMATOPOIESIS MACROCYTIC ANAEMIA MOST CASES PANCYTOPENIA
ALSO AFFECTS GI MUCOSA
INADEQUATE DNA
INCREASED DNA
GIVE FOLIC ACID
THYMIDINE
AUTO INJECT IM

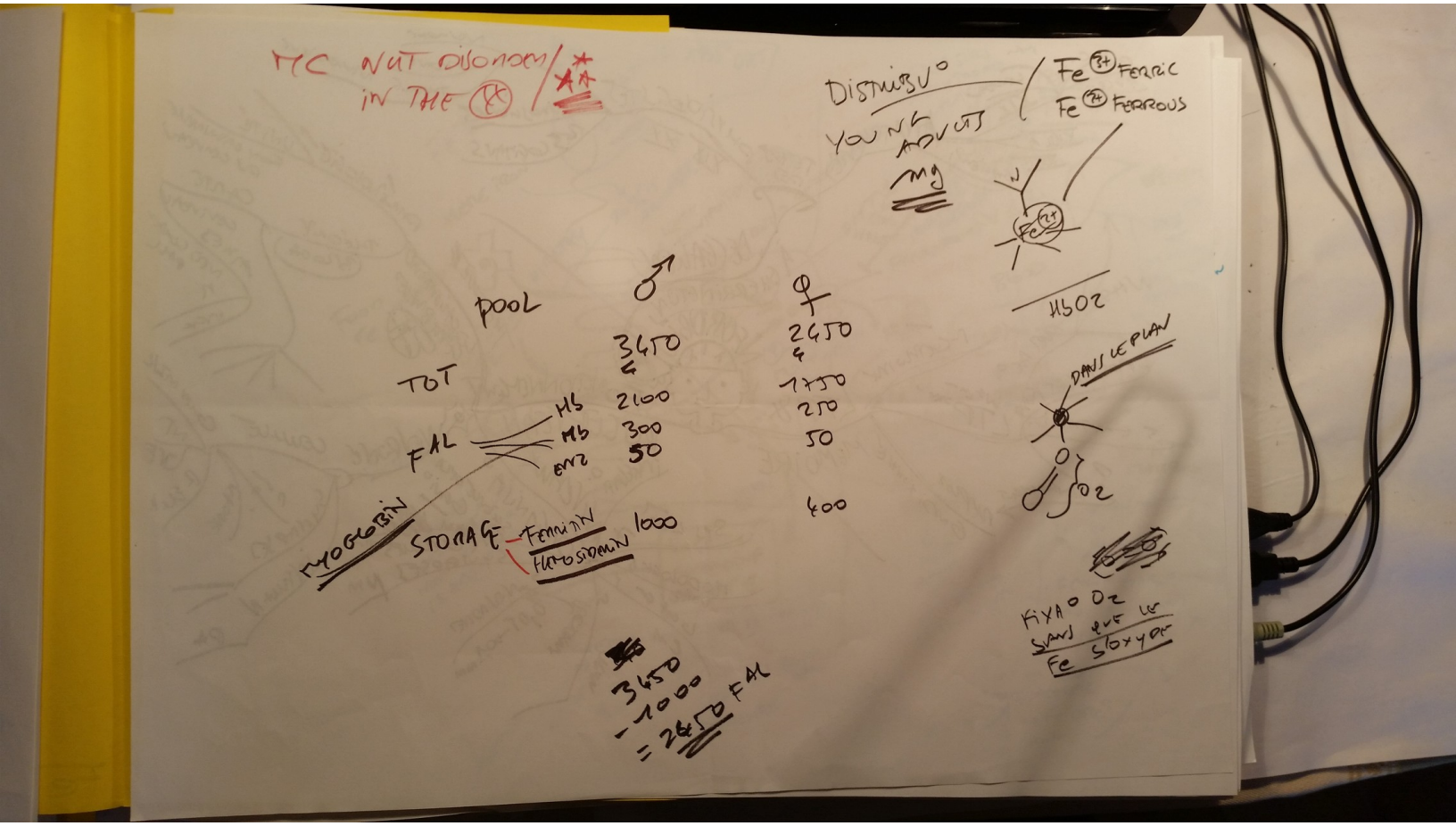

TETRAHYDROFOLIC ACID*
dUMP
IMPAIRING DNA
dTMP
DNA
THYMIDYLATE SYNTHETASE
5,10 METHYLENE FH4
METHYL-CBL
HOMOCYSTEINE
METHIONINE SYNTHASE
FH4
5-METHYL FH4
METHIONINE
-CBL
COBALAMINE
DEFICIENCY

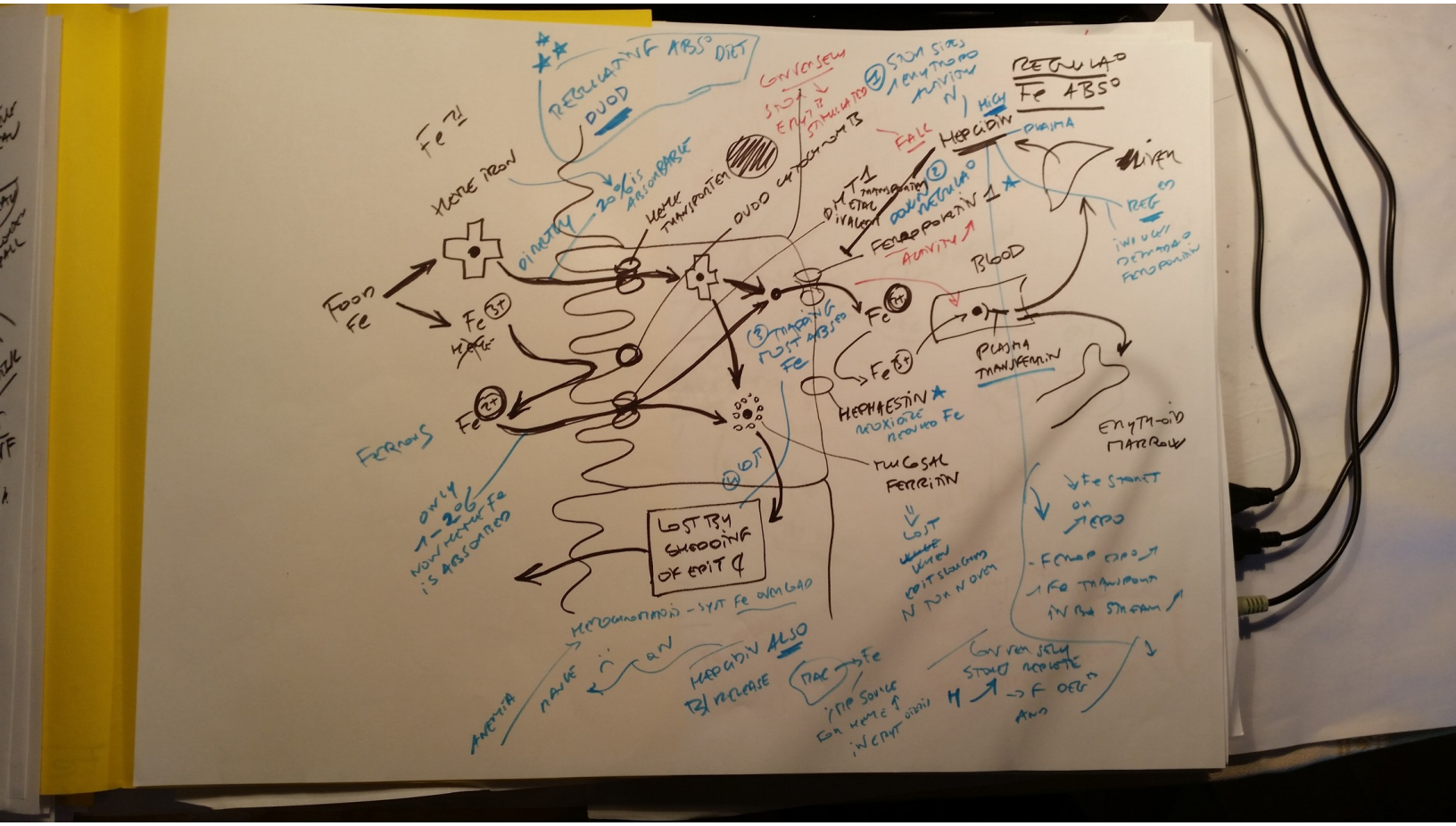

Role of folate derivatives in the transfer of one C fragments for biomolecules
THF
FH4 derivatives
(one C donor pool)
one C fragments used in synthesis of
purines
methionine
dTMP
deoxythymidine monophosphate
FH4
(one C acceptor)
FH2
DHF
one C fragments obtained from serine, FIGlu
Formimino glutamate

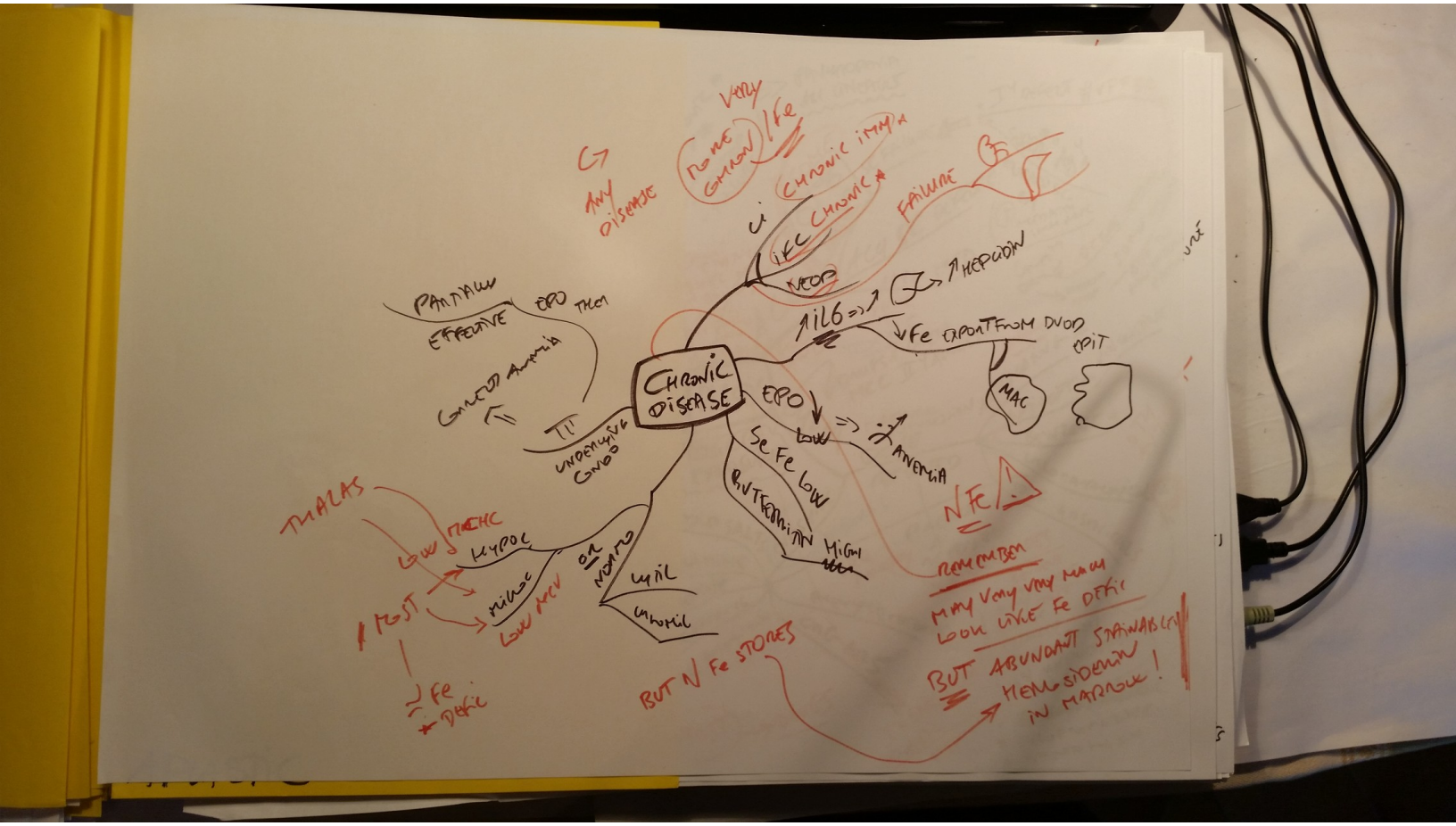

Fe Deficiency
MC ANEMIAS
MAY OCCUR
INAPPROPRIATE
LOW DIET
MALARIA
INFANC
PREGN
Fe DEFIC
PG
OCCULT
Bd LOSS
MOD IMP WOMT
DEPLETED
MONOPH
ANEMIA
(LOW) Se Fe
Female
Malignancy
SATURATED LEVELS
MCV
RDW
HIGH

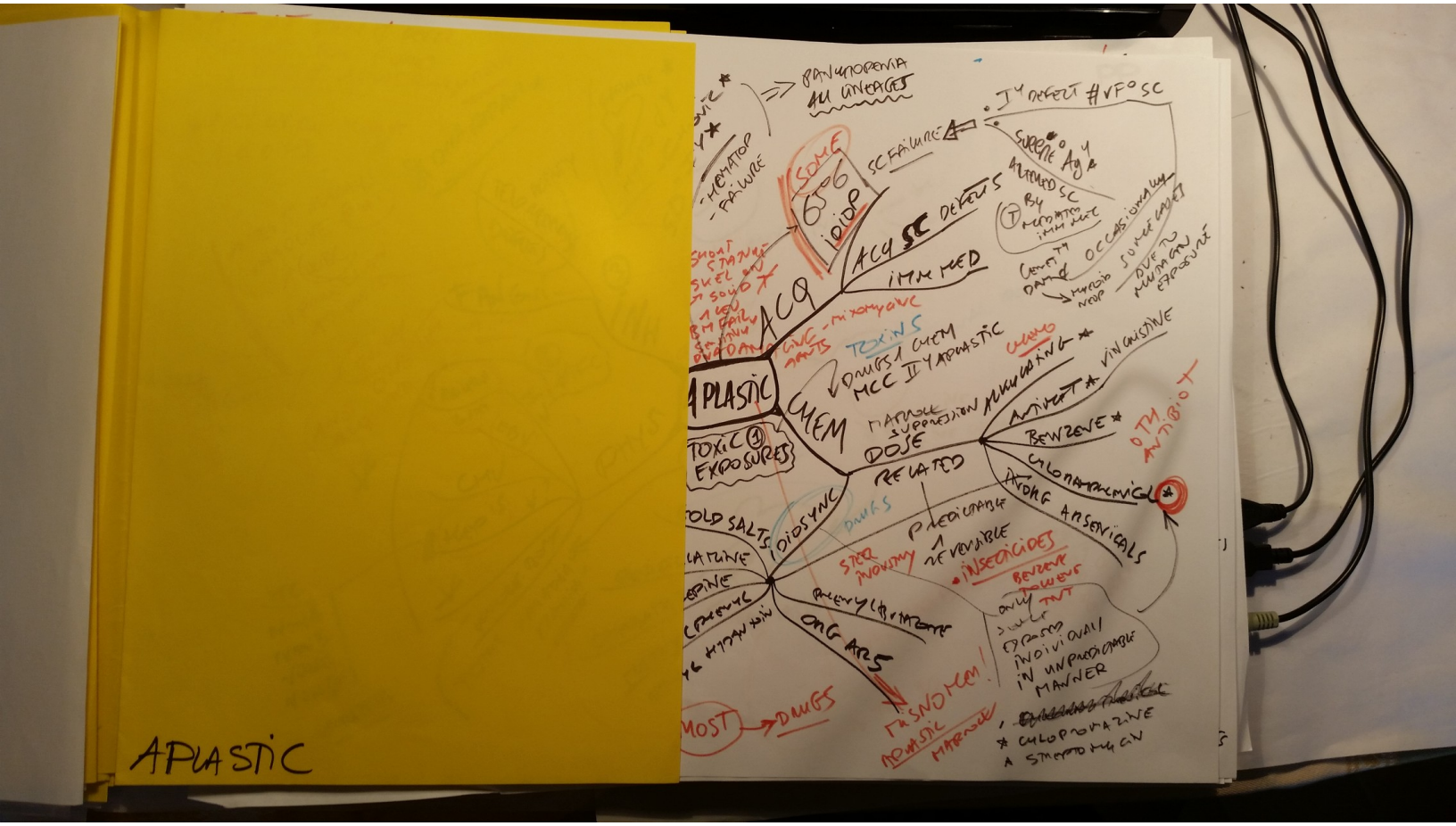

ADULT ♂: GI Bd LOSS
PREMEN ♀: MENORRHAGIA
POSTMEN ♀: GI Bd LOSS
MC ANEMIAS
Fe DEFIC
PG
Cli
Fe MET
2 BEST LAB TESTS
MAC
MONPH
RETIC
HYPOC
HYPOCHROMIA
MICROCYTOSIS
LOW MCHC
LOW MAC
KOILONYCHIA
ATROPHY
CAN
PALLOR
EPITH
STAIN MARROW Fe
IN MARROW MAC
Se FERRITIN
"Fe" STAIN
HEMOSIDERIN STAIN
ANISOCYTOSIS
TO DIVIDE INDICES
MCHC
MCV
RDW
MORPHOLOGY
INAPPROPRIATE
GLOSSITIS
MALAISE
DEMAND
INFANC
PREGN
Bd LOSS
OCCULT
MOST IMP VERY
Bd ING ONLY WAY TO LOSE Fe RECAPTURE RECYCLED!
REFRACT DEPLETED
ANEMIA
GI MALIG
PU
CA
CANC
HEMOR
MENSES
(LOW) Se Fe
FEMININ
MASCULIN
SATURATED LEVEL
ACHLORHYDRIA
+ POIKILOCYTOSIS
LIMITE
GAIT
MUC
ATROPHY
TONGUE
KOILONYCHIA
MORPHIA
CAN
PLUMMER VINSON TRIAD
HYPOC
ATROPHIC GASTRITIS
MAY OCCUR
EJOPH WEBS
PREMAL
ESSENTIAL Fe DEFING ENZ
PALLOR
EPITH
HE: COUNTERSTAIN = HEMOSIDERIN
ANTACID PIGMENT
TRICHOMES CLUMPING

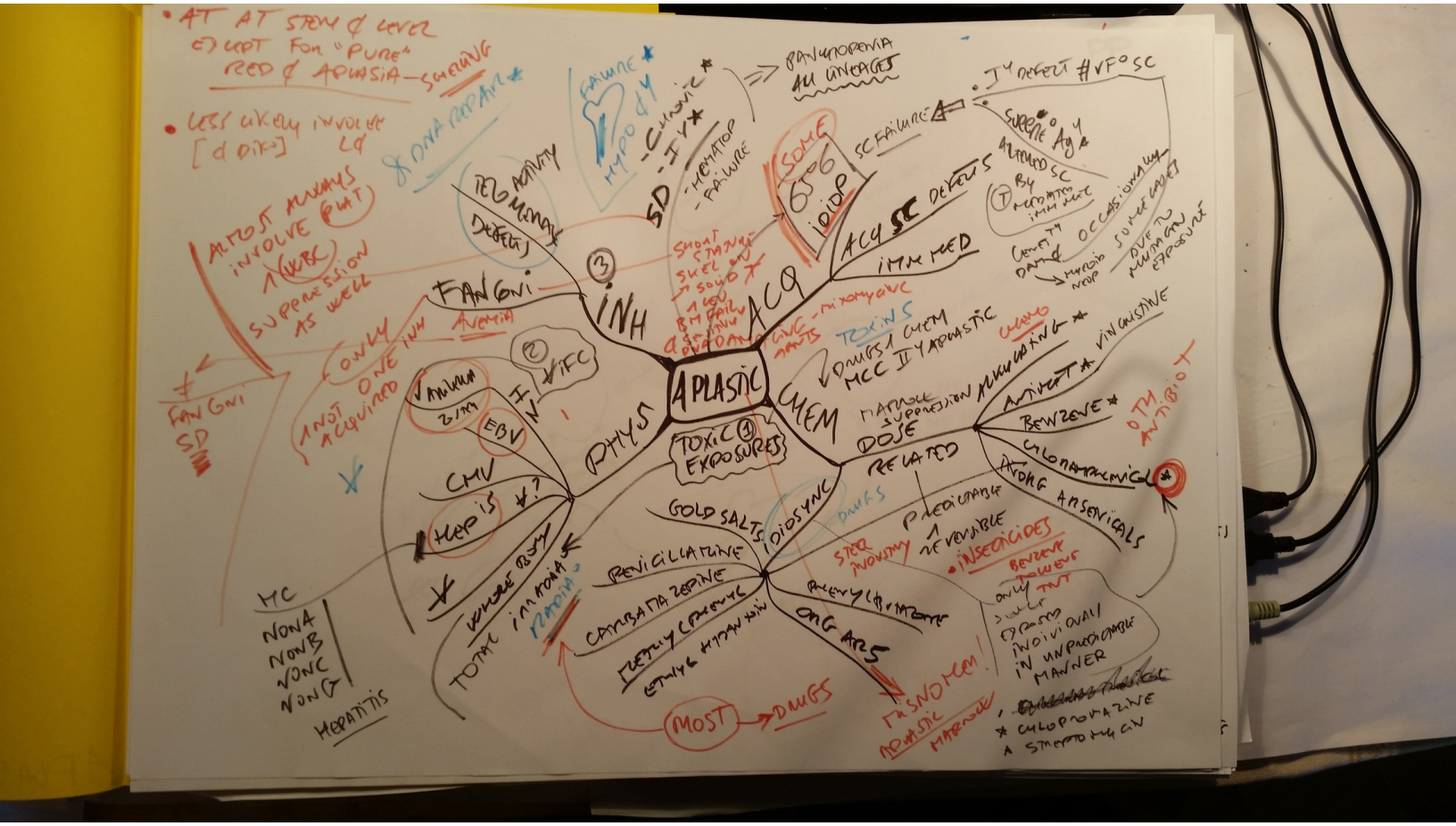

Fe
N 10 - 20 mg DAILY
HEME TOXIC
IRONG
VEG
Fe MET
INTEST
HORRIBLE TEST
PLASMA
Fe
Tf
HbFe
MONOC PHAG STORE
IV
MAIN STORAGE
FERRITIN / APO-
CIRCULATING ERYTHROCYTES
Hb-Fe
SKIN GUT EPITHELIUM
STORAGE Fe LOSS
1-2 mg/day
SUFFIC
TOT BODY Fe
15-20%
STORED FORM
REST - COMPLEXED FAIR
80% Hb
+ Mb
CAPABLE
1 MTOC
SMART TEST
TOT Fe STORES
EQUILIBRIUM
CAN BE HIGHLY TOXIC

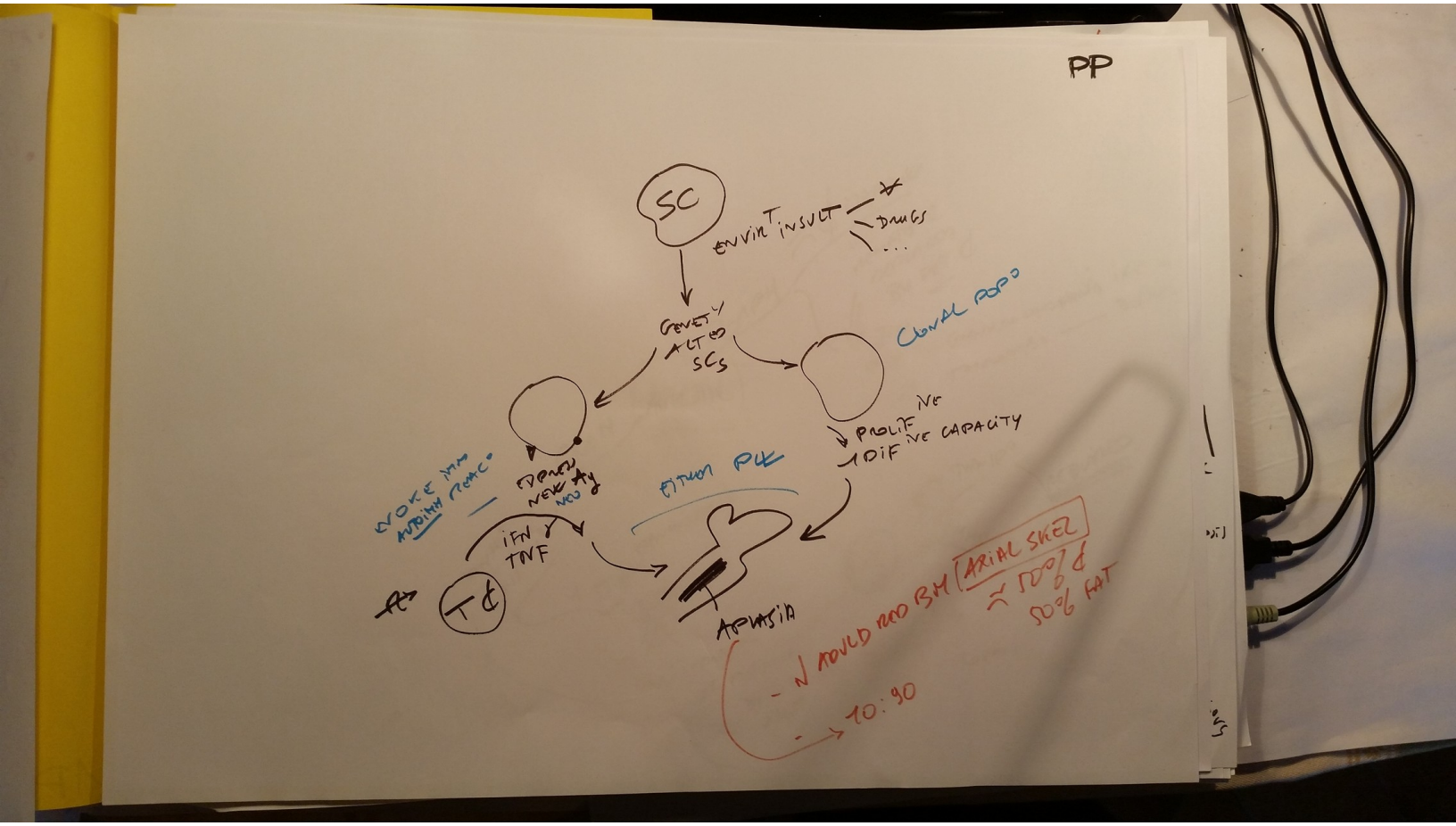

TC NOT DISORDER IN THE
DISTRIBUTION YOU'RE ABOUT
Fe 3+ FERRIC
Fe 2+ FERROUS
Mg
H2O2
POOL
TOT
FAL
MB 2100
MB 300
MB2 50
STORAGE
FERRITIN
HEMOSIDERIN 1000
MYOGLOBIN
DANS LE PLAN
O2
FIXA O2
SANS QUE LE
Fe S'OXYDE
3450
-1000
= 2450 FAL

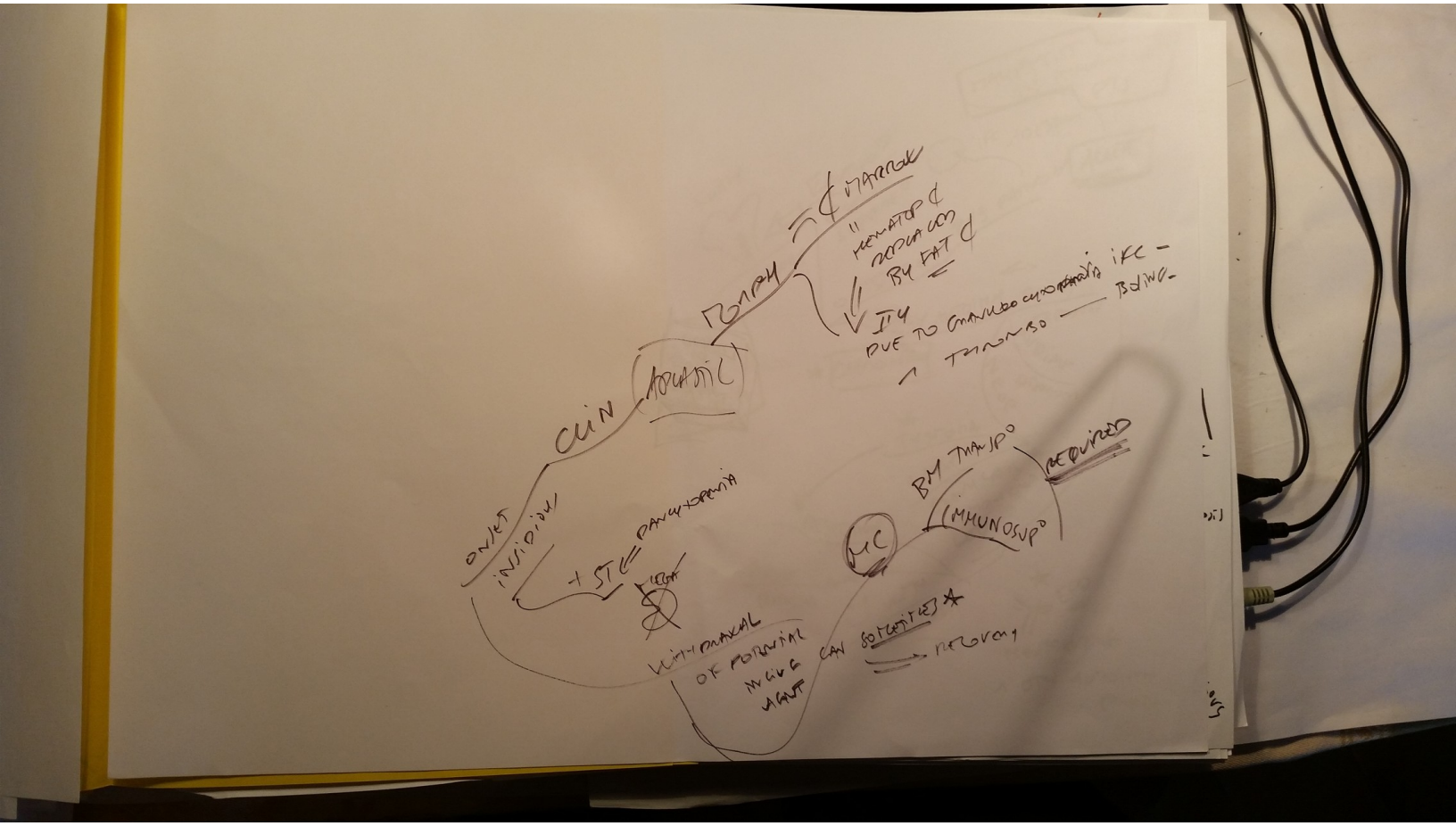

REGULATING ABSO DIET
DUOD
Fe 2+
HAEM IRON
DIRECTLY
20% IS ABSORBABLE
HAEM TRANSPORTER
DUOD CATIONS
Fe 3+
Fe 2+
FERROUS
ONLY 1-2% NON-HAEM Fe IS ABSORBED
LOST BY SHEDDING OF EPIT
HAEMOGLOBIN - SYN Fe OVERLOAD
ANAEMIA
RARE
HEPCIDIN ALSO
Fe RELEASE
TRAC Fe
FOOD Fe
MAPPING GUT ABSO Fe
LOST
HEPHAESTIN
MOBILISE STORED Fe
MUCOSAL FERRITIN
LOST
PLASMA TRANSFERRIN
BLOOD
HEPCIDIN
PLASMA
LIVER
REG
FERROPORTIN 1
ACTIVITY
FALL
REGULATED Fe ABSO
ERYTHROID MARROW
Fe STORES ON EPO
EPO
Fe TRANSPORT

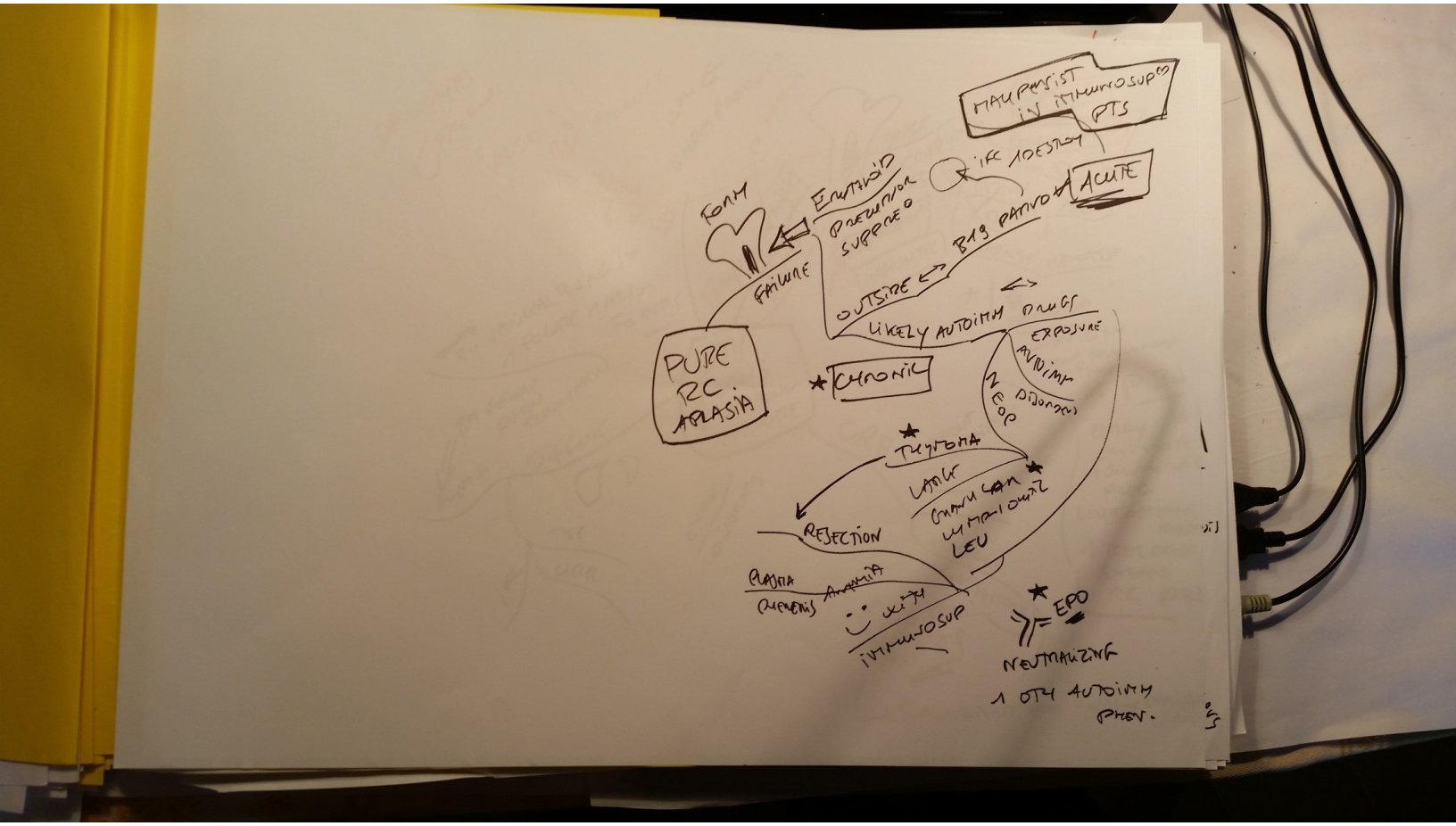

CHRONIC DISEASE
ANY DISEASE
IL6
HEPCIDIN
Fe EXPORT FROM DUOD
MAC
EPIT
EPO
ANEMIA
Se Fe LOW
INTERMITTAN
NFE
REMEMBER
BUT ABUNDANT STAINABLE
HEMOSIDERIN
IN MARROW !
BUT N Fe STORES
THALAS
TEST
Fe DEFIC
UNDERLYING CAUSE

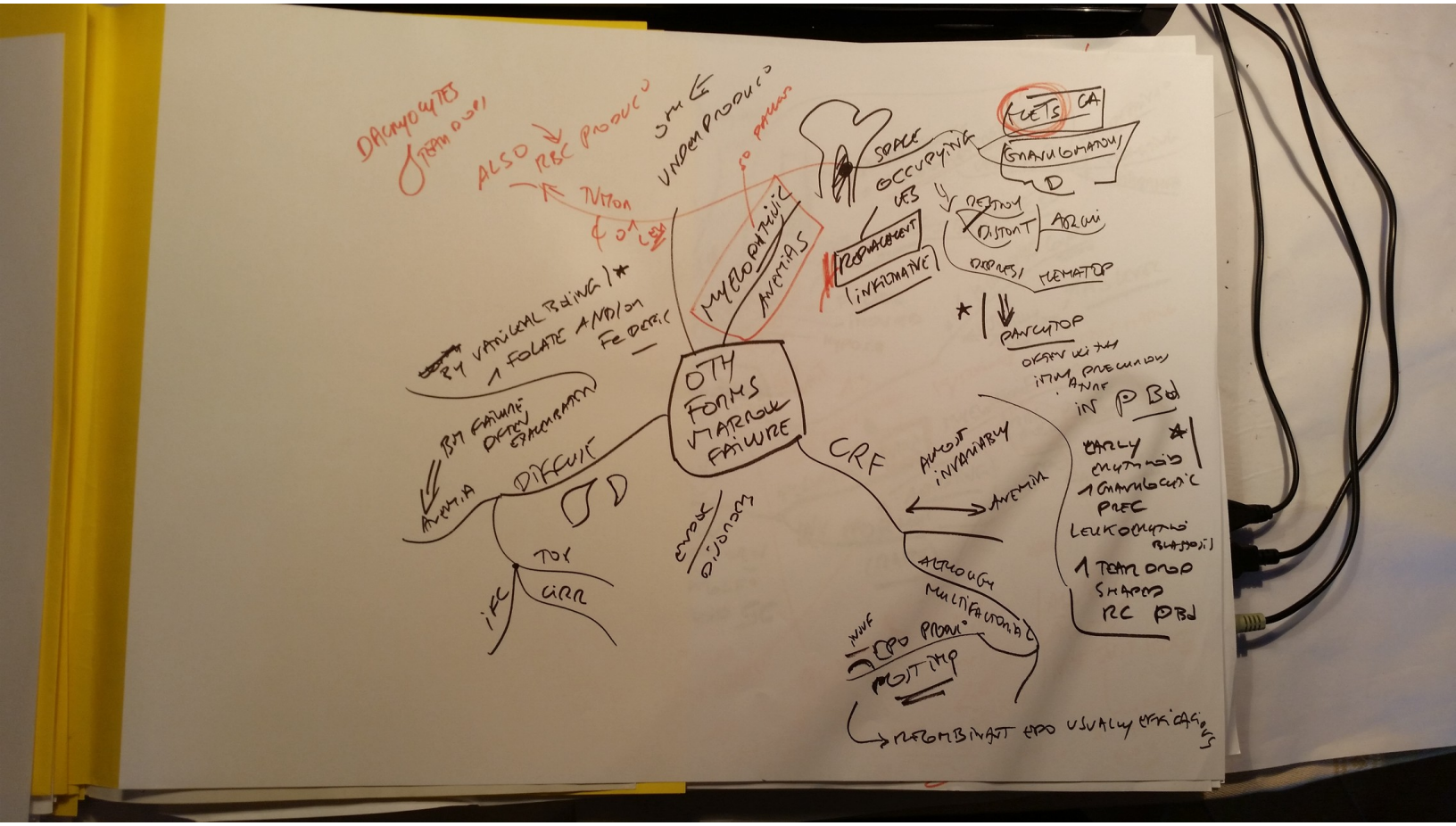

APLASTIC
PANCYTOPENIA
ALL LINEAGES
SCFAILURE
SOME
60%
IDIOP
ACQ SC DEFECTS
IMM MED
ACQ
APLASTIC
CHEM
TOXINS
DRUGS / CHEM
MCC II APLASTIC
TOXIC EXPOSURES
IDIOSYNC
DRUGS
DOSE
RELATED
PREDICTABLE
INSECTICIDES
BENZENE
ORG ARS
MOST
DRUGS
ONLY TNT
EXPOSED
INDIVIDUAL
IN UNPREDICTABLE
MANNER
CHLORAMPHENICOL
ARSENICALS


APLASTIC
PHYS
CHEM
ACQ
INH
CONG
TOXIC EXPOSURES
FANCONI
SD
HEP
HIV
EBV
CMV
PARVO
HC
NONA
NONB
NONC
NONG
HEPATITIS
MOST
DRUGS
BENZENE
CHLORAMPHENICOL
ANTIBIOT
INSECTICIDES
PENICILLAMINE
CARBAMAZEPINE
ONG ARS
GOLD SALTS
IDIOSYNC
PANCYTOPENIA
ALL LINEAGES
SCID
SOME
IDIOP
MCC II APLASTIC
DOSE
RELATED
PARTIAL
TRANSIENT
APLASTIC
MARROW

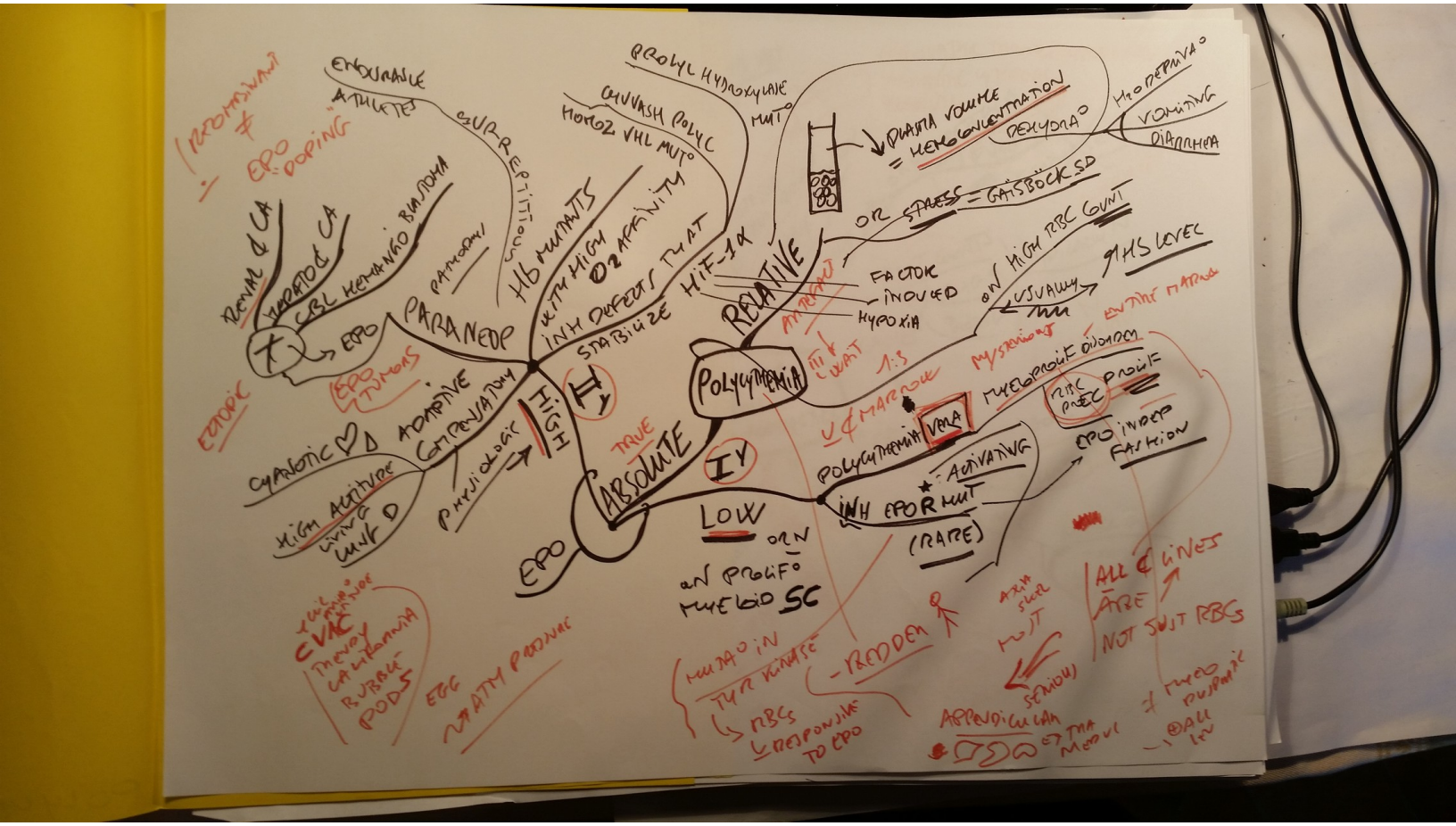

PP
SC
ENVIR T INSULT
DRUGS
...
GENETICALLY ALTERED SCs
CLONAL POP°
PROLIFERATIVE CAPACITY
DIFFERENTIATION
IFN γ
TNF
APOPTOSIS
- N WOULD ROD BM
ARIAL SKEL
≃ 100 d
50% FAT
- → 10:90

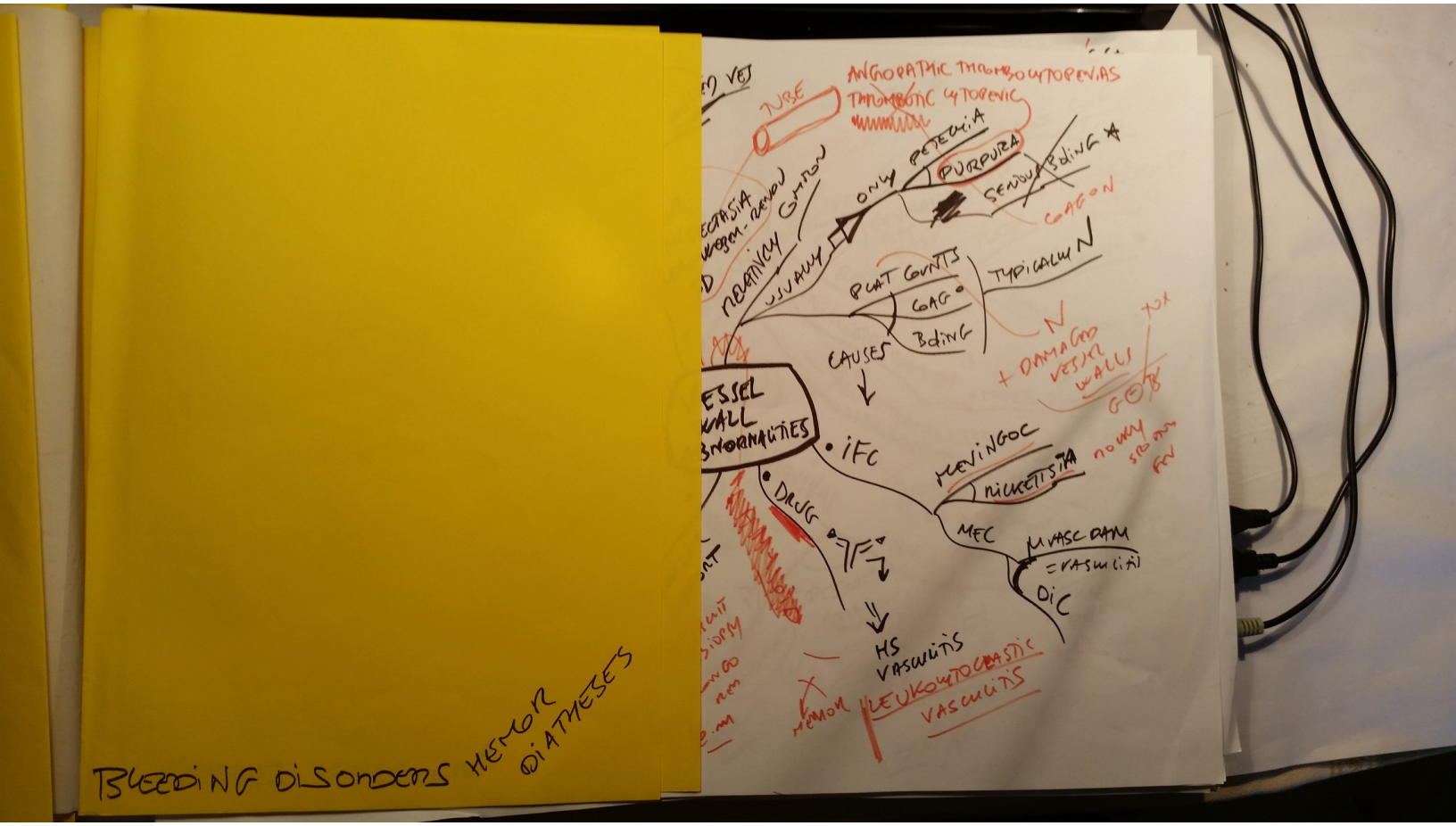


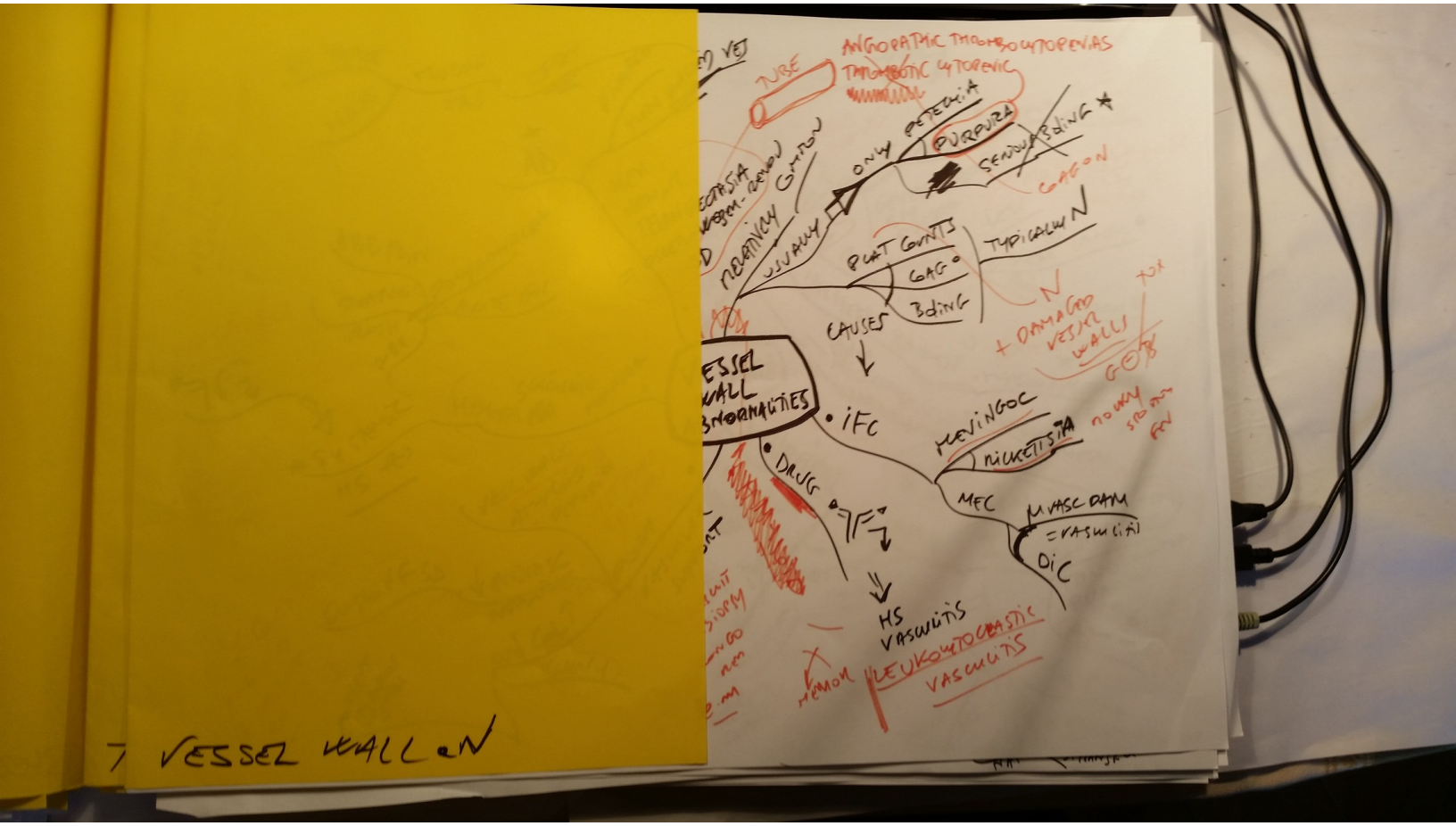

MAY PERSIST IN IMMUNOSUPPTS
IF NO RESPONSE
ACUTE
BIG PARVO
OUTSIDE
LIKELY AUTOIMM DRUGS
EXPOSURE
AUTOIMM
DISORDERS
NEOP
CHRONIC
PURE RC APLASIA
FAILURE
ERYTHROID PRECURSOR SUPPRESSION
THYMOMA
LOSS
GRAM CAN LYMPHOMA LEU
REJECTION
PLASMA CYTOPENIAS
ANAEMIA
IMMUNOSUP
EPO
NEUTRALIZING
1 OTH AUTOIMM PHEN.

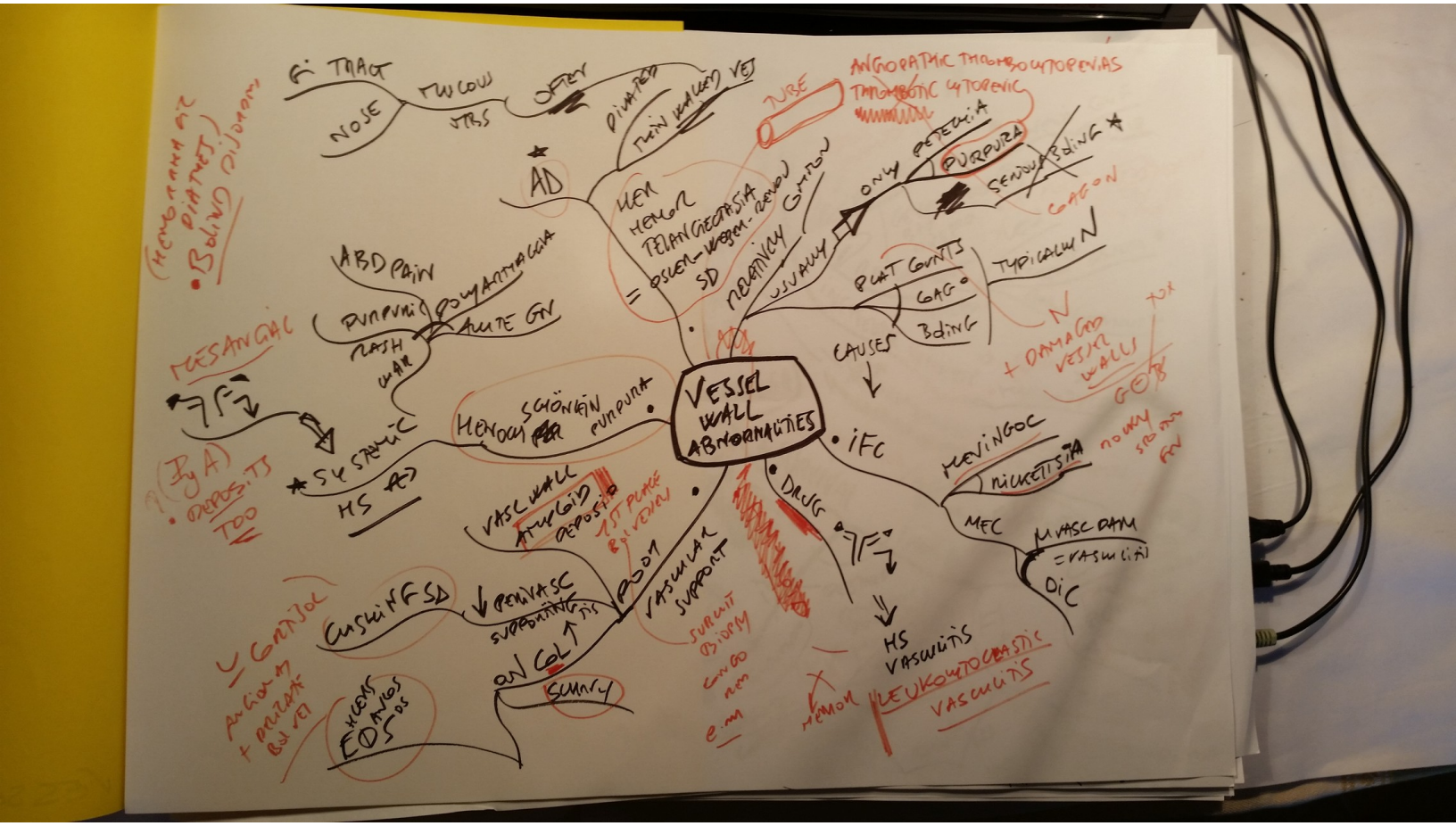

OTH
FORMS
MARROW
FAILURE
MYELOPHTHIC
ANEMIAS
DIFFUSE
CRF
ANEMIA
TOX
CIRR
ALSO
RBC PRODUC
UNDERPRODUC
SPACE
OCCUPYING
LES
REPLACEMENT
INFILTRATIVE
GRANULOMATOUS
D
DISTANT
ARCHI
PARACRINE
EARLY
GRANULOCYTIC
PREC
LEUKOCYTOSIS
1 TEMP ORTHO
SHARED
RC PBd
ALTHOUGH
MULTIFACTORIAL
EPO PROBL°
POSITIVE
RECOMBINANT EPO USUALLY EFFICACIOUS

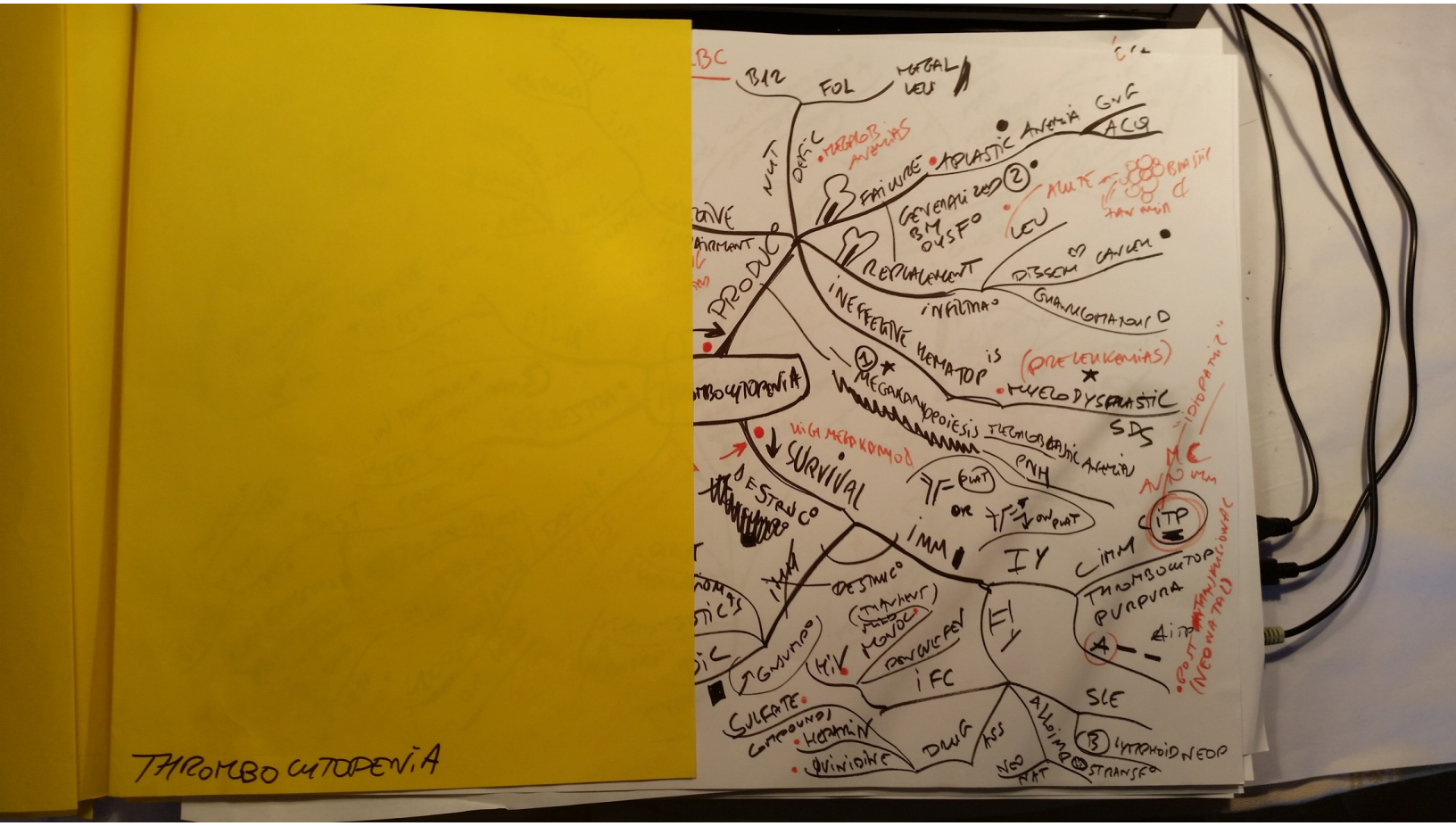
POLYCYTHEMIA
PLASMA VOLUME
= HEMOCONCENTRATION
DEHYDRA°
HYPOTENSIVE°
VOMITING
DIARRHEA
OR STRESS = GAISBOCK SD
FACTOR
INDUCED
HYPOXIA
RELATIVE
HIGH RBC COUNT
USUALLY
Hb LEVEL
1:3
MYSTERIOUS
ERYTHROPOIETIC DISORDER
RBC PRECURSOR
POLYCYTHEMIA VERA
ACTIVATING
INH EPOR MUT
(RARE)
EPO INDEP FASHION
ORN
SC
-RBDDEN
ALL LINES
ARE
NOT SUIT RBCs
RBCs
RESPONSIVE
TO EPO
APPENDICULAR
SEVERE
ERYTHROPOIETIC
DISORDER
ALL IN

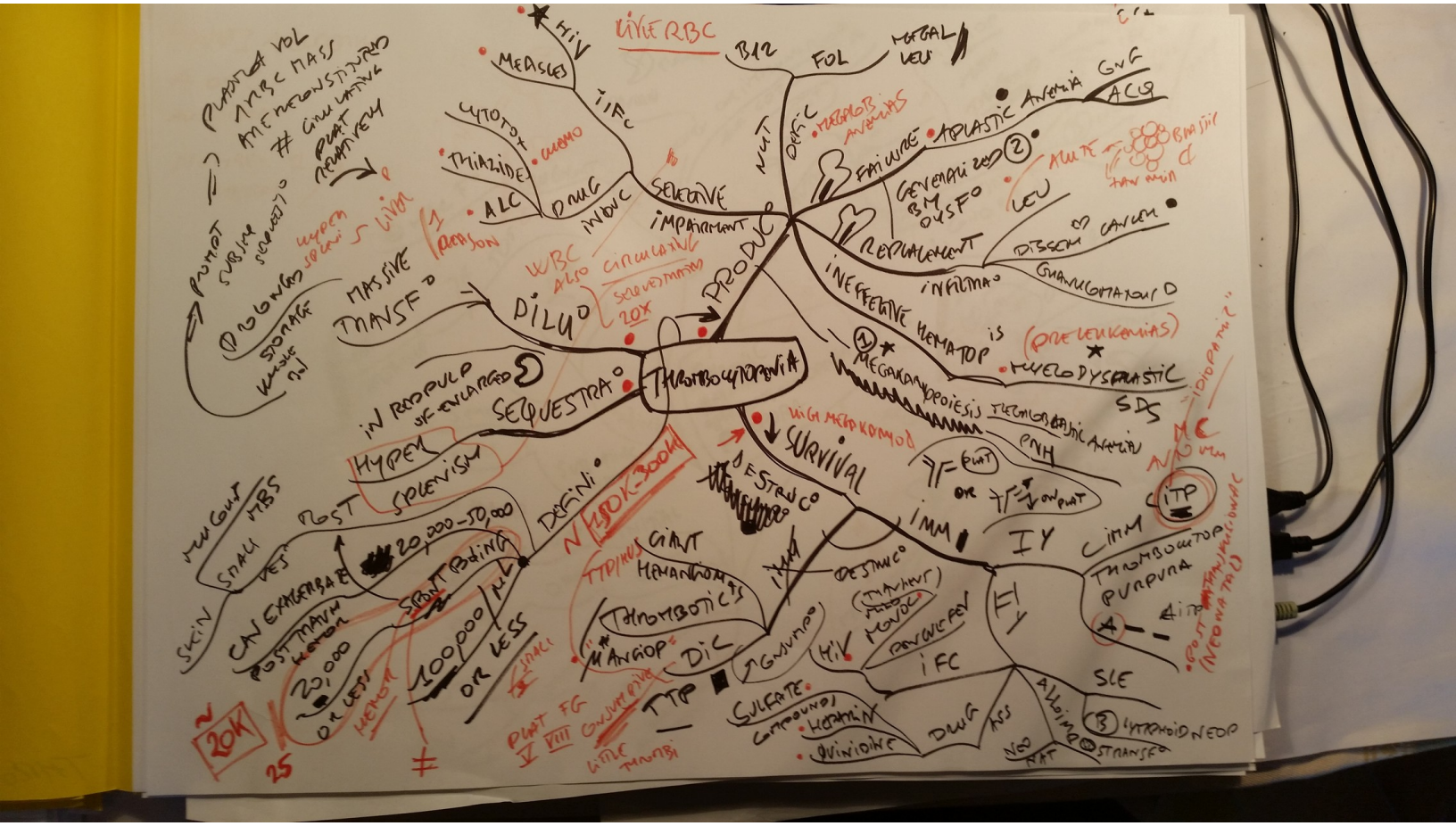

ERYTHROPOIETIN
ERYTHROPOIESIS
POLYCYTHAEMIA
RELATIVE
ABSOLUTE
PARANEOP
EPO
HIF-1α
VHL
PROLYL HYDROXYLASE
CHUVASH POLYC
HOMOZ VHL MUT°
HB MUTANTS
WITH HIGH O2 AFFINITY
INH DEFECTS THAT
STABILIZE HIF-1α
ERYTHROPOIETIN
ENDOGENOUS
ATHLETES
SUPRAPHYSIOLOGIC
RENAL & CA
HEPATOC CA
CBL HEMANGIO
RAMOSIS
ECTOPIC
EPO TUMORS
ADAPTIVE COMPENSATORY
PHYSIOLOGIC
HIGH
CYANOTIC
HIGH ALTITUDE
LIVING
LIVE
PLASMA VOLUME
= HAEMOCONCENTRATION
DEHYDRA°
DIARRHOEA
VOMITING
OR STRESS = GAISBÖCK SD
FACTOR
INDUCED
HYPOXIA
ON HIGH RBC CONT
USUALLY
HS LOVEC
ENTIRE MARROW
MYELOPROLIF DISORDER
RBC PROLIF
EPO INDEP FASHION
POLYCYTHAEMIA VERA
ACTIVATING
INH EPOR MUT
(RARE)
LOW
ON PROLIF° MYELOID SC
CVAC
MEMORY CALISTHENICS
RUBBLE PODS
ECG
ALL LINES
ARE
NOT JUST RBCS
APPENDICULAR
SKELETAL MUSCLE
ALL IN

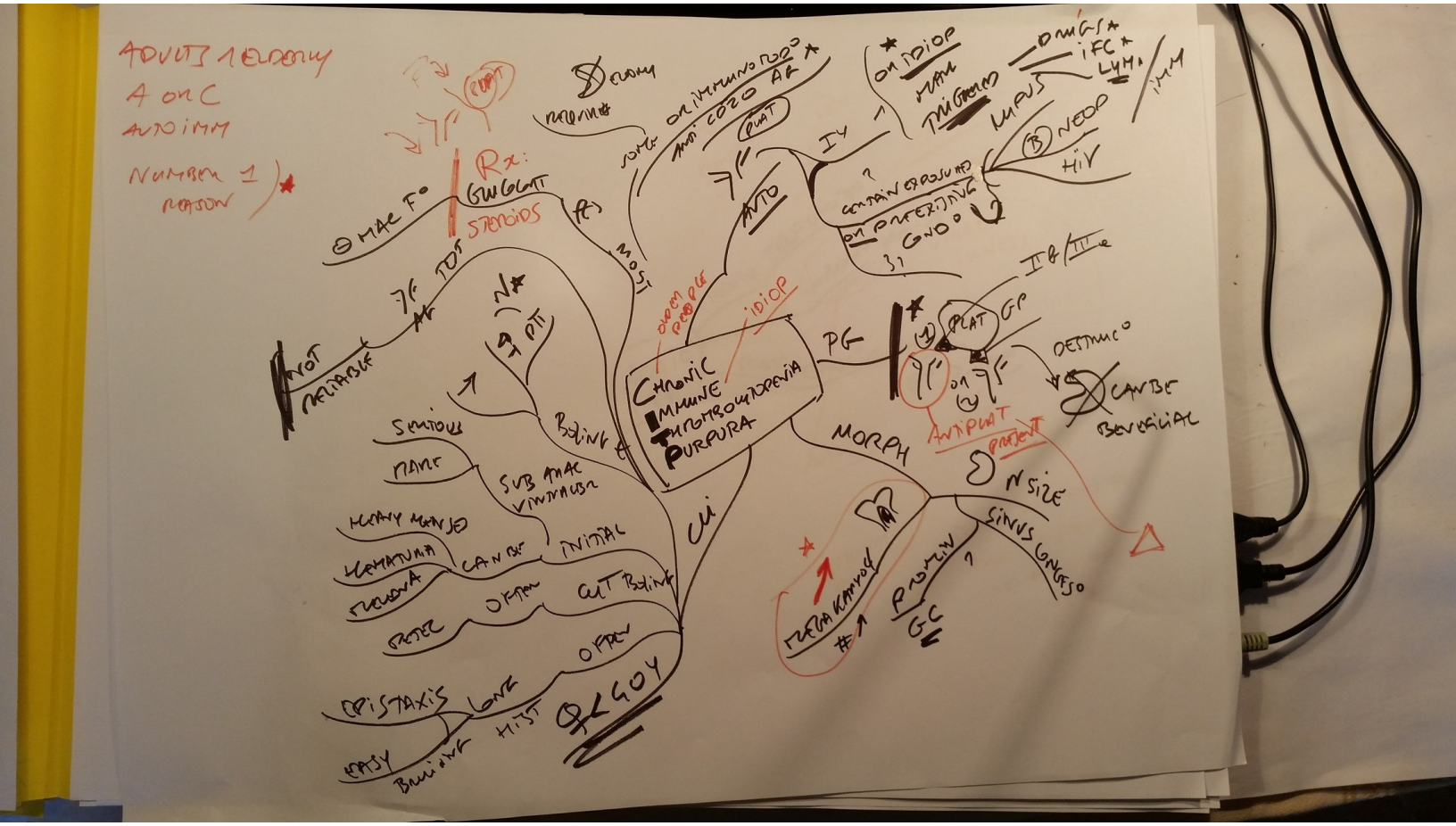

BLEEDING DISORDERS HEMOR DIATHESES
ANGIOPATHIC THROMBOCYTOPENIAS
THROMBOTIC CYTOPENIC
PETECHIA
PURPURA
USUALLY
CAUSES
iFC
DRUG
MENINGOC
MEC
DIC
HS VASCULITIS
LEUKOCYTOCLASTIC VASCULITIS

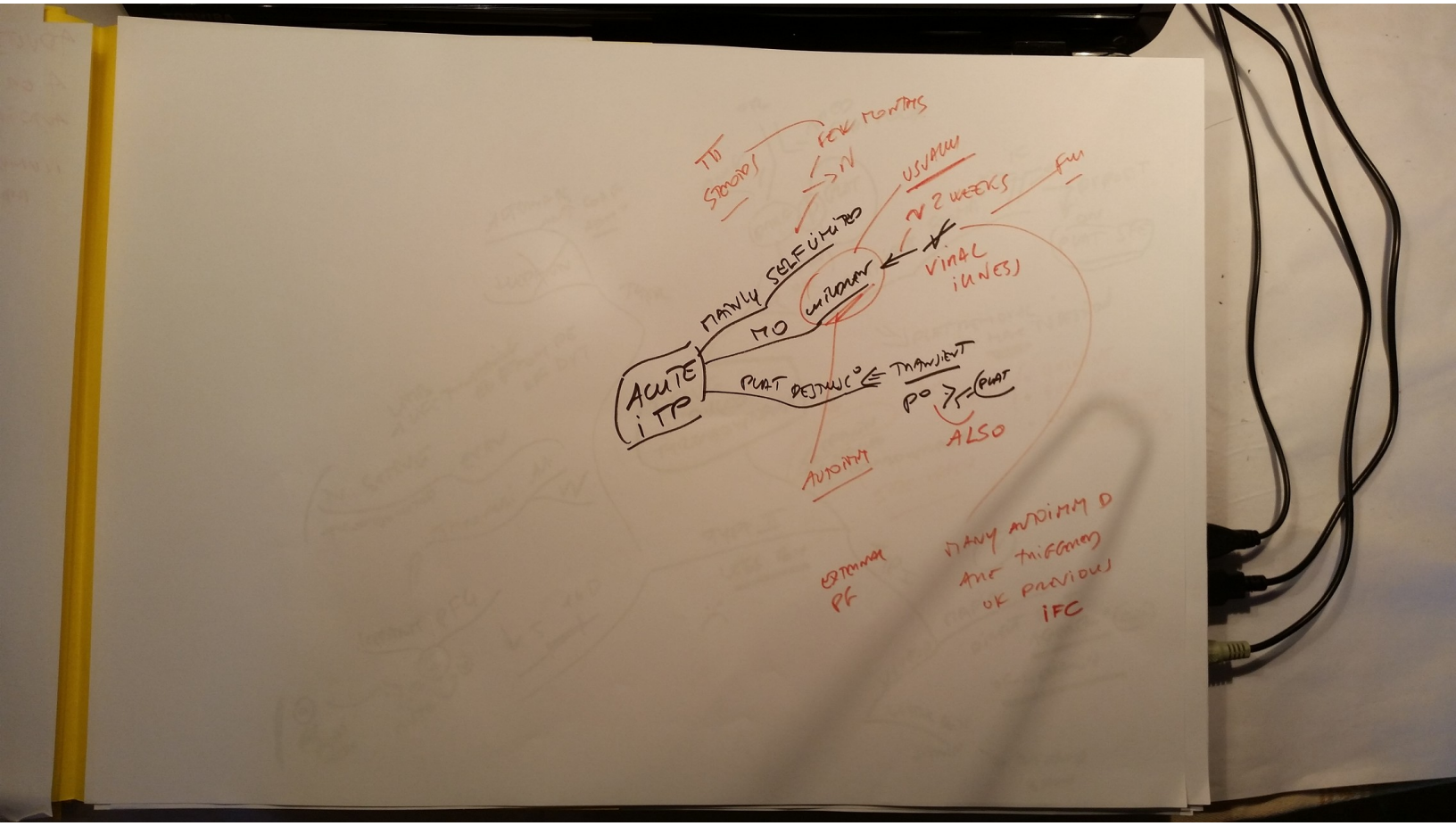

7 VESSEL WALL
ANGIOPATHIC THROMBOCYTOPENIAS
PURPURA
CAUSES
iFC
DRUG
HS VASCULITIS
LEUKOCYTOCLASTIC VASCULITIS
DIC

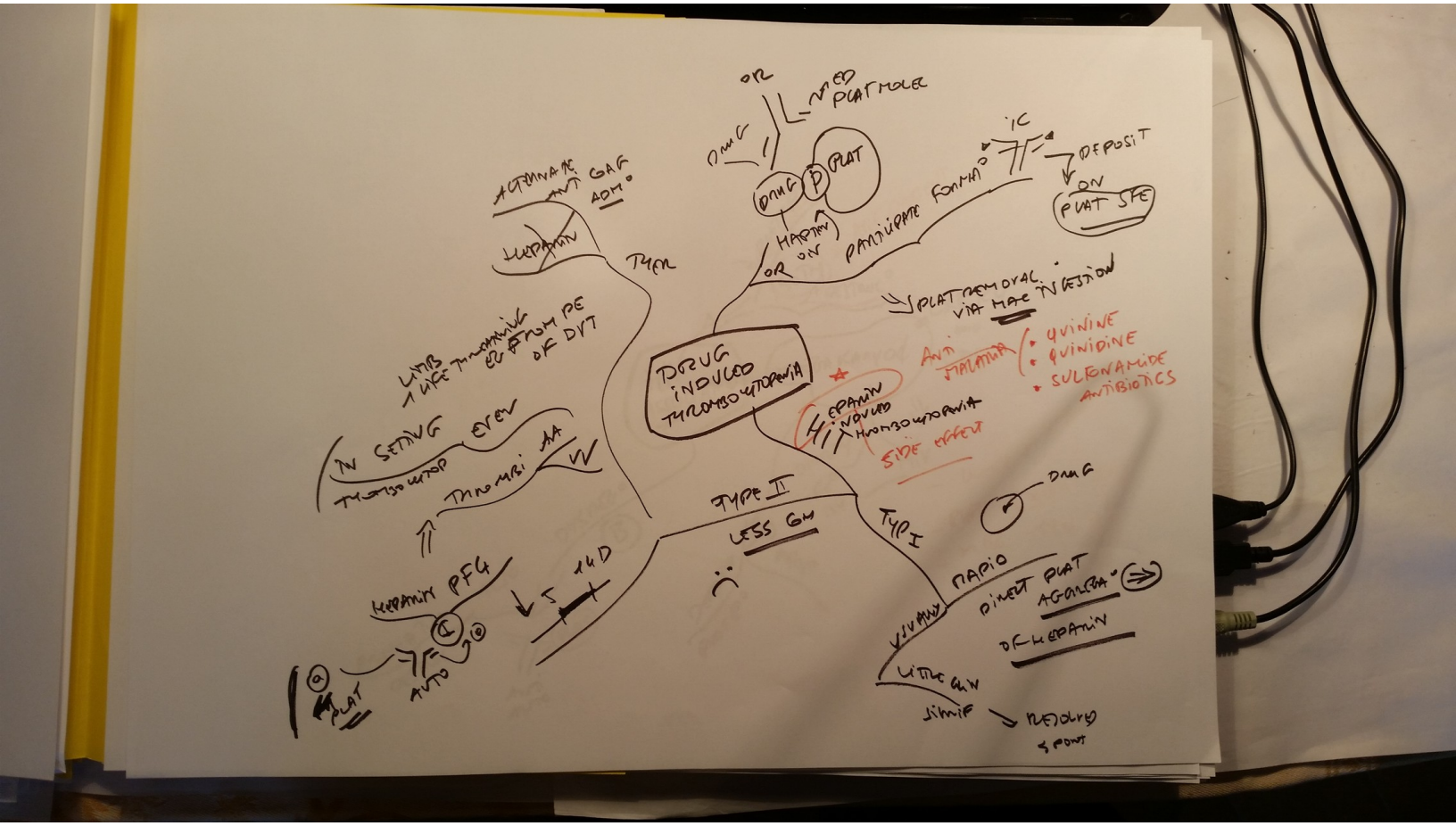

VESSEL WALL ABNORMALITIES
GI TRACT
NOSE
AD
ABD PAIN
PURPURA
HS
SYSTEMIC
VASCULAR SUPPORT
CAUSES
iFC
DRUGS
HS VASCULITIS
LEUKOCYTOCLASTIC VASCULITIS
DIC
MFC
PURPURA
CAGON
BdING
TYPICALLY
N
+ DAMAGED VESSEL WALLS
NICKETTSIA
HEVINGOC
SCHÖNLEIN PURPURA
VASC WALL ATH/GID DEPOSITS
CUSHINGS
ANGIOPATHIC THROMBOCYTOPENIAS
THROMBOTIC CYTOPENIC
PETECHIA
SENILE PURPURA
HEMORRHAGIC
SYSTEMIC
HS
ON CCL
SCURVY
ECCHYMOSES
DIABETES
BdING DISORDER
ANGIOMA
+ PRICKLY HEAT
DURE
TWIN (scalloped) VEJ
ONLY
USUALLY
NEGATIVE
SD
= OSLER-WEBER-RENDU
ACUTE GN
RASH
CHAR
POLYARTHRALGIA
PURPURA
ABD Pain
NOSE
MOUTH
GUMS
OESOPH
STOMACH
INTS
COLON
RECTUM
ANUS
VASCULITIS
N
NOT
GOOD
NO HX SUGGESTIVE OF
SURGERY
BLEEDING
CANCER
EMBOLISM
PLATELETS
TOO
LOW
(HyA)
DEPOSITS
1ST PLACE
REVERSAL
SUBCUT
BLEEDING
CANCER
EMBOLISM

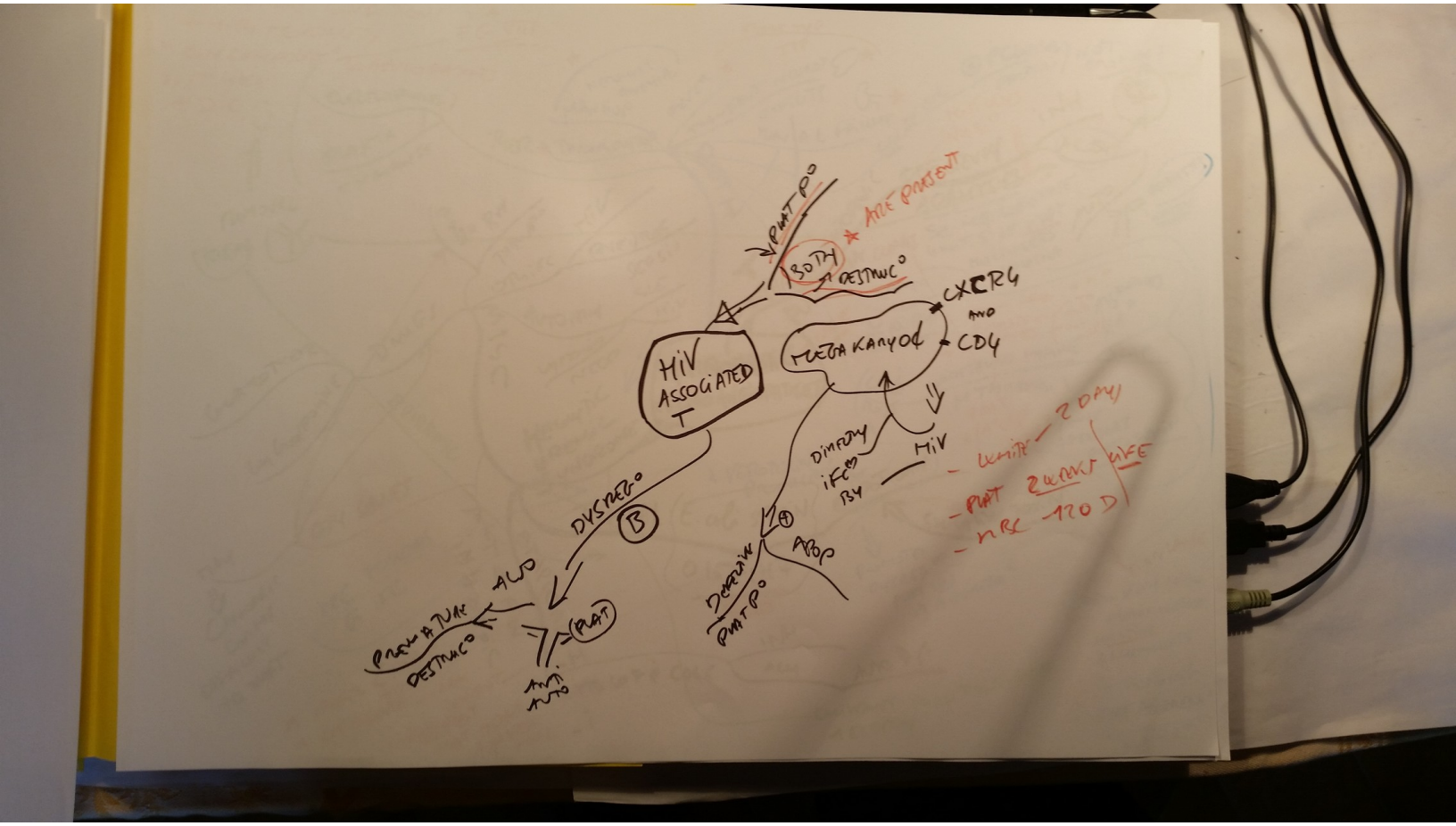

THROMBOCYTOPENIA
B12
FOL
MEGAL
PRODUC
SURVIVAL
DESTRUC
IMM
THROMBOCYTOPURPURA
SLE
DRUG
HIV
PREGNANCY
SULFATE
HEPARIN
QUINIDINE
ACS
ALLOIMM
ITP
PNH
MYELODYSPLASTIC
SDS
PRE LEUKEMIAS
INEFFECTIVE HEMATOP
REPLACEMENT
INFILTRAT
APLASTIC ANEMIA
FAILURE
ACUTE LEU
CHRONIC LEU
DISEASE OF CANCER
MEGAKARYOPOIESIS
TIGHT MICROKOMOD

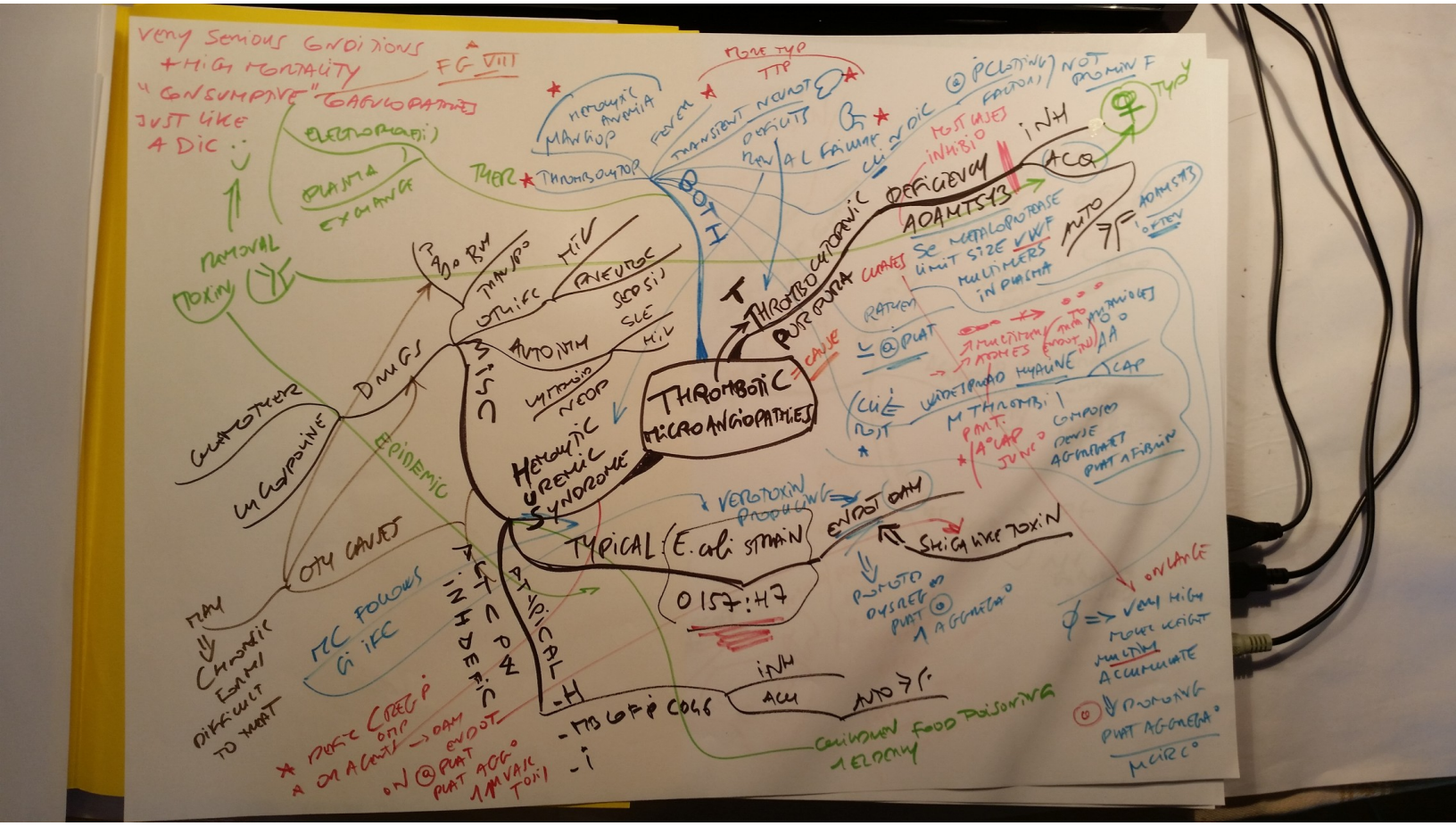

THROMBOCYTOPENIA
PRODUC
DILU
SEQUESTRA
SURVIVAL
IMM
IY
CIMM
CITP
SLE
DIC
TTP
HIV
B12
FOL
MEASLES
CHEMO
ALC
DRUG
SELECTIVE
IMPAIRMENT
APLASTIC ANEMIA
ACQ
INEFFECTIVE HEMATOP
MEGAKARYOPOIESIS
MYELODYSPLASTIC
SDS
MASSIVE TRANSF
HYPERSPLENISM
GIANT HEMANGIOMAS
THROMBOTICS
SULFATE
HEPARIN
QUININE
ALLOIM
THROMBOCYTOPENIA PURPURA
SMALL VES
20,000-30,000
100,000 OR LESS
20K
25

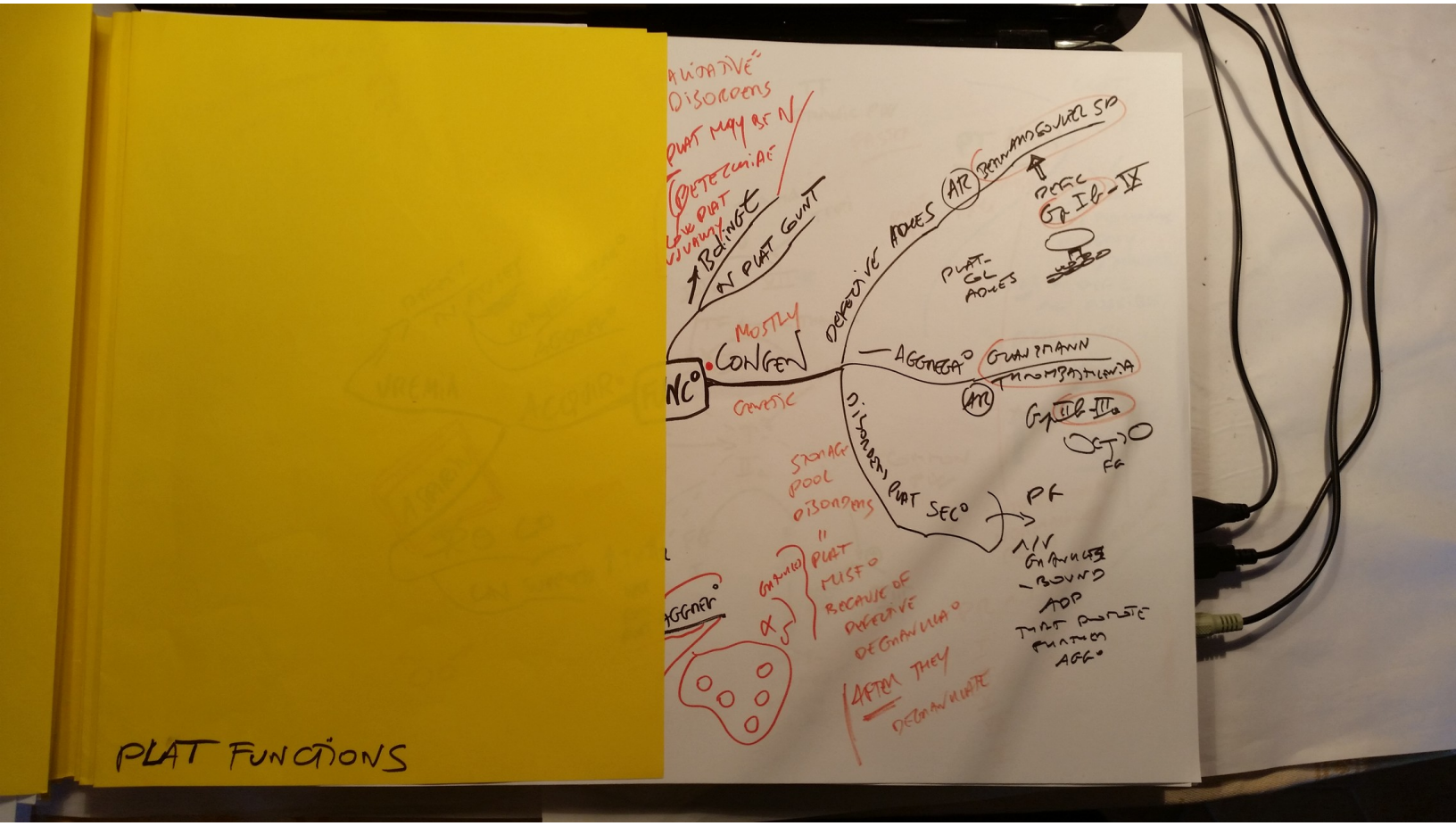

ADULT THROMBOCYTOPENIA
ACUTE
CHRONIC
AUTOIMM
NUMBER 1
REASON
Rx:
STEROIDS
CHRONIC IMMUNE THROMBOCYTOPENIA PURPURA
IDIOP
PG
SPLAT
MORPH
SPLENECTOMY
SPLENIC SIZE
SINUS CANCER
PROGRESSION
GC
EPISTAXIS
HIST
BLEEDING
INITIAL
CAN BE BENEFICIAL

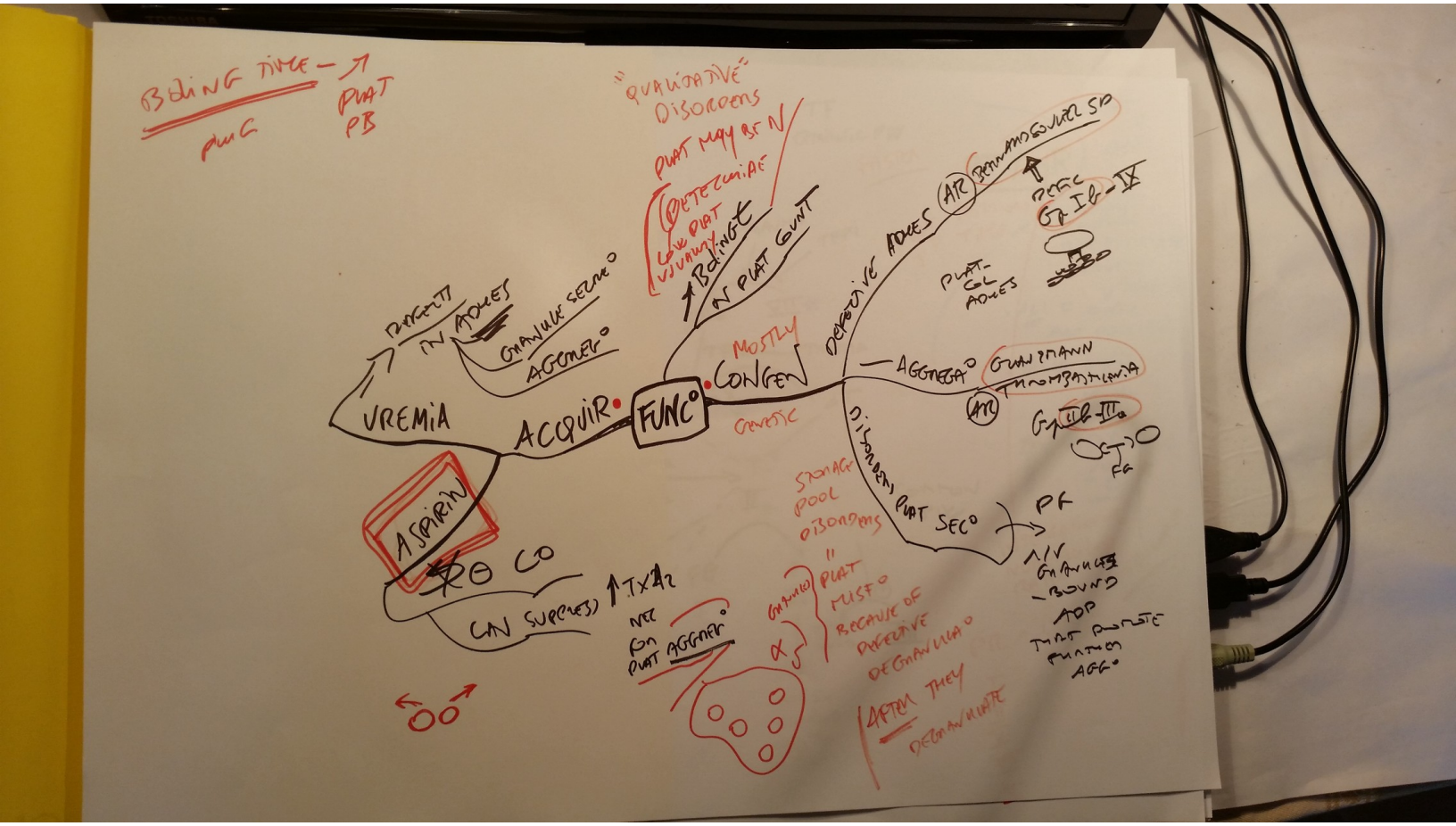

TD
FEW MONTHS
USUALLY
2 WEEKS
VIRAL
ILLNESS
MANY SELF LIMITED
MD
CHRONIC
ACUTE
ITP
PLAT DEFICIT
TRANSIENT
PO
PLAT
ALSO
AUTOIMM
MANY AUTOIMM D
ARE TRIGGERED
OR PREVIOUS
IFC

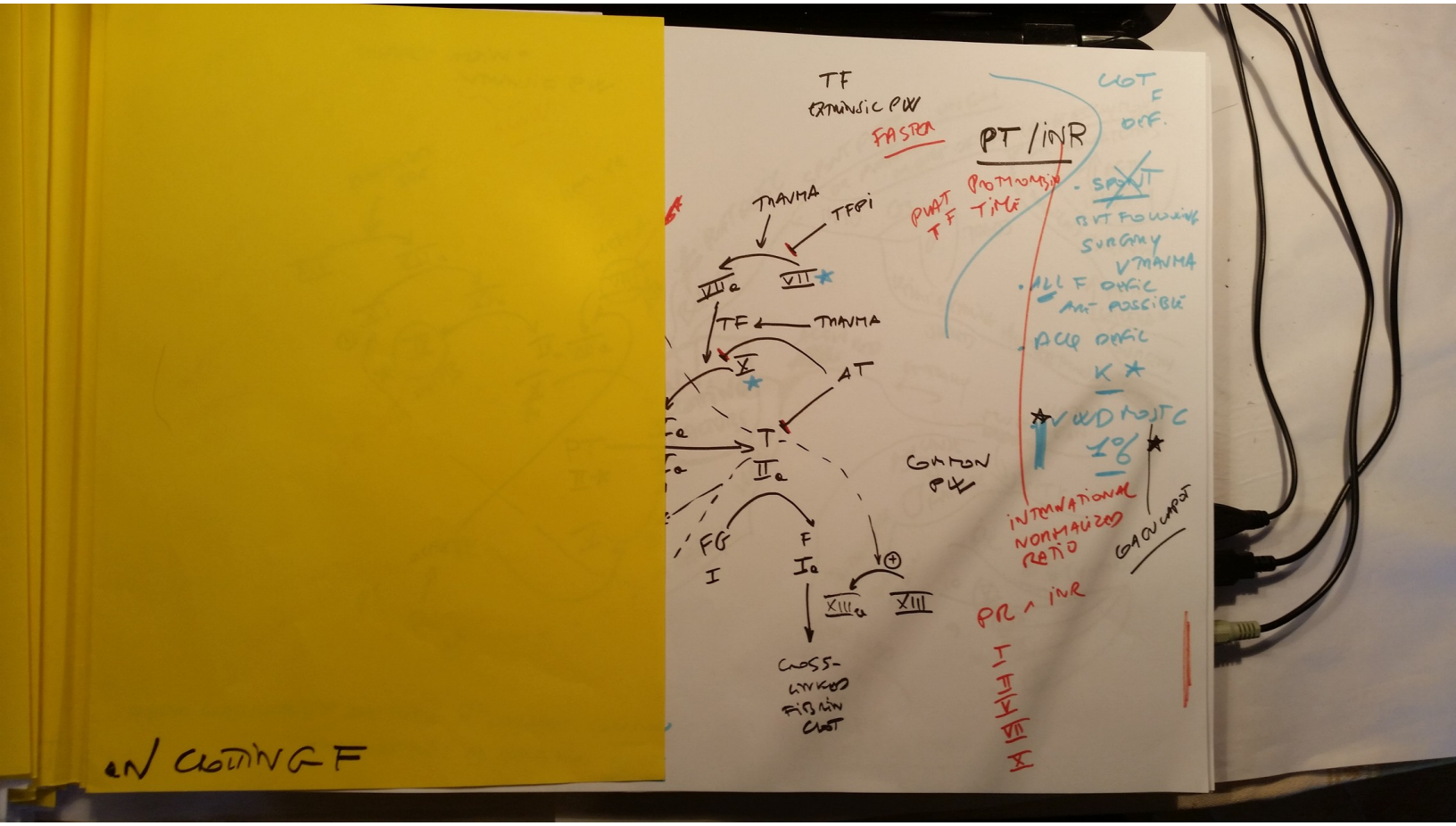

DRUG INDUCED THROMBOCYTOPENIA
TYPE II
LESS COMMON
TYPE I
HEPARIN INDUCED THROMBOCYTOPENIA
SIDE EFFECT
ANTI MALARIA
QUININE
QUINIDINE
SULFONAMIDE ANTIBIOTICS
DRUG
PLAT
DRUG
PLAT
OR
DRUG
PLAT MOLEC
DEPOSIT ON PLAT SPE
PLAT REMOVAL VIA MAC INGESTION
HEPARIN
ANTI GAG ADM°
TYPE
HEPARIN PFG
PLAT
ANTI
14D
RAPID
DIRECT PLAT AGGREG°
OF HEPARIN
VIVO
LITTLE CLIN SIGNIF
PLATELET COUNT

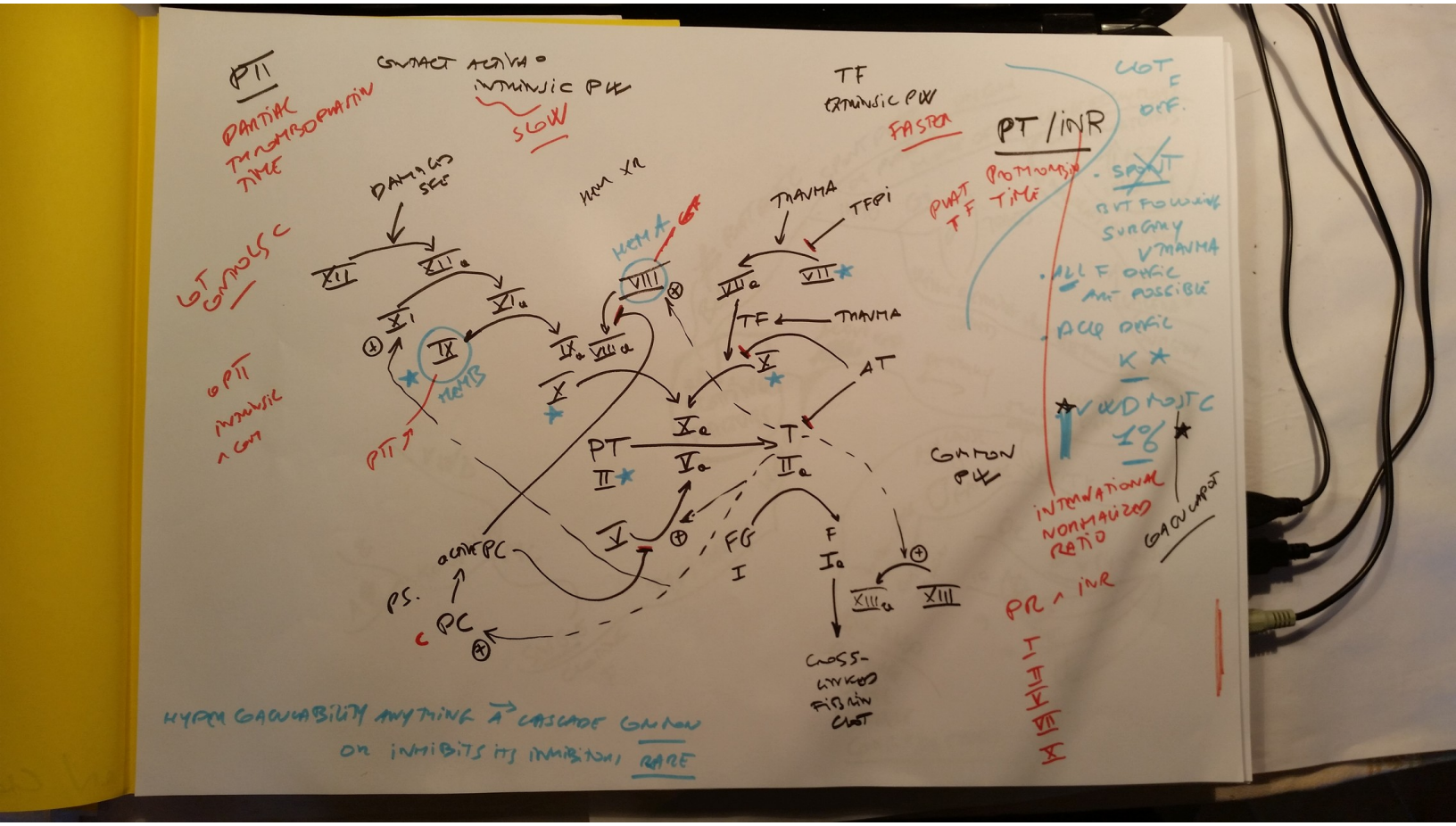

HIV ASSOCIATED T
CXCR4 AND CD4
DYSREG°
B
ABOP

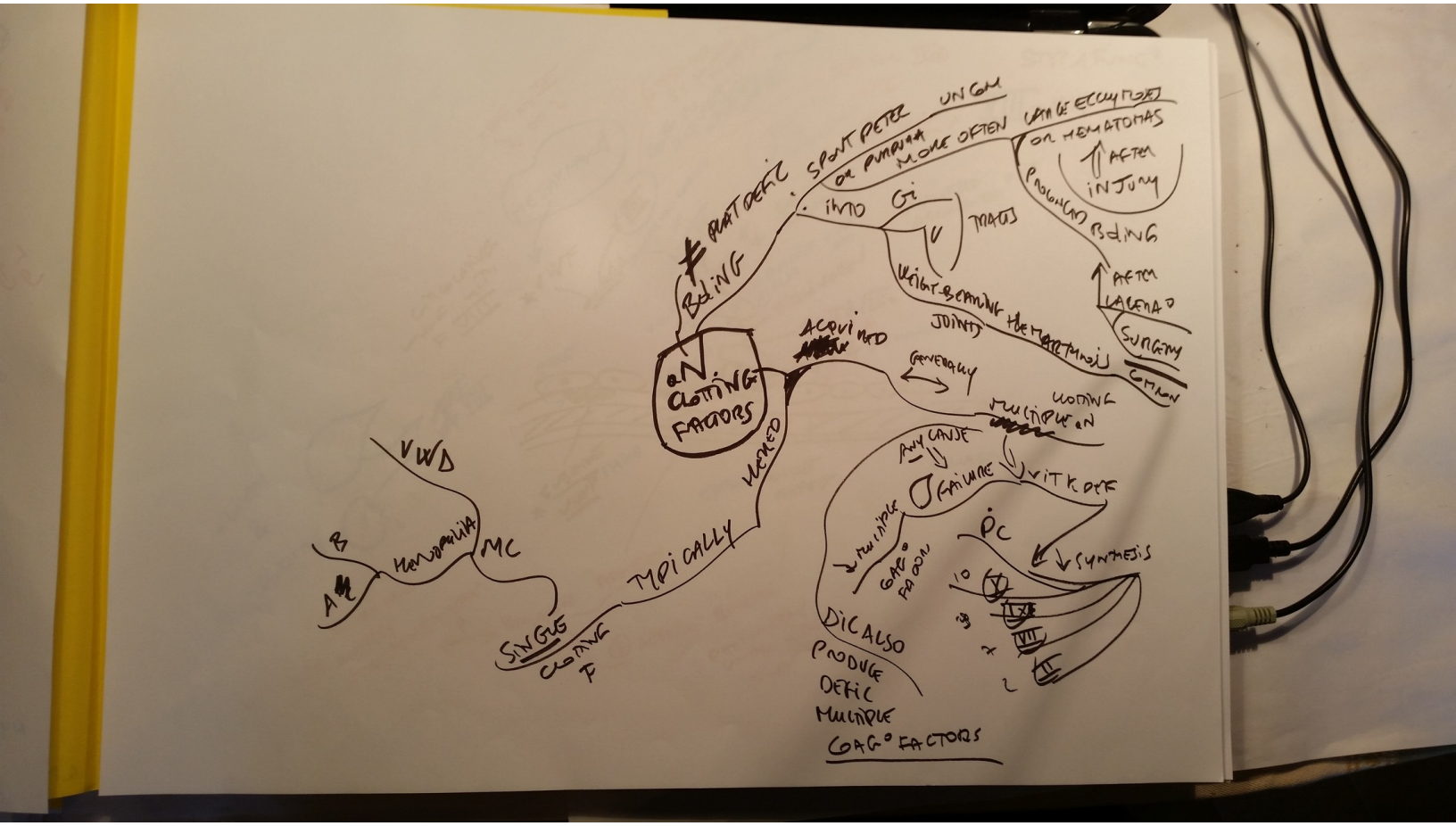

THROMBOTIC MICROANGIOPATHIES
HEMOLYTIC UREMIC SYNDROME
TYPICAL
E.coli STRAIN
0157:H7
SHIGA LIKE TOXIN
ATYPICAL
DRUGS
PREGNANCY
PURPURA
THROMBOCYTOPENIC
ADAMTS13
TTP
HIV
SLE
ANTIPH
ACQ
INH
AUTO
DIARRHEA
EPIDEMIC
VERO TOXIN PRODUCING
ENTEROHEMORRHAGIC
FOOD POISONING
CHEMOTHER
CYCLOSPORINE
MITOMYCIN
PLASMA EXCHANGE
REMOVAL TOXIN
VERY SERIOUS CONDITIONS
HIGH MORTALITY
"CONSUMPTIVE" COAGULOPATHIES
JUST LIKE A DIC
FACTOR VIII
HEMOLYTIC ANEMIA
THROMBOCYTOPENIA
FEVER
TRANSIENT NEURO DEFICITS
RENAL FAILURE
MORE TYP TTP
PLATELETS
MOST USED INHIBITOR
CLINICAL DIC
RATHER
CAUSE
CURES
SEVERE
LIMIT SIZE VWF MULTIMERS IN PLASMA
MULTIMERS
MICRO
ACCUMULATE
PLATELET AGGREGATES
ORGANS
CAP
MTHROMBI
PMT
ACAP
SVVC
DENSE AGGREGATES
PLAT FIBRIN
ENTEROT DAM
PLASTO DYSREG
PLAT AGGREGATES
ORGANS
VERY HIGH MOLECULAR WEIGHT
MULTIM
ACCUMULATE
PLATELET AGGREGATES
MICRO
CAUSE FOOD POISONING
DIARRHEA
-H
-TMB GPIb COLG
ACH
AUTO
-I
ON PLAT ACG
PLAT AGGREGATES
ON LARGE
ENDOT DAM
PLAT ACG
1 AGGREGATES
1 ADHESIVE
TOXI
ACTIVATION
INHIBITION
ETIOLOGY
OTH CAUSES
RTX FOLLOWS
CHRONIC FORM
DIFFICULT TO TREAT
PLASMA EXCHANGE
ELECTROPHORESIS
TYPE
THROMBOCYTOP
BOTH
TYP
ACQ
AUTO
ADAMTS13
SECOSIS
SLE
HIV
TRANSPO
OTH IFC
TRANSPO
OTH IFC
PAPO BM
NEOP
AUTOIMM
SYSTEMIC
DRUGS
CHEMOTHER
CYCLOSPORINE
REMOVAL TOXIN
PLASMA EXCHANGE
ELECTROPHORESIS
VERY SERIOUS CONDITIONS
+HIGH MORTALITY
"CONSUMPTIVE" COAGULOPATHIES
JUST LIKE A DIC
FACTOR VIII
HEMOLYTIC ANEMIA
MARROP
FEVER
TRANSIENT NEURO DEFICITS
RENAL FAILURE
MORE TYP TTP
PLATELETS
MOST USED INHIBITOR
CLINICAL DIC
RATHER
CAUSE
CURES
SEVERE
LIMIT SIZE VWF MULTIMERS IN PLASMA
MULTIMERS
MICRO
ACCUMULATE
PLATELET AGGREGATES
ORGANS
CAP
MTHROMBI
PMT
ACAP
SVVC
DENSE AGGREGATES
PLAT FIBRIN
ENTEROT DAM
PLASTO DYSREG
PLAT AGGREGATES
ORGANS
VERY HIGH MOLECULAR WEIGHT
MULTIM
ACCUMULATE
PLATELET AGGREGATES
MICRO
CAUSE FOOD POISONING
DIARRHEA
-H
-TMB GPIb COLG
ACH
AUTO
-I
ON PLAT ACG
PLAT AGGREGATES
ON LARGE
ENDOT DAM
PLAT ACG
1 AGGREGATES
1 ADHESIVE
TOXI
ACTIVATION
INHIBITION
ETIOLOGY
OTH CAUSES
RTX FOLLOWS
CHRONIC FORM
DIFFICULT TO TREAT
PLASMA EXCHANGE
ELECTROPHORESIS
TYPE
THROMBOCYTOP
BOTH
TYP
ACQ
AUTO
ADAMTS13
SECOSIS
SLE
HIV
TRANSPO
OTH IFC
TRANSPO
OTH IFC
PAPO BM
NEOP
AUTOIMM
SYSTEMIC
DRUGS
CHEMOTHER
CYCLOSPORINE
REMOVAL TOXIN

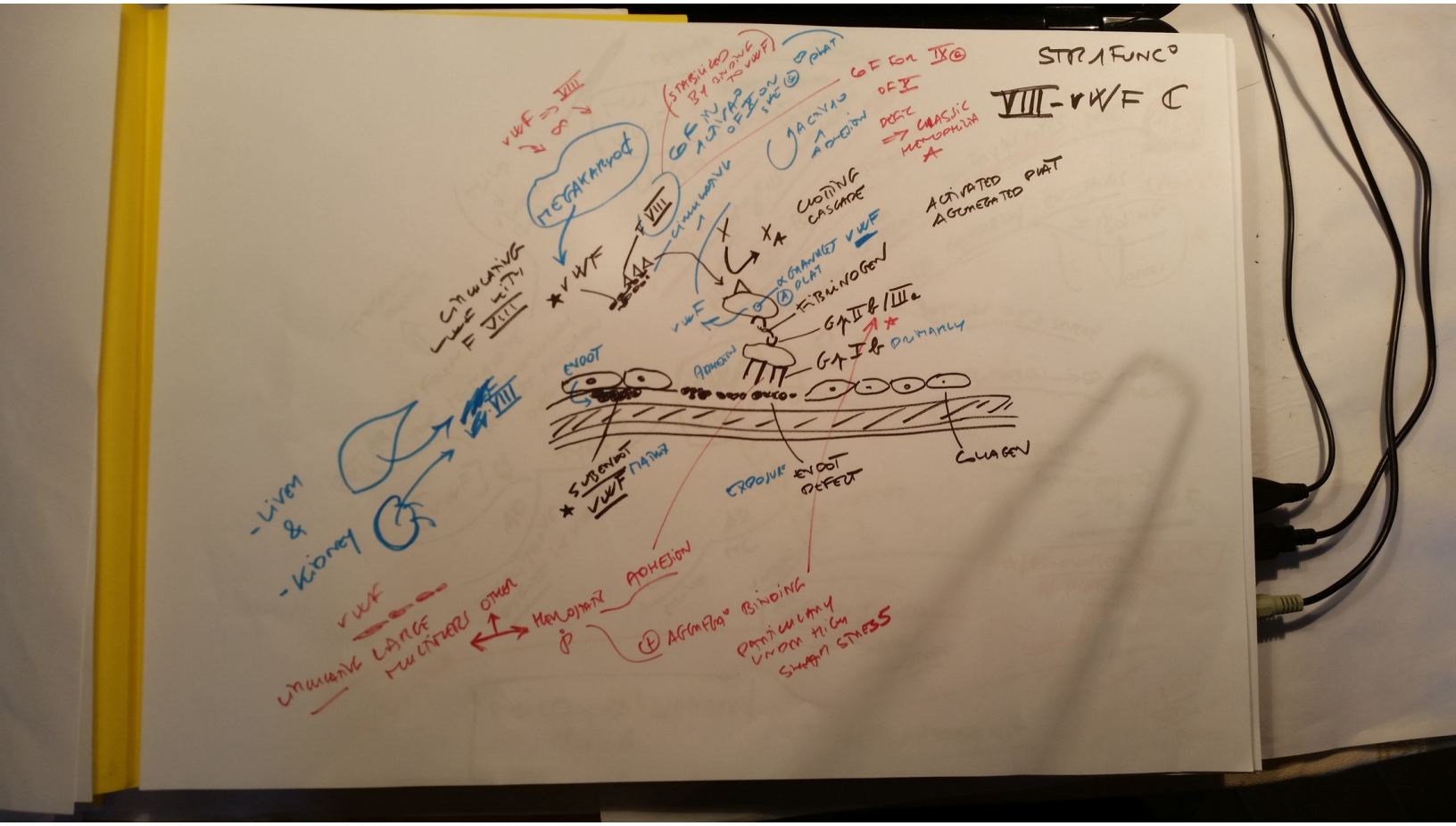

PLAT FUNCTIONS
MOSTLY
CONGEN
GENETIC
AGGREGA°
PF
PLAT
PLUG°
BECAUSE OF
DEFECTIVE
DEGRANULA°
AFTER THEY
DEGRANULATE

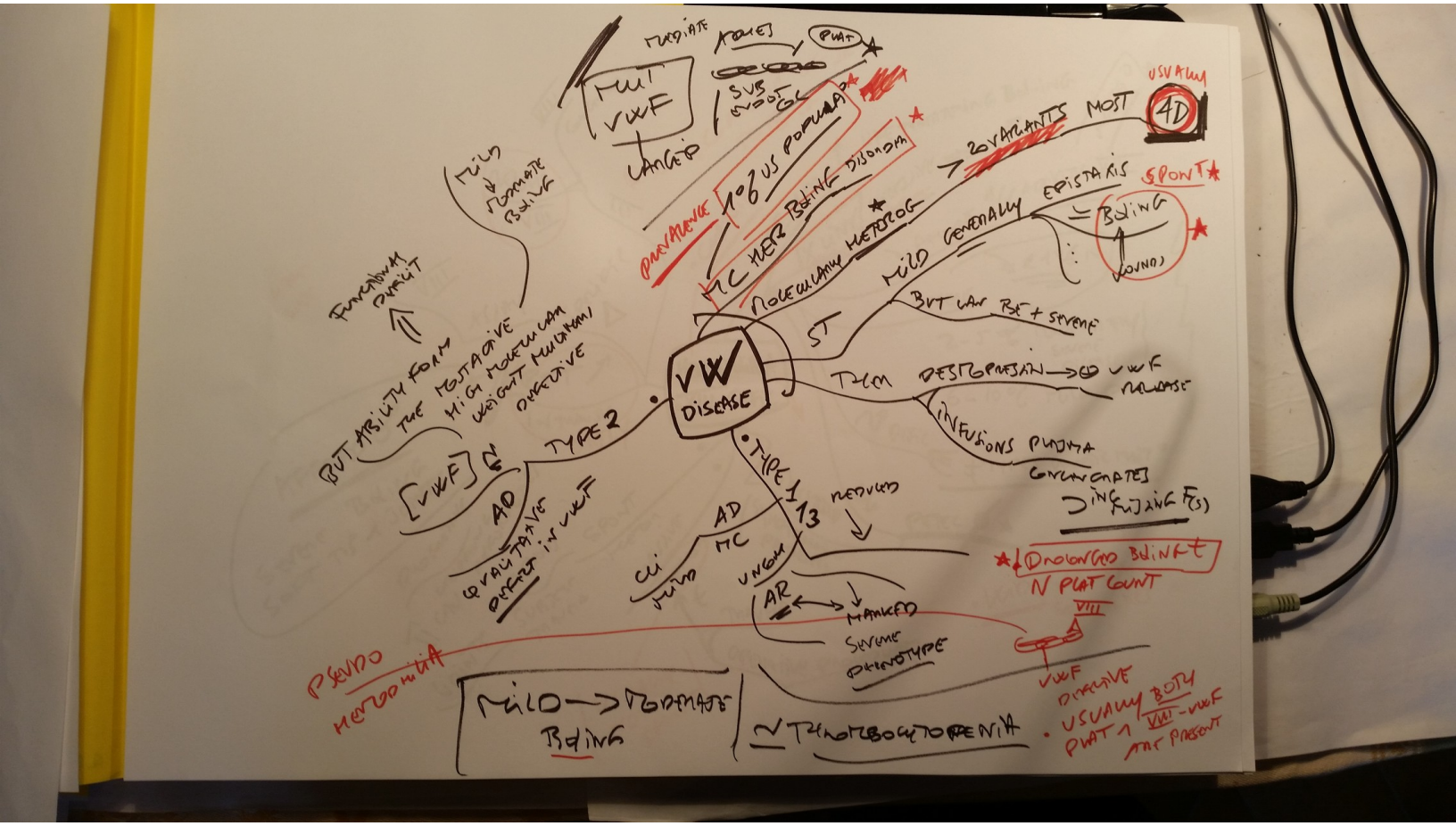

BLEEDING TIME
PLAT PB
PLAT
"QUALITATIVE" DISORDERS
PLAT MEMBRANE
DETECTION
LOW PLAT VWF
BLEEDING
NL PLAT COUNT
DEFECTIVE ADHES
AGGREGATION
PLATELET IN ADHES
GRANULE SECRETION
AGGREGATION
VREMIA
ACQUIR
FUNC
CONGEN
MOSTLY
GENETIC
ASPIRIN
CAN SUPPRESS
TXA2
NOT ON PLAT AGGREGATION
STORAGE POOL DISORDERS
DILUTIONAL PLAT SEQ
PF
PLAT PLUG BECAUSE OF DEFECTIVE DEGRANULATION
AFTER THEY DEGRANULATE
ADP
THAT PROMOTES PLATELET AGG

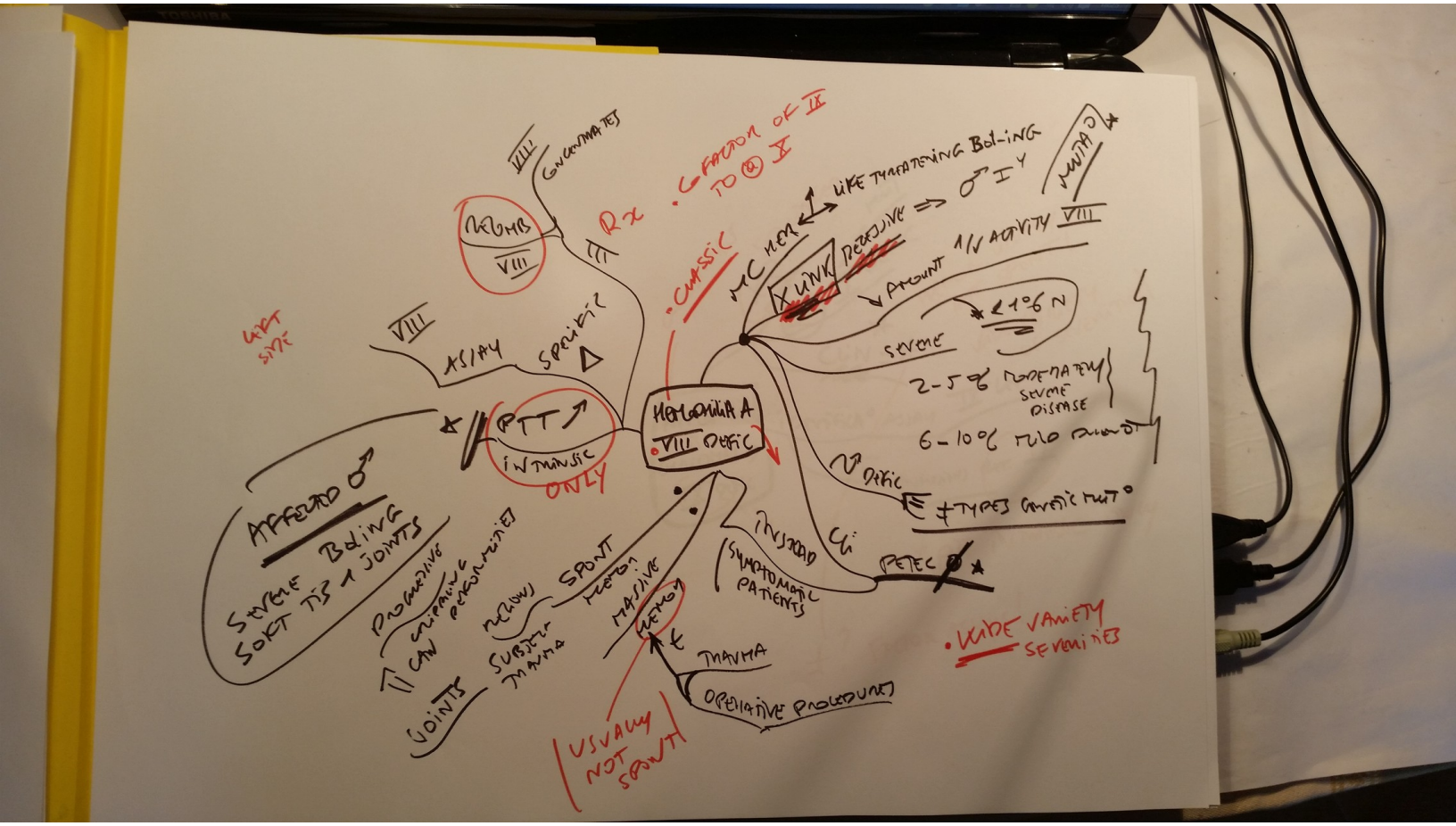

TF
EXTRINSIC PW
FASTER
PT/INR
CLOT
DEF.
THANMA
TFPI
VIIa
VII
TF
THANMA
X
AT
IIa
FG
I
F
Ia
XIIIa
XIII
CROSS-
LINKED
FIBRIN
CLOT
PROTHROMBIN
TIME
INTERNATIONAL
NORMALIZED
RATIO
PR > INR
I II V VII X
on CLOTTING F

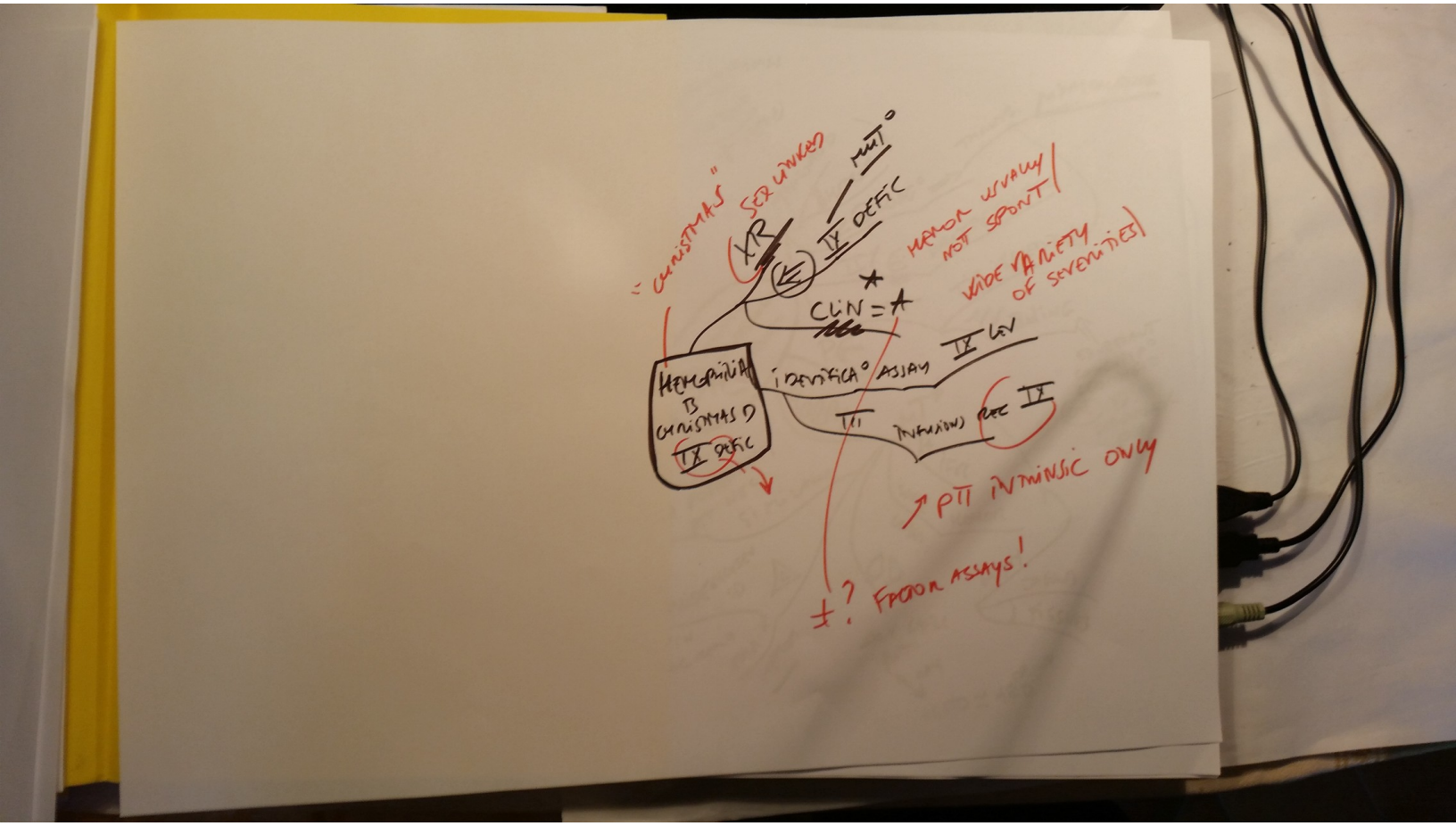

PTT
PARTIAL THROMBOPLASTIN TIME
CONTACT ACTIVATED INTRINSIC PW
SLOW
TF EXTRINSIC PW
FASTER
PT/INR
CLOT FORM
DAMAGED SEC
HMW KA
HEMA
TRAUMA
TFPI
TF
AT
PTT PROLONGED
PT PROLONGED
SPECIFIC FACTOR DEFIC
ACQ DEFIC
K
VIT K DEPEND FACTOR DEFIC
INTERNATIONAL NORMALIZED RATIO
PC + INR
CROSS-LINKED FIBRIN CLOT
HYPERCOAGULABILITY ANYTHING ↑ CASCADE COAGULATION OR INHIBITS ITS INHIBITION RARE

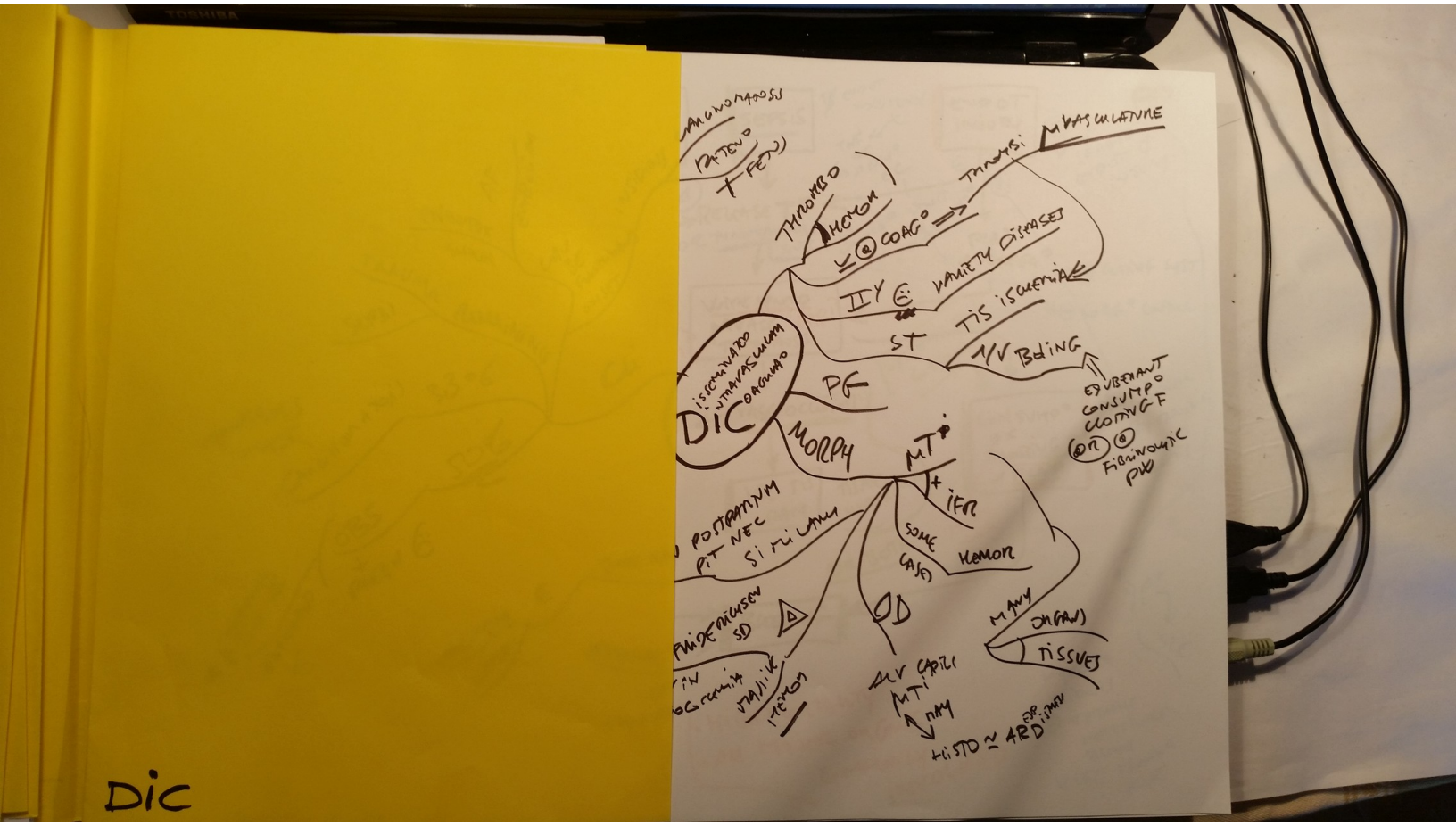

VWD
HEMOPHILIA
MC
SINGLE
TYPICALLY
ACQUIRED
CLOTTING FACTORS
BLEEDING
SPONTPETER
UNCOM
MORE OFTEN
INTO GI
MUSCLES
JOINTS
AFTER INJURY
AFTER LACERAT°
SURGERY
COMMON
GENERALLY
MULTIPLE
ANY CAUSE
FAILURE
WITH DPF
PC
SYNTHESIS
DICALSO
PRODUCE
DEFIC
MULTIPLE
COAG° FACTORS

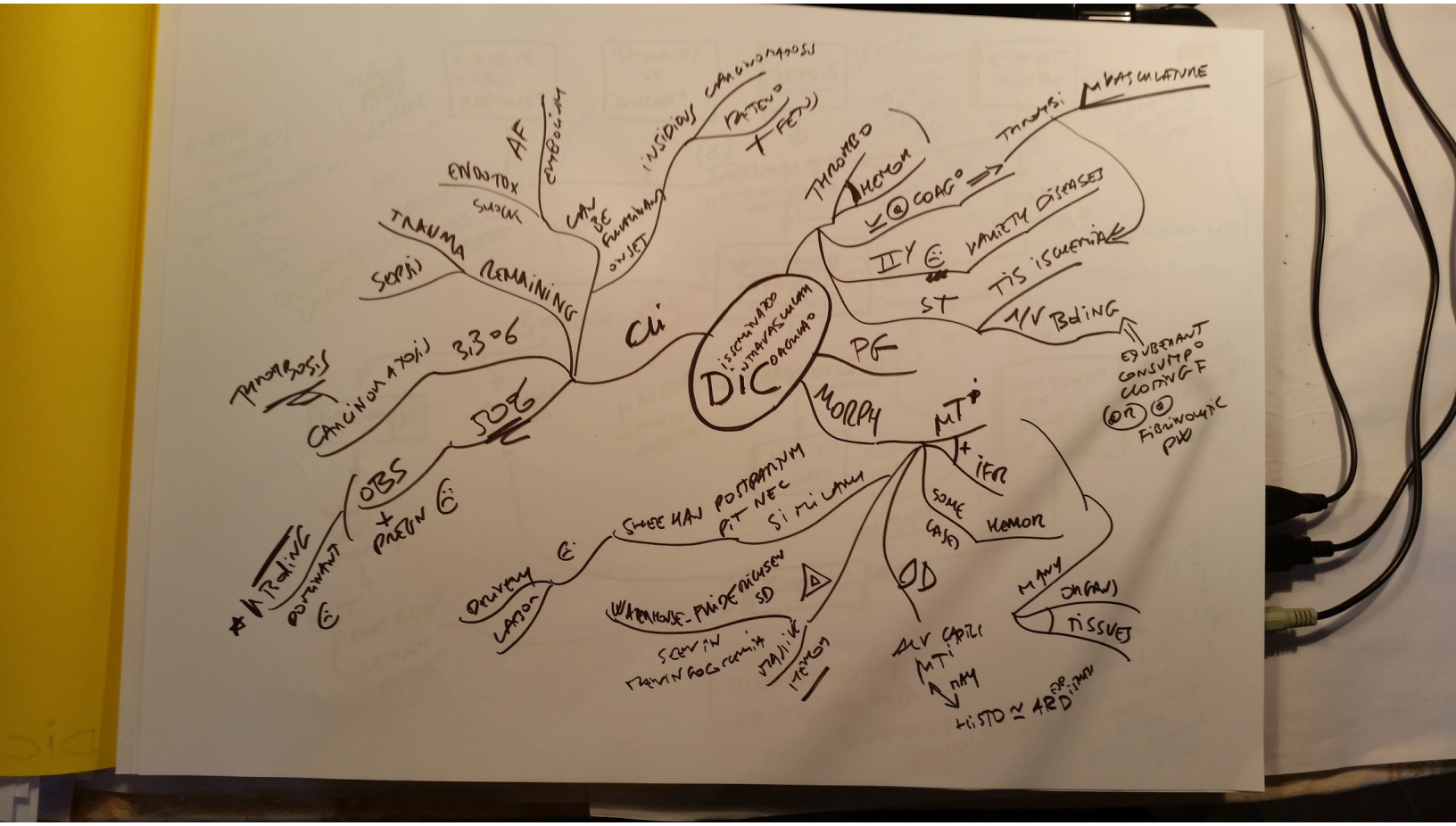

STRATEGY
VIII - vWF C
vWF
VIII
MEGAKARYOCYTE
vWF
VIII
CLOTTING CASCADE
X
Xa
FIBRINOGEN
GpIIb/IIIa
GpIb
ENDOT
ADHESION
SUBENDOT
COLLAGEN
ENDOT DEFECT
LIVER & KIDNEY
vWF
ADHESION
BINDING
PARTICULARLY UNDER HIGH SHEAR STRESS

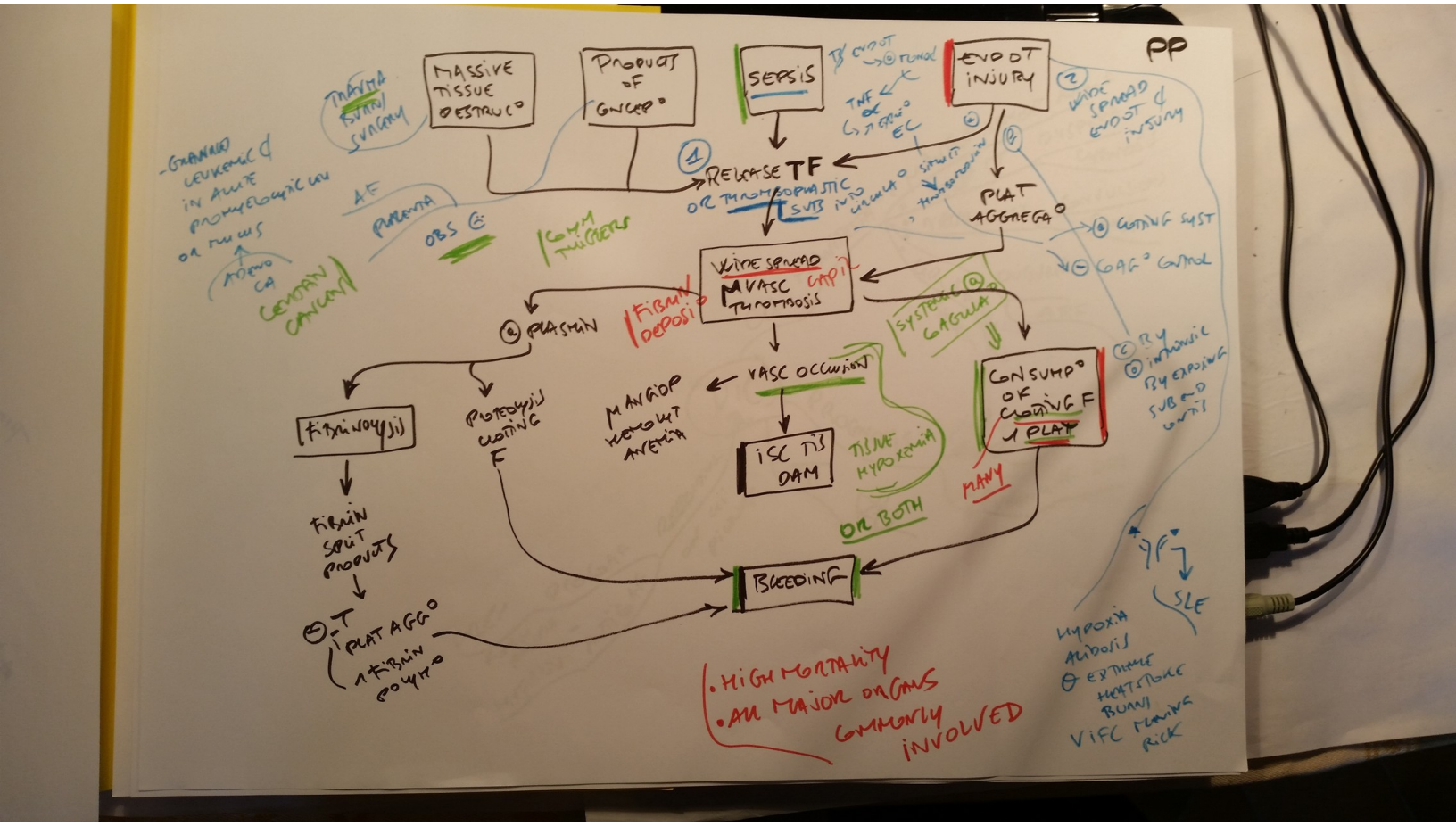

VW DISEASE
TYPE 2
TYPE 1
ST
[VWF]
AD
AR
MC
MILD
MODERATE
SEVERE
PSEUDO
HEMOPHILIA
THROMBOCYTOPENIA
DESMOPRESSIN
INFUSIONS PLASMA
CONCENTRATES
4D
20 VARIANTS MOST
EPISTASIS
BLEEDING
PROLONGED BLEEDING
N PLAT COUNT
VWF DEFICIENT
USUALLY BOTH
PLAT + VWF
MAY PRESENT

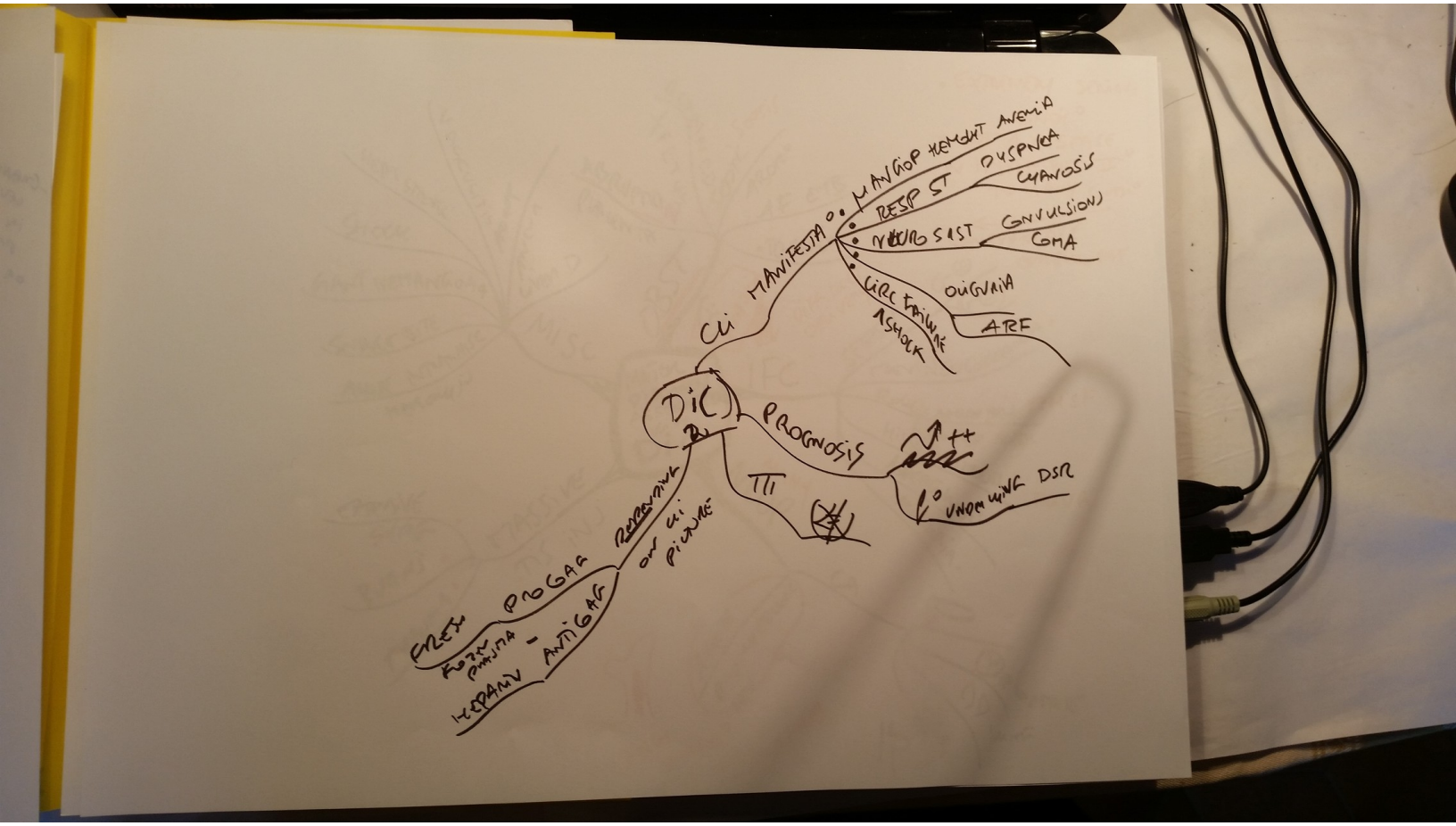

HEMOPHILIA A
VIII DEFIC
PTT ↗
IN VITRO
ONLY
AFFECTED ♂
SEVERE BLEEDING
SOFT TIS + JOINTS
SPONT
MASSIVE
HEMOR
JOINTS
SURGERY
TRAUMA
USUALLY
NOT
SPONT
TRAUMA
OPERATIVE PROCEDURES
SYMPTOMATIC
PATIENTS
PETEC
SEVERE
2-5%
6-10%
DEFIC
LIFE THREATENING BLEEDING
DECREASE
AMOUNT
ACTIVITY
VIII
RX
CLASSIC
SPECIFIC
ASPAY
VIII
VIII
GENETICS
REGIMB
VIII
WIDE VARIETY
SEVERITIES

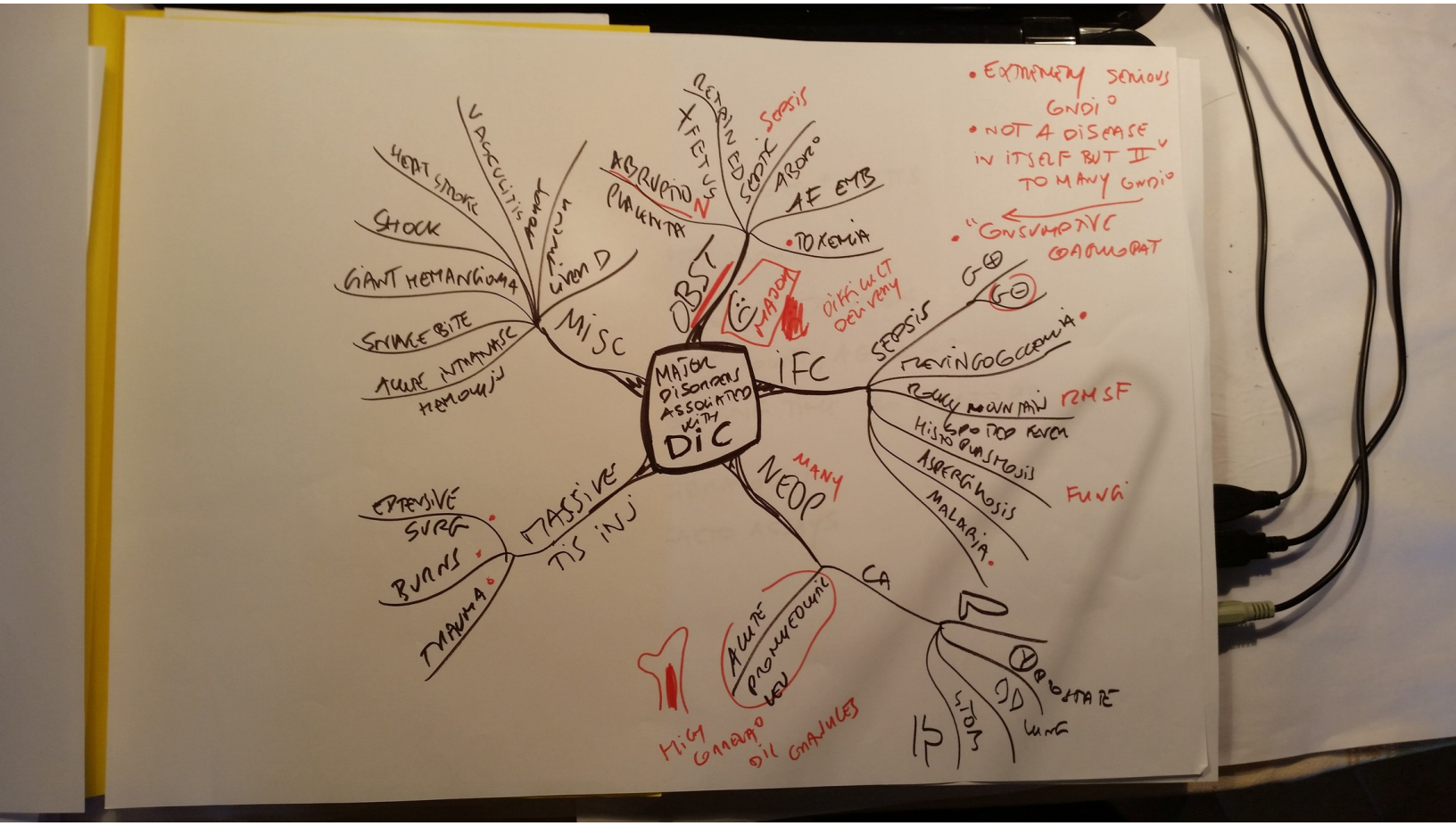

"CHRISTMAS"
SEX LINKED
XR
IX DEFIC
MUT°
CLIN = ★
MAJOR USUALLY NOT SPONT
WIDE VARIETY OF SEVERITIES
HEMOPHILIA B CHRISTMAS D
IX DEFIC
IDENTIFICA° ASSAY
IX LOW
XI
INTRINSIC
IX
↗ PTT INTRINSIC ONLY
±? FACTOR ASSAYS!

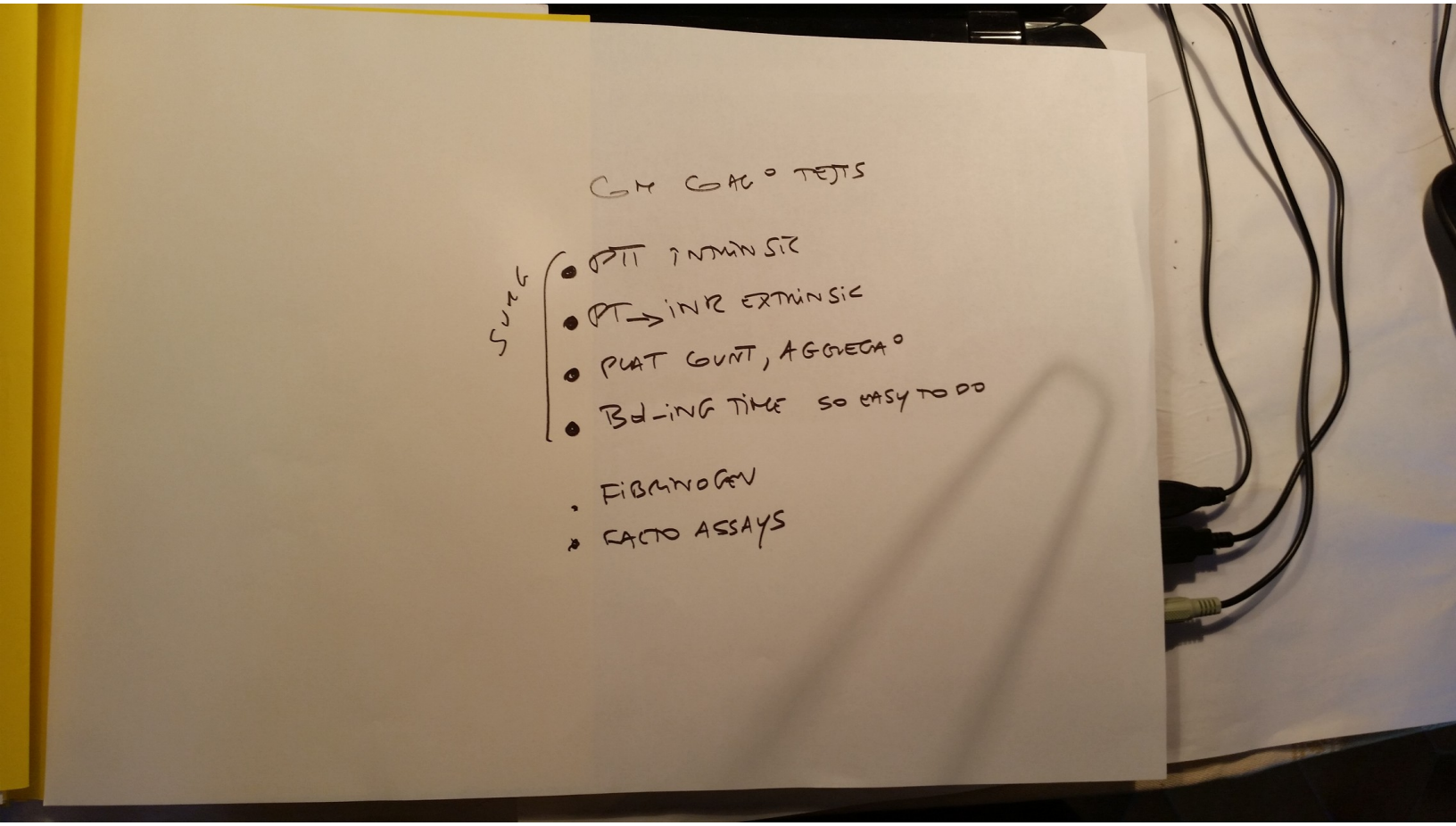

DIC
PF
MORPH
MT
ST
II
III
TIS ISCHEMIA
TRANSF
COAG
THROMBO
EMBOLISM
PATENT
FEN
DIC


DIC
Cli
PF
MORPH
MT°
SOFA
OBS
+ PAREN
SEPSIS
TRAUMA
REMAINING
AF
EMBOLISM
ENDOTOX
SHOCK
CAN BE ELIMINATED
INSIDIOUS
THROMBO
PHOTON
COAG°
THROMBI
VASCULATURE
VARIETY DISEASES
TIS ISCHEMIA
ST
1/V BEING
EQUIPMENT
CONSUMPTION
FIBRINOLYTIC
PAI
CARCINOMATOSIS
3.3=6
PHYSIOLOGIC
+ IFN
SOME CASES
DEMON
SHEEHAN POSTPARTUM PIT NEC
SI ALI LAMA
DELIVERY
LABOR
WATERHOUSE-FRIDERICHSEN SD
SEVERE TRAUMA
SEPSIS
ITP
MANY
DRUGS
TISSUES
ALV CAPILL
MTI
HAM
HISTO ≈ ARDS
ER DIMER


MASSIVE TISSUE DESTRUC°
PRODUCT OF GNECR°
SEPSIS
ENDOT INJURY
RELEASE TF
WIDE SPREAD MVASC THROMBOSIS
PLAT AGGREG°
PLASMIN
FIBRINOLYSIS
FIBRIN SPLIT PRODUCTS
PROTEOLYSIS CLOTTING F
VASC OCCLUSION
ISC TIS DAM
CONSUMP° OF CLOTTING F + PLAT
BLEEDING
ON BOTH
MANY
• HIGH MORTALITY
• ALL MAJOR ORGANS COMMONLY INVOLVED
SLE
HYPOXIA
ACIDOSIS


DIC
Cli MANIFESTA
PROGNOSIS
TTI
HEMOLIZA
DYSPNEA
CIANOZA
GRUVULSIONI
COMA
OLIGURIA
ARF
UNDERLYING DSR
PROGA
ANTIGAG


MAJOR DISORDERS ASSOCIATED WITH DIC
MISC
OBST
IFC
MASSIVE TIS INJ
NEOP
CA
SEPSIS
MENINGOCOCCEMIA
RMSF
ASPERGILLOSIS
MALARIA
FUNGI
SEVERE BITE
GIANT HEMANGIOMA
SHOCK
HEAT STROKE
ABRUPTIO PLACENTA
RETAINED SEPTIC FETUS
ABORT
AF EMB
TOXEMIA
MAJOR
DIFFICULT DELIVERY
EXTREMELY SERIOUS GNDI
NOT A DISEASE IN ITSELF BUT TO MANY GNDI
"SYMPTOMATIC COMPLICATION"
EXTENSIVE SURG
BURNS
TRAUMA
MANY
ACUTE PROMYELOCYTIC LEU
HIGH GRADE DIL GRANULES
PROSTATE
GD
LUNG
STOM
LP


COMMON TESTS
SCREEN
PTT INTRINSIC
PT → INR EXTRINSIC
PLAT COUNT, AGGREGA°
BLEEDING TIME SO EASY TO DO
FIBRINOGEN
FACTO ASSAYS