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In vitro

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Structure and Function of Bone Marrow

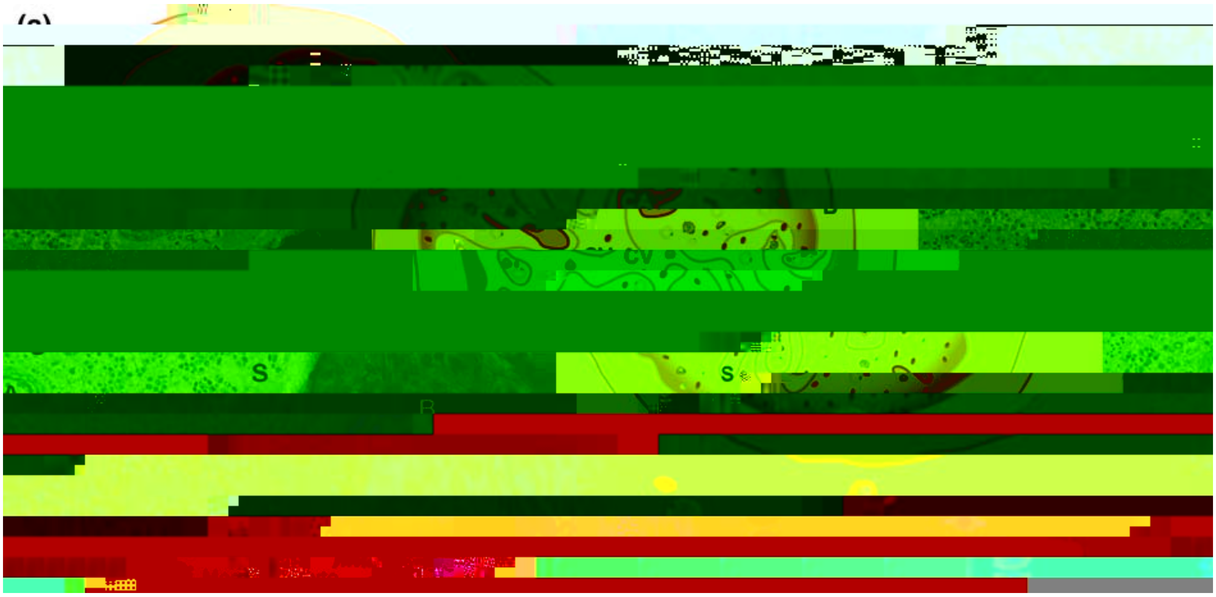

FIGURE 1. (a) Layout of bone marrow in a cross-sectional view of a tubular bone. Bone (B) is surrounding the bone marrow (BM). Central artery (CA) and central vein (CV) are running parallel to each other and longitudinally along the long bone (perpendicular to the plane of the page). The central artery and central vein branch toward the periphery to form arterioles (A) and sinusoids (S) which then combine and join with the central vein. Hematopoietic space (H) is interspersed by the sinuses. Developing red blood cells and granulocytic cells appear in the hematopoietic space. Megakaryocytes develop subjacent to the endothelium of marrow sinuses. It is possible to observe the radial distribution of marrow as the yellow marrow in the central regions and the red marrow in the periphery (Adapted from Tavassoli and Yoffey[104] and reprinted with permission of John Wiley & Sons, Inc.). (b) A toluidine-blue stained section taken transversely to the longer axis of a tubular bone. The micrograph displays the endosteal junction between bone and marrow (125×). The distribution of abundant number of red blood cells indicates that the bone marrow is hematopoietic (Courtesy of David C. Van Sickle, Purdue University).

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Hydrostatic Pressure

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TABLE 1. Blood pressure and intramedullary pressure (IMP) values reported in the literature.

	Animal	Blood pressure		IMP	
		Location	Value (mmHg)	Location	Value (mmHg)
Stein .[96,a]	Dog	Femoral artery	110–140	Tibial diaphysis	25–75
Shaw[90,a]	Cat	Contralateral femoral or carotid artery	130	Femoral diaphysis	37
Azuma[3,a]	Rabbit	Carotid artery	100–110	Femur or tibia	25 (4–70)
Michelsen[55,a]	Rabbit	Carotid artery	73–118	Tibia	18–36
Harrelson and Hill[32,a]	Mongrel dogs	Femoral artery contralateral	110–140	Mid-diaphysis of femur	35
		Femoral vein contralateral	2		
Shim .[92,a]	Rabbit	Carotid artery	120	Femur	20–60
	Dog	Carotid artery	130	Femur	40–120
Wilkes and Visscher[121,b]	Dog	Femoral artery	134.0 (13.2)	Tibia	23 (5.3)
		Nutrient vein	19.3 (6.3)		
Tondevold .[108,a]	Mongrel dogs	Left brachial artery	112.9 (0.9)	Femoral epiphysis	30.7 (2.6)
				Femoral metaphysis	20.5 (1.5)
				Femoral diaphysis	25.7 (1.7)
Thomas .[107,a]	Rabbit	Not measured	–	Lower femoral diaphysis	33 (7–81)
Bauer and Walker[5,a]	Dog	Not measured	–	Femoral diaphysis	27.6 (15.4)
				Femoral metaphysis	17.6 (10.5)
				Tibial diaphysis	26.4 (13.0)
				Tibial metaphysis	17.9 (11.8)
				Humeral diaphysis	26.2 (15.8)
				Humeral metaphysis	13.4 (7.7)
				Radial diaphysis	15.4 (18.9)
Stevens .[97,c]	Mouse	Not measured	–	Femur	10.7 (1.4)

[a] IMP was measured with a cannula inserted into the bone in anesthetized animals.
[b] IMP was measured with a tonometric pressure transducer in anesthetized dogs.
[c] IMP was measured by radiotelemetry in unanesthetized ambulatory mouse.

TABLE 2. The effects of occlusion, epinephrine, norepinephrine, vasodilators, vasoconstrictors and skeletal muscle contraction on intramedullary pressure (IMP) and systemic blood pressure.

	Occlusion				Drugs		Skeletal muscle contraction	
	Arterial	Venous	Epinephrine	Norepinephrine	Vasodilator	Vasoconstrictor	Abdominal	Lower limb
Stein .[96,a]			›	›	fl	›		
Shaw[90,a]	fl	fi	›	›	fl	›		
Azuma[3,a]	fi	fi	› fl		fl › fi			fi
Michelsen[55,a,b]	fl	›		›	fl › fi			
Shim .[92,b]	fi	fi	fl	›			fi	fi
Stevens .[97,c]								

, , : Increase, decrease or no change in IMP; › ,fl, fi : Increase, decrease or no change in systemic blood pressure; or › fl: First increase, then decrease or vice versa; vasodilator: acetylcholine, benzyl-imidazoline; vasoconstrictor: amphetamine, histamine.

[a] IMP was measured with a cannula inserted into the bone in anesthetized animals.

[b] Blood pressure was measured at the femoral artery; vasodilator (acetylcholine) was injected into femoral artery.

[c] IMP was measured by radiotelemetry in unanesthetized ambulatory mouse.

All injections were made intravenously; systemic blood pressures were measured at the carotid artery.

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Hydrostatic Pressure

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EFE E CE

Biorheology

J. Orthop. Res.

Angiology

J. Cell. Physiol.

Am. J. Vet. Res.

Stem Cells

Scand. J. Clin. Lab. Invest.

J. Biomech.

J. Biomech.

Proc. Inst. Mech. Eng. [H]

Bone

J.
Cell. Physiol.

Gene

Biomed. Mater. Eng.

J. Biomed. Biotechnol.

Dev. Brain Res.

J. Bone Joint Surg. Am.
A

Br. J. Radiol.

J. Bone Joint Surg. Am.
A

J. Bone
Miner. Res.

Bone

BMC Musculoskelet. Disord.

J. Bone
Miner. Res.